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JOURNAL of VERTEBRATE PALEONTOLOGY

ABSTRACTS OF PAPERS

SIXTY-FIFTH ANNUAL MEETING
SOCIETY OF VERTEBRATE PALEONTOLOGY
MESA SOUTHWEST MUSEUM AND
PHOENIX MARRIOTT MESA
MESA, ARIZONA

OCTOBER 19-22, 2005

SOCIETY OF VERTEBRATE PALEONTOLOGY

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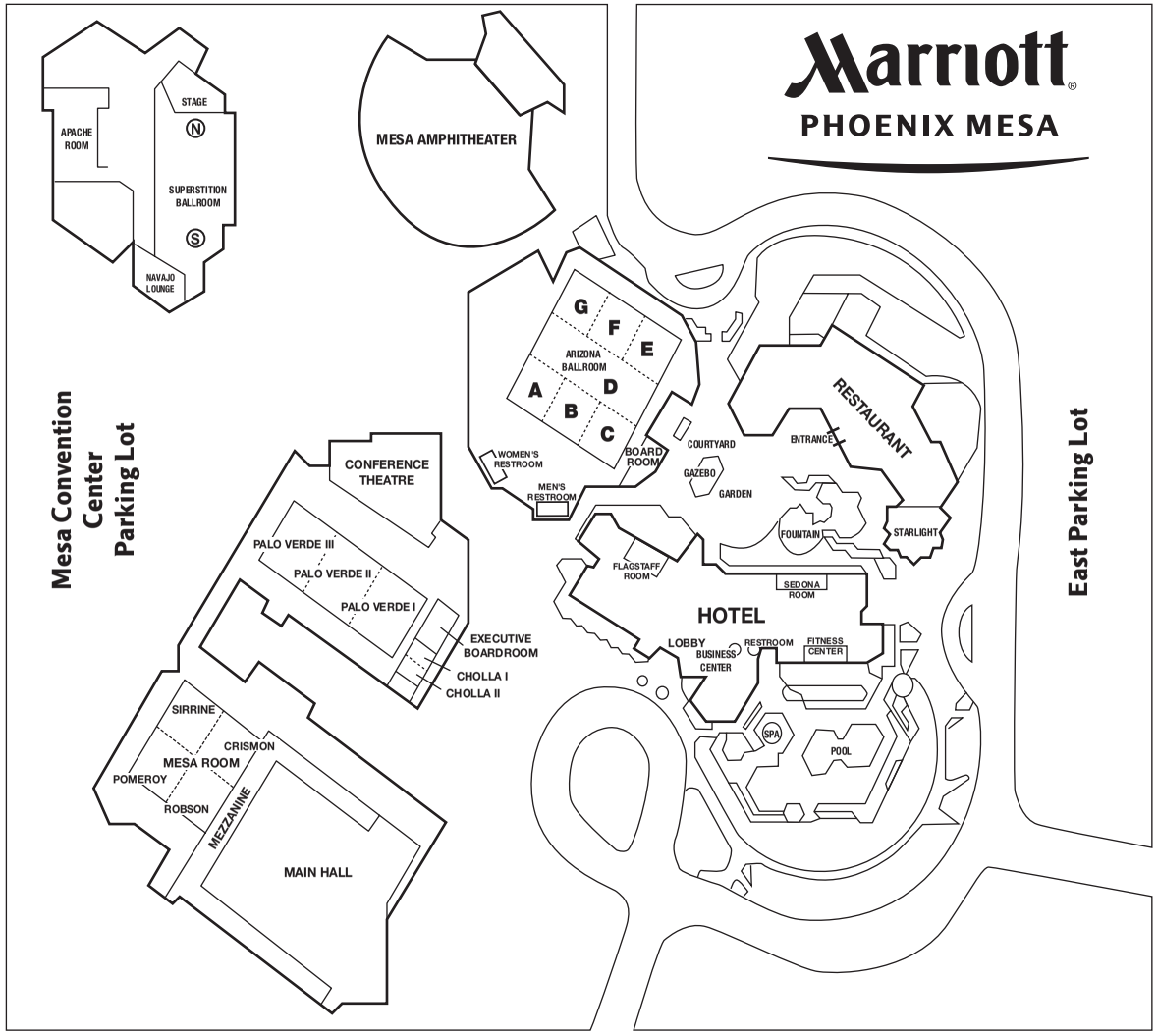
SVP
66th Annual Meeting
October 18–21, 2006
Marriott Ottawa/
The Crowne Plaza Ottawa
Ottawa, ON, Canada
Ottawa
Ontario, Canada
www.vertpaleo.org
THE SOCIETY OF VERTEBRATE PALEONTOLOGY


Marriott
PHOENIX MESA
Mesa Convention Center Parking Lot
East Parking Lot
MESA AMPHITHEATER
STAGE
APACHE ROOM
SUPERSTITION BALLROOM
NAVAJO LOUNGE
G
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ARIZONA BALLROOM
A
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BOARD ROOM
WOMEN'S RESTROOM
MEN'S RESTROOM
COURTYARD
GAZEBO
GARDEN
ENTRANCE
RESTAURANT
FOUNTAIN
STARLIGHT
FLAGSTAFF ROOM
SEDONA ROOM
HOTEL
LOBBY
BUSINESS CENTER
RESTROOM
FITNESS CENTER
SPA
POOL
CONFERENCE THEATRE
PALO VERDE III
PALO VERDE II
PALO VERDE I
EXECUTIVE BOARDROOM
CHOLLA I
CHOLLA II
SIRRINE
CRISMON
MESA ROOM
POMEROY
ROBSON
MEZZANINE
MAIN HALL

VOL. 25, SUPPLEMENT TO NUMBER 3 JOURNAL OF VERTEBRATE PALEONTOLOGY ABSTRACTS SEPTEMBER 2005

JOURNAL OF VERTEBRATE PALEONTOLOGY

VOLUME 25, SUPPLEMENT TO NUMBER 3

September, 2005

ABSTRACTS OF PAPERS

SIXTY-FIFTH ANNUAL MEETING
SOCIETY OF VERTEBRATE PALEONTOLOGY
MESA SOUTHWEST MUSEUM AND
PHOENIX MARRIOTT MESA
MESA, ARIZONA
OCTOBER 19-22, 2005

2005 SVP SCHEDULE OF EVENTS

(may be subject to change)

Event/Functions	Tuesday, October 18	Wednesday, October 19	Thursday, October 20	Friday, October 21	Saturday, October 22
Registration/Membership	4 pm – 7 pm Palo Verde Foyer	7 am – 5 pm Palo Verde Foyer	7 am – 6 pm Palo Verde Foyer	8 am – 5 pm Palo Verde Foyer	8 am – 5 pm Palo Verde Foyer
Welcome		8 am – 8:15 am Arizona Ballroom A-D			
Plenary/A.S. Romer Prize Presentations			8:15 am – Noon Arizona Ballroom A-D		
Symposium		10:15 am – 12:15 pm Arizona Ballroom A-D		8 am – 12:30 pm Arizona Ballroom E-G	8 am – Noon Arizona Ballroom A-D
Preparators Symposium		1:30 pm – 6:00 pm Arizona Ballroom E-G			
Symposium		1:30 pm – 6:00 pm Palo Verde Ballroom 1-3			
Technical Session		8:15 am - 10:00 am Arizona Ballroom A-D	1:30 pm – 3:15 pm Arizona Ballroom A-D	8 am - 12:30 pm Arizona Ballroom A-D	8 am – 12:30 pm Arizona Ballroom E-G
Technical Session		8:15 am – 12:30 pm Arizona Ballroom E-G	1:30 pm – 3:15 pm Arizona Ballroom E-G	8 am – 12:30 pm Palo Verde Ballroom 1-3	8 am – 12:30 pm Palo Verde Ballroom 1-3
Technical Session		8:15 am – 12:30 pm Palo Verde Ballroom 1-3	1:30 pm – 3:15 pm Palo Verde Ballroom 1-3	1:30 pm – 3:15 pm Superstition Ballroom	1:30 pm – 5:15 pm Arizona Ballroom A-D
Technical Session		1:30 pm – 5:45 pm Arizona Ballroom A-D		1:30 pm – 3:15 pm Arizona Ballroom E-G	1:30 pm – 5:15 pm Arizona Ballroom E-G
Technical Session				1:30 pm – 3:15 pm Palo Verde Ballroom 1-3	1:30 pm – 5:45 pm Palo Verde Ballroom 1-3
Posters		4:30 pm – 8:30 pm. Poster I Set-up Main Hall	9:30 am – 5 pm Poster I Viewing Main Hall	7 am – 9:30 am Poster II Set-up Main Hall	9:30 am – 1:30 pm Poster II Viewing Main Hall
Posters			5 pm Poster I Dismantle Main Hall	9:30 am – 5:30 pm Poster II Viewing Main Hall	1:30 pm Poster II Dismantle Main Hall
Exhibits		Noon – 6 pm Exhibit Set-up/Main Hall	9:30 am – 5 pm Main Hall	9:30 am – 5:30 pm Main Hall	9:30 am – 1:30 pm Main Hall
Business Meeting/Open Executive Committee Meeting			5 pm – 6 pm Arizona Ballroom E-G		12:30 pm – 1:30 pm Arizona Ballroom E-G
Press Conference			10:30 am – 11:30 am Starlight		
Social Events		**Welcome Reception** 7 pm – 10 pm Mesa Southwest Museum	**Poster Reception** 3 pm - 5 pm Main Hall	**Poster Reception** 3:30 pm – 5:30 pm Main Hall **Auction/Reception** 6:30 pm – 10:30 pm Arizona Ballroom	**Awards Reception/Banquet** 7 pm – 10 pm Arizona Ballroom **After Hours Party** 10 pm – 2 am Starlight
Beverage Service		7 am – 8 am Arizona Ballroom Foyer	7 am –8 am Arizona Ballroom Foyer	7 am – 8 am Arizona Ballroom Foyer	7 am – 8 am Arizona Ballroom Foyer
Beverage Service		10 am – 10:15 am Arizona Ballroom Foyer	10 am – 10:15 am Main Hall	10 am – 10:15 am Main Hall	10 am – 10:15 am Main Hall
Beverage Service		3:15 pm – 3:30 pm Arizona Ballroom Foyer			3:15 pm – 3:30 pm Arizona Ballroom Foyer
Student Roundtable Forum and Reprint Exchange			6:30 pm – 8:00 pm Palo Verde Ballroom 1/2		
SVP Town Meeting on Evolution III		12:30 pm – 1:30 pm Arizona Ballroom A-D			
Women in Palentology Luncheon				12:30 pm – 1:30 pm Starlight	
Speaker Ready Room		6 am – 5 pm Cholla 1/2	6 am – 5 pm Cholla 1/2	7 am – 5 pm Cholla 1/2	7 am – 4 pm Cholla 1/2
Committee Mtg. Rooms		7 am – 6 pm - Starlight	7 am – 6 pm - Starlight	7 am – 6 pm - Starlight	7 am – 6 pm - Starlight
Committee Mtg. Rooms		7 am – 6 pm - Sirrine	7 am – 6 pm - Sirrine	7 am – 6 pm - Sirrine	7 am – 6 pm - Sirrine
Committee Mtg. Rooms		7 am – 6 pm - Pomeroy	7 am – 6 pm - Pomeroy	7 am – 6 pm - Pomeroy	7 am – 6 pm - Pomeroy

PROGRAM AT A GLANCE

TIME	Wed.1	Wed.2	Wed.3	Thurs.1	Thurs.2	Thurs.3	Friday1	Friday2	Friday3	Sat.1	Sat.2	Sat.3
8:00		WELCOME					Larsson	Hanke	Barnes	Sereno	Tintori	Flynn
8:15	Steyer	Sadleir	Rinaldi		Bader		Schweitzer	Karatajuhe	Gingerich	Wedel	Newbrey	Ferrusquia
8:30	Anderson	Sullivan	Burger		Butler		Wittmeyer	Burrow	Fordyce	Pol	Markey	Croft
8:45	Meredith	Salisbury	Racicot		Chew		O'Connor	Goujet	Kondrashov	Galton	Lund	Gunnell
9:00	Tanner	Whatley	Pyenson		Claessens		Martin	Elliott	MacPhee	Langer	Kriwet	Schwartz
9:15	Smith	Wang	Uhen		Decherd		Lamanna	Carr	McAfee	Klein	Friedman	Sargis
9:30	Roberts	Kellner	Terry		Delmer		Clarke	Maisey	Samonds	Upchurch	Eiting	MacLatchy
9:45	Varricchio	Andres	Muldoon		Goswami		Chiappe	Schultze	Zalmout	Barrett	Claeson	Garcia
10:00	BREAK										BREAK	
10:15	Dodson	Tsuji	Ekdale		Holliday		Polly	Daeschler	Gobetz	Loewen	Brazeau	Folinsbee
10:30	Godfrey	Germain	Akersten		Joyce		Lee	Coates	Rybczynski	Fedak	Boisvert	Beard
10:45	Terry	Georgi	Finarelli		Ladeveze		Erickson	Arratia	Stevens	Yates	Anderson	Asher
11:00	Vlamis	Maddin	Fox-Dobbs		Moreno		Turner	Hilton	Sussman	Reisz	Preuschoft	Hoffman
11:15	Jacobs	Mueller	Ruez		Robinson		Brochu	Long	Tseng	Senter	Colbert	Dewar
11:30	Sampson	D'Amore	Wang		Schwartz		Goehlich	Gottfried	Van Tuinen	Parrish	Geisler	Kaiser
11:45	MacFadden	Nydam	Wheeler		Tsuihiji		MacLeod	Zhu	Yeakel	Wilson	Fox	Kohn
12:00	Scotchmoor	Bloch	Gabriel				Britt	Clement	Badgley		Murphey	Passey
12:15		Chapman	Holroyd				Straight		Evans		Buchholtz	Case
12:30												
12:45					LUNCH							
1:00												
1:15												
1:30	Rega	Chaney	Barnosky	Witmer	Yule	Martin	Carrano	Krauss	Behrensmeye	Clauss	Blom	Libed
1:45	Sumida	Smith	Wesley-Hunt	Therrien	Jass	Luo	Heathcote	Ksepka	Flynn	Wings	Snyder	Wood
2:00	O'Keefe	Keillor	Alroy	Lee	Kraatz	Morlo	Parker	Maxwell	Townsend	Remes	Smith	Rountrey
2:15	Sidor	Jabo	Secord	Carr	McCullough	Macrini	Irmis	Steadman	Tsubamoto	McCrea	Ruta	Fisher
2:30	Modesto	Small	Retallack	Brusatte	Sears	Archibald	Nesbitt	Triche	Williamson	Mallison	Monks	Todd
2:45	Kammerer	Tedrow	Mihlbachler	Prieto	Miller	Chinsamy	Ferigolo	Dyke	Wyss	Ikejiri	Froebisch	Biasatti
3:00	Angielczyk	Fox	Damuth	Padian	Lansing	Hunter	Noto	Campbell	Zack	CurryRogers	Njau	Clifford
3:15	BREAK										BREAK	
3:30	Green	Murray	Semprebon							Werning	Farlow	Draus
3:45	Gao	Mason	Rivals							Gates	Polcyn	Eberle
4:00	Buchy	Van Beek	Hopkins							Evans	Hall	Hieronymus
4:15	Schmitz	Burnham	Stromberg		POSTER			POSTER		Horner	Evans	Metais
4:30	Jiang	Reser	Fortelius		SESSION A			SESSION B		Fujiwara	Murray	Prothero
4:45	Bell	Denton	Schubert							Gillette	Nave	Orliac
5:00	Sues	Shinya	Beatty							Fremd	Oheim	O'Sullivan
5:15	Jamniczky	Mason	Bell									Penkrot
5:30	Head	Kronthal	Feranec									Shockey
5:45	Beck	Down	Martin									

WEDNESDAY MORNING, OCTOBER 19, 2005

TECHNICAL SESSION I
ARIZONA BALLROOM A-D
MODERATORS: DAVID VARRICCHIO AND JASON ANDERSON

8:00 **WELCOME**

8:15 **Steyer, J. S., Damiani, R., Sidor, C., Smith, R.M.H., O'Keefe, F. R., and Larsson, H**. PERMIAN TEMNOSPONDYLS FROM THE SAHARA SHOW EDOPOID COLONIZATION OF AFRICA

8:30 **Anderson, J., and Bolt, J**. A NEARLY COMPLETE AMPHIBAMID SKULL FROM RICHARDS SPUR, OKLAHOMA, AND ITS IMPLICATIONS FOR INTERPRETATION OF DENTAL CHARACTERS RELATED TO THE ORIGIN OF MODERN AMPHIBIANS

8:45 **Meredith, R., Case, J., and Martin, J**. NEW FROG MATERIAL FROM THE OLIGO-MIOCENE ETADUNNA FORMATION OF SOUTH AUSTRALIA

9:00 **Tanner, L., Lucas, S., and Zeigler, K**. TETRAPOD EVOLUTION AND ATMOSPHERIC OXYGEN IN THE LATE TRIASSIC

9:15 **Smith, K**. BETA DIVERSITY IN ANCIENT AND MODERN BIOTAS

9:30 **Roberts, E**. TAPHONOMY OF WET ALLUVIAL SYSTEMS: A CASE EXAMPLE FROM THE CRETACEOUS WESTERN INTERIOR BASIN OF UTAH

9:45 **Varricchio, D., Jackson, F., Scherzeer, B., and Shelton, J**. DON'T HAVE A COW, MAN! IT'S ONLY ACTUALISTIC TAPHONOMY ON THE YELLOWSTONE RIVER OF MONTANA

SVP, EVOLUTION AND SOCIETY
ARIZONA BALLROOM A-D
CONVENORS: BRUCE MACFADDEN, JUDY SCOTCHMOOR AND MARK TERRY

10:15 **Dodson, P**. FIGHT THE GOOD FIGHT—WHAT PALEONTOLOGISTS NEED TO KNOW ABOUT RELIGION

10:30 **Godfrey, S., and Smith, C**. THE STRUCTURE OF THE UNIVERSE THROUGH THE EYES OF THE BIBLE: A PERSONAL PILGRIMAGE FROM A YOUNG-EARTH "SCIENTIFIC CREATIONIST" POSITION

10:45 **Terry, M**. EVOLUTION EDUCATION IN THE TIME OF THE WEDGE

11:00 **Vlamis, T**. BLEEDING KANSAS IN THE EVOLUTION DEBATE

11:15 **Jacobs, L**. TEACHING EVOLUTION AT THE UNDERGRADUATE LEVEL

11:30 **Sampson, S**. EVOLITERACY: ESTABLISHING THE EDUCATIONAL RELEVANCY OF EVOLUTION THROUGH CONNECTIONS WITH ECOLOGY AND THE WEB OF LIFE

11:45 **MacFadden, B., and Dunckel, B**. COMMUNICATING EVOLUTION THROUGH NATURAL HISTORY MUSEUM EXHIBITS AND RELATED PUBLIC PROGRAMS

12:00 **Scotchmoor, J., Thanukos, A., Caldwell, R., and Lindberg, D.** CASE STUDIES: A NEW VENUE FOR SHARING EVOLUTION RESEARCH WITH A BROADER AUDIENCE

POSTERS ASSOCIATED WITH SVP, EVOLUTION AND SOCIETY

Booth

1. **Gaboardi, M**. UNDERSTANDING THE NATURE OF SCIENCE: EVOLUTION THROUGH EXPLORATION IN K-12 CLASSROOMS

2. **Edmunds, B., Ruedas, L., Cummings, M., and Lindsay, T**. BRINGING TO LIFE THE LIFE OF THE PAST: TACTILE, MODELING, AND ON-SITE EXTENSIONS FOR STUDENT APPREHENSION OF ABSTRACT CONCEPTS OF CHANGE THROUGH TIME, DEEP TIME, AND EVOLUTION OF LIFE ON EARTH

3. **Lindsay, T., Shaw, B., Ruedas, L., and Cummings, M**. LIGERS AND GRIFFINS AND MULES, OH, MY!: MISUNDERSTANDING / MISPREPRESENTATION OF THE CONCEPT OF "THEORY" AS BEING UNCLEAR AND UNFINISHED IN AN ATTEMPT TO HYBRIDIZE THE STUDY OF BIOLOGY BY MODELING SPIRITUAL BELIEFS WITH SCIENTIFIC PRINCIPLES

TECHNICAL SESSION II
ARIZONA BALLROOM E-G
MODERATORS: ROBIN WHATLEY AND RANDALL NYDAM

8:15 **Sadleir, R., and Chapman, R**. THE MECHANICAL PERFORMANCE OF TOOTH SHAPE VARIATION IN CARNIVOROUS REPTILES: THEROETICAL MORPHOSPACE AND FINITE ELEMENT MODELS

8:30 **Sullivan, C**. STRUCTURE AND FUNCTION OF THE TARSUS IN CRUROTARSAN AND PROTEROCHAMPSID ARCHOSAURS

8:45 **Salisbury, S., and Frey, E**. GASTROPUBIC RECOIL ASPIRATION IN CROCODILIANS AND EARLY ARCHOSAURS

9:00 **Whatley, R**. PHYLOGENY OF THE RHYNCHOSAURIA

9:15 **Wang, X., Kellner, A., Zhou, Z., and Campos, D**. A CTENOCHASMATID FLYING REPTILE (ARCHAEOPTERODACTYLOIDEA, PTEROSAURIA) FROM THE LIAONING DEPOSITS, LOWER CRETACEOUS, CHINA

9:30 **Kellner, A., Line, S., Campos, D., Gobbo-Rodrigues, S., and Sayao, J**. NEW EXTREMELY WELL PRESERVED PTEROSAUR SOFT TISSUE FROM THE ARARIPE BASIN (BRAZIL) AND DISCUSSION OF THE PTEROSAUR WING MEMBRANE

9:45 **Andres, B., and Clark, J**. JURASSIC PTEROSAURS FROM XINJIANG, CHINA: THE EARLIEST PTERODACTYLOID AND THE ORIGINS OF THE GROUP

10:00 **BREAK**

10:15 **Tsuji, L., and Reisz, R**. PARAREPTILIAN PHYLOGENY IN LIGHT OF THE POSTCRANIAL ANATOMY OF *MACROLETER* (AMNIOTA: REPTILIA) FROM THE UPPER PERMIAN OF RUSSIA

10:30 **Germain, D., and Laurin, M**. MICROANATOMY OF THE RADIUS AND LIFESTYLE IN AMNIOTES

10:45 **Georgi, J., and Sipla, J**. SEMICIRCULAR CANAL SHAPE IN SECONDARILY AQUATIC NON-SYNAPSID AMNIOTES: TRACKING MAJOR TRANSITIONS IN LOCOMOTION

11:00 **Maddin, H., Evand, D., and Reisz, R**. A LARGE VARANODONTINE VARANOPID (SYNAPSIDA: EUPELYCOSAURIA) FROM RICHARDS SPUR, OKLAHOMA

11:15 **Mueller, J., and Reisz, R**. THE PHYLOGENY OF THE EARLY EUREPTILIA (AMNIOTA, REPTILIA)

11:30 **D'Amore, D**. FEEDING IN THE KOMODO DRAGON, *VARANUS KOMODOENSIS*: TAPHONOMIC AND FUNCTIONAL IMPLICATIONS OF ZIPHODONT DENTITION

11:45 **Nydam, R., and Fitzpatrick, B**. LACERTILIA FROM THE TURONIAN OF SOUTHERN UTAH

12:00 **Bloch, J., Cadena, E., Herrera, F., Wing, S., and Jaramillo, C**. PALEOCENE VERTEBRATES FROM THE CERREJON FORMATION, GUAJIRA PENINSULA, NORTHEASTERN COLOMBIA

12:15 **Chapman, R., Deck, L., Andersen, A., Petersen, C., and Schlader, R**. PROTOCOLS FOR THE THREE-DIMENSIONAL DIGITIZING OF SPECIMENS FOR RESEARCH, OUTREACH, AND SPECIMEN ARCHIVING

TECHNICAL SESSION III
PALO VERDE BALLROOM
MODERATORS: MARK UHEN AND H. TODD WHEELER

8:15 **Rinaldi, C., Cole III, T., and Nievergelt, Y**. A 3-D METHOD FOR THEORETICAL MODELING AND MORPHOMETRIC COMPARISON OF HELICAL FORM OF RODENT INCISORS

8:30 **Burger, B., Eberle, J., and Honey, J**. MAMMALIAN FAUNAL CHANGE IN THE PALEOCENE-EOCENE BOUNDARY SPANNING DEBEQUE FORMATION, NORTHERN PICEANCE CREEK BASIN, WESTERN COLORADO: PRELIMINARY STUDY OF FOSSIL UNGULATES

8:45 **Racicot, R., and Berta, A**. MORPHOLOGICAL DETAILS OF THE PTERYGOID SINUS IN EXTANT AND EXTINCT PORPOISES (CETACEA: PHOCOENIDAE) REVEALED BY CT DATA

9:00 **Pyenson, N**. MAXILLA AND MANIDIBLE: TOOTH COUNTS, TELESCOPING, AND DENTAL EVOLUTION IN NEOCETI

9:15 **Uhen, M**. A NEW *XENOROPHUS*-LIKE ODONTOCETE CETACEAN FROM THE OLIGOCENE OF NORTH CAROLINA

9:30 **Terry, R**. RAPTORS, RODENTS, AND PALEOECOLOGY: THE PERSISTENCE OF SKELETAL DAMAGE PATTERNS IN THE HOLOCENE FOSSIL RECORD

9:45 **Muldoon, K., and Simons, E**. NEW LATE HOLOCENE MICROMAMMALS FROM ANKILITELO CAVE, SW MADAGASCAR

10:00 **BREAK**

10:15 **Ekdale, E**. ONTOGENY OF THE INNER EAR OF MAMMALS: IMPLICATIONS FOR THE PHYLOGENETIC ASSESSMENT OF FOSSILS

10:30 **Akersten, W**. THE ROLE OF INCISORS AND FORELIMBS IN THE SHEAR BITE AND FEEDING OF *SMILODON*

10:45 **Finarelli, J., and Flynn, J**. ESTIMATING BRAIN SIZE IN FOSSIL CARNIVORANS USING EXTERNAL SKULL MEASURES

11:00 **Fox-Dobbs, K., Peterson, R., and Koch, P**. DETERMINING ISOTOPIC FRACTIONATIONS FOR CARNIVORES: A CASE STUDY AT ISLE ROYALE

11:15 **Ruez, Jr., D**. STRATIGRAPHIC CHANGES IN THE CARNIVORAN ASSEMBLAGE AT HAGERMAN FOSSIL BEDS NATIONAL MONUMENT, IDAHO, AND THE CONNECTION TO PALEOECOLOGY

11:30 **Wang, X., Whistler, D., and Takeuchi, G**. A NEW SPECIES OF *MARTINOGALE* (CARNIVORA, MEPHITINAE) FROM THE DOVE SPRING FORMATION (UPPER MIOCENE) OF SOUTHERN CALIFORNIA AND ITS IMPLICATIONS FOR THE ORIGIN OF NEW WORLD SKUNKS

11:45 **Wheeler, H. T., and Jefferson, G**. TABULATION AND SIGNIFICANCE OF LIMB PROPORTIONS OF *PANTHERA ATROX* FROM THE LATE PLEISTOCENE OF NORTH AMERICA

12:00 **Gabriel, S., and Polly, P. D**. MONOPHYLY, DICHOTOMY OR NEITHER: INVESTIGATING 'LIPOTYPHLAN' PHYLOGENY USING GEOMETRIC MORPHOMETRICS

12:15 **Holroyd, P., and Strait, S**. NEW GEOLABIDID LIPOTYPHLANS AND BODY MASS DISTRIBUTION OF "INSECTIVORAN-GRADE" MAMMALS IN THE EARLY EOCENE OF WYOMING

WEDNESDAY AFTERNOON, OCTOBER 19, 2005
TECHNICAL SESSION IV
ARIZONA BALLROOM A-D
MODERATORS: F. ROBIN O'KEEFE AND JASON HEAD

1:30 **Rega, E., Sumida, S., Noriega, K., Pell, C., and Lee, A**. EVIDENCE-BASED PALEOPATHOLOGY I: ONTOGENETIC AND FUNCTIONAL IMPLICATIONS OF DORSAL SAILS IN *DIMETRODON*

1:45 **Sumida, S., Rega, E., and Noriega, K**. EVIDENCE-BASED PALEOPATHOLOGY II: IMPACT ON PHYLOGENETIC ANALYSIS OF THE GENUS *DIMETRODON*

2:00 **O'Keefe, F., Sidor, C., and Larsson, H**. EVOLUTIONARY DEVELOPMENT OF THE AMNIOTE ASTRAGALUS: NEW FOSSILS, NEW PERSPECTIVES

2:15 **Sidor, C., Larsson, H., O'Keefe, F. R., Blackburn, D., and Smith, R**. UPPER PERMIAN CAPTORHINID AND PAREIASAUR REPTILES FROM NIGER: NEW DATA AND INTERPRETATION

2:30 **Modesto, S., Berman, D., Scott, D., Muller, J., and Reisz, R.** THE CRANIAL SKELETON OF THE CAPTORHINID REPTILE *LABIDOSAURUS HAMATUS* FROM THE LOWER PERMIAN OF TEXAS

2:45 **Kammerer, C., Flynn, J., Ranivoharimanana, L., and Wyss, A**. NEW DATA ON THE CYNODONT FAUNA FROM THE TRIASSIC OF MADAGASCAR

3:00 **Angielczyk, K., and Botha, J**. AN INTEGRATIVE APPROACH TO DISTINGUISHING THE DICYNODONT SPECIES *OUDENODON BAINI* AND *TROPIDOSTOMA MICROTREMA* (THERAPSIDA: ANOMODOMTIA)

3:15 **BREAK**

3:30 **Green, J., Schneider, V., Schweitzer, M., and Clarke, J**. NEW EVIDENCE FOR NON-*PLACERIAS* DICYNODONTS IN THE LATE TRIASSIC (CARNIAN-NORIAN) OF NORTH AMERICA

3:45 **Gao, K., Fox, R., and Ksepka, D**. EARLY CRETACEOUS CHORISTODERES FROM WESTERN LIAONING, CHINA: TAXONOMIC DIVERSITY AND PHYLOGENETIC RELATIONSHIPS

4:00 **Buchy, M.-C., and Smith, K**. AN AIGIALOSAUR (SQUAMATA: ANGUIMORPHA) WITH SOFT-TISSUE PRESERVATION FROM THE UPPER CRETACEOUS OF NUEVO LEON, MEXICO

4:15 **Schmitz, L., Jiang, D., Motani, R., Hao, W., and Sun, L**. EXPLOSIVE RADIATION OF DUROPHAGOUS MARINE REPTILES DURING THE POST-PERMIAN RECOVERY

4:30 **Jiang, D., Hao, W., Sun, Y., Sun, Z., and Schmitz, L**. TWO NOTHOSAURIDS (REPTILIA, SAUROPTERYGIA) FROM THE ANISIAN (MIDDLE TRIASSIC) OF SOUTHWESTERN CHINA

4:45 **Bell, G., and Polcyn, M**. AN EXCEPTIONALLY CONSERVATIVE MOSASAUR FROM THE SANTONIAN OF KANSAS AND ITS PHYLOGENETIC RELEVANCE WITHIN MOSASAURIDAE

5:00 **Sues, H.-D., and Clark, J**. THALATTOSAURS (REPTILIA: DIAPSIDA) FROM THE LATE TRIASSIC (CARNIAN) OF NEVADA AND THEIR PALEOBIOGEOGRAPHIC SIGNIFICANCE

5:15 **Jamniczky, H., Brinkman, D., and Russell, A**. TURTLE CAROTID CIRCULATION: A CHARACTER ANALYSIS CASE STUDY

5:30 **Head, J**. *ARCHAEOPHIS PROAVUS* AND THE EVOLUTIONARY HISTORY OF PALAEOPHIID SNAKES

5:45 **Beck, A**. PATTERNS OF LIMB EVOLUTION IN THE NON-MAMMALIAN SYNAPSIDS

PREPARATORS SYMPOSIUM
ARIZONA BALLROOM E-G
CONVENORS: GAVIN McCULLOUGH AND PETER RESER

1:30 **Chaney, D**. A FOSSIL PLANT! NOW WHAT DO I DO?

1:45 **Smith, M., Fremd, T., and Kilpatrick, C**. THE USE OF CASTS WITHIN NOVEL EXHIBIT DESIGNS

2:00 **Keillor, T**. UNSOLVED MYSTERIES: SCULPTING THE SOFT TISSUE ANATOMY OF A TYRANNOSAUR BUST

2:15 **Jabo, S**. THE VERTEBRATE PREPARATION LABORATORY AS A MULTI-DISCIPLINARY, MULTI-FUNCTIONAL SPACE (OR, OTHER INTERESTING PROJECTS I'VE WORKED ON)

2:30 **Small, B**. THE CHALLENGES OF MOLDING PALEOZOIC FOOTPRINTS AT A REMOTE, HIGH ALTITUDE SITE

2:45 **Tedrow, A**. THE PRODUCTION OF RIGID BASES FOR THE LONG-TERM STORAGE AND EXHIBITION OF LARGE FOSSIL BONES.

3:00 **Fox, M**. THE FIRST INTERNATIONAL WORKSHOP FOR MICROPREPARATION OF VERTEBRATE FOSSILS

3:15 **BREAK**

3:30 **Murray, W**. PNEUMATIC PREP TOOLS, THEN AND NOW

3:45 **Mason, J**. A PLAQUE-MOUNTED TYPE SPECIMEN RESTORED: *HYDROTHEROSAURUS* REVEALED

4:00 **Van Beek, C**. THREE-DIMENSIONAL PREPARATION OF A LATE CRETACEOUS STURGEON FROM MONTANA

4:15 **Burnham, D., and Hines, C**. TRANSFER PREPARATION OF AN *ICHTHYORNIS* SPECIMEN FROM THE NIOBRARA FORMATION

4:30 **Reser, P., and Williams, S**. A TECHNIQUE USING CYANOACRYLATE AND GROUND MATRIX EXCLUSIVELY IN THE PREPARATION AND RESTORATION OF LATE TRIASSIC, CHINLE FORMATION, FOSSIL MATERIAL

4:45 **Denton, R.** MINIMIZING THE RISK—A REVIEW OF THE RELATIVE TOXICITY AND SAFE HANDLING OF POLYMERIC ADHESIVE AND CASTING MATERIALS USED IN PALEONTOLOGICAL PREPARATION

5:00 **Shinya, A., Bergwall, L., and Van Beek, C**. BSV SCALING: A SIMPLE VISCOSITY SCALE FOR ADHESIVES AND CONSOLIDANTS AND ITS APPLICATIONS

5:15 **Mason III, W**. A NEW SILICA BONDING TREATMENT PROVIDING LONG-TERM WEATHERING PROTECTION FOR FOSSIL TRACKWAYS IN A WIDE VARIETY OF ROCK SUBSTRATES

5:30 **Kronthal, L., Bisulca, C., and Davidson, A**. THE USE OF CONSERVARE OH-100 FOR THE STABILIZATION OF PARTICULARLY FRAGILE DINOSAUR BONE

5:45 **Down, J., and Kaminska, E**. DEGRADATION OF CYANOACRYLATE ADHESIVES IN THE PRESENCE AND ABSENCE OF FOSSIL MATERIAL

POSTERS ASSOCIATED WITH PREPARATOR'S SYMPOSIUM

Booth

1. **Benton, R., and Elder, A**. MUSEUM COLLECTION MANAGEMENT—IS IT REALLY WORTH DIGGING IN A NATIONAL PARK?
2. **Bergwall, L., and Shinya, A**. TRAVELING WITH ELMER
3. **Brown, G**. MOLDING AND CASTING OF *IN SITU* ARTICULATED SKELETONS IN SOFT MATRIX: A CASE STUDY FROM THE ASHFALL FOSSIL BEDS, NEBRASKA

4. **Cavin, J., Sheldon, M., Weiler, M., Johnson, S., Tate, A., and Herbel, C**. A LOOK AT THE UNIQUE AND PROBLEMATIC PRESERVATION FOUND WITH THE BIG PIG DIG QUARRY SITE, CONATA PICNIC AREA, BADLANDS NATIONAL PARK, SOUTH DAKOTA
5. **Cherry, M., Herbel, C., and Greenwald, M**. RESEARCH VS. SECURITY: COMMON SENSE APPROACHES TO PROTECTING YOUR COLLECTIONS
6. **Kroehler, P**. *CAMPTOSAURUS BROWNI*, GILMORE: THE HOLOTYPE IS NO LONGER MOUNTED
7. **Mugnai, R., Silva, H. de P., and Kellner, A**. APPLYING A PVC FILM FOR MOLDING MEDIUM-SIZE FOSSIL VERTEBRATES: VARIATION OF A TRADITIONAL TECHNIQUE
8. **Potapova, O**. RECONSTRACTION AND CONSERVATION OF A COLUMBIAN MAMMOTH *MAMMUTHUS COLUMBI* (FALCONER, 1857) TUSK IN MONITORED CONDITIONS
9. **Rinke, L., and Wahl, W**. USES OF HEATING ELEMENTS TO GENTLY AND CHEAPLY WARM DMSO. INEXPENSIVE HOTPLATES AS LABORATORY TOOLS
10. **Slezak, J**. PREPARING DINOSAUR EGGSHELL FOR MUSEUM DISPLAY
11. **Sroka, S., Finlayson, H., and Bennis-Smith, M**. THE DISCOMBOBULATED COLLECTION: TURNING A CURATOR'S NIGHTMARE INTO A RESEARCHER'S DREAM
12. **Weiler, M., Johnson, S., Sheldon, M., Tate, A., and Herbel, C**. PREPARATION OF UNIQUELY PRESERVED VERTEBRATE FOSSILS FROM THE BIG PIG DIG QUARRY IN BADLANDS NATIONAL PARK, SOUTH DAKOTA
13. **Williams, S**. THE LITTLE MUSEUM THAT COULD: HOW THE BURPEE MUSEUM OF NATURAL HISTORY PREPARED A JUVENILE TYRANNOSAUR

MAMMALIAN EVOLUTION IN THE CONTEXTS OF PALEOECOLOGICAL AND CLIMATIC CHANGE
PALO VERDE BALLROOM
CONVENORS: MATTHEW MIHLBACHLER, GINA SEMPREBON, NIKOS SOLOUNIAS AND FLORENT RIVALS

1:30 **Barnosky, A., Carrasco, M., Davis, E., and Tausczik, Y**. REMOVING THE SPECIES-AREA EFFECT FROM PALEODIVERSITY ESTIMATES

1:45 **Wesley-Hunt, G., and Werdelin, L**. ECOMORPHOLOGICAL STRUCTURE OF MODERN CARNIVORAN DIVERSITY AND THE IMPACT OF ENVIRONMENT

2:00 **Alroy, J., and Paleobiology Database VP Working Group**. ECOLOGICAL SPECTRA THROUGH THE CRETACEOUS AND CENOZOIC TETRAPOD FOSSIL RECORD

2:15 **Secord, R., and Wing, S**. PALEOENVIRONMENTAL INTERPRETATION OF AN EARLY EOCENE FAUNA USING STABLE ISOTOPES FROM MAMMAL TEETH

2:30 **Retallack, G**. MAMMALS, GRASSES AND CENOZOIC PALEOCLIMATE

2:45 **Mihlbachler, M., and Solounias, N**. MESOWEAR AND THE DIETARY HISTORY OR NORTH AMERICAN HORSES FROM *HYRACOTHERIUM* TO *EQUUS* AND ITS RELATIONSHIP WITH CLIMATIC AND MORPHOLOGICAL EVOLUTION

3:00 **Damuth, J., and Janis, C**. PALEOECOLOGICAL INFERENCES USING TOOTH WEAR RATES, HYPSODONTY AND LIFE HISTORY IN UNGULATES

3:15 **BREAK**

3:30 **Semprebon, G**. MIOCENE SAVANNAS AND THE GREAT TRANSFORMATION: TESTING DIETARY SHIFTS WITHIN THE EQUIDAE USING LOW-MAGNIFICATION STEREOMICROSCOPY

3:45 **Rivals, F., and Semprebon, G**. DENTAL WEAR AND DIETARY EVOLUTION OF ANTILOCAPRIDAE DURING THE MIOCENE-PLEISTOCENE CLIMATIC TRANSFORMATION

4:00 **Hopkins, S**. WHY ARE THERE SO FEW KINDS OF APLODONTIDS? THE RELATIVE ROLES OF CLIMATE, VEGETATION, AND COMPETITION IN THE DECLINE OF A LINEAGE

4:15 **Stromberg, C., and Werdelin, L**. ECOSYSTEM EVOLUTION IN THE EASTERN MEDITERRANEAN DURING THE MIOCENE: CORRELATION BETWEEN FAUNAL, FLORAL AND CLIMATIC CHANGE

4:30 **Fortelius, M., Passey, B., Kaakinen, A., Zhu, Y., Zhang, Z., and Zhou, L.** PALEOENVIRONMENTS AND MAMMAL COMMUNITIES OF THE LATE NEOGENE RED CLAY AT BAODE, SHANXI, NORTH CHINA

4:45 **Schubert, B., Ungar, P., Sponheimer, M., Reed, K., and Lee-Thorp, J**. BOVID PALEODIETS AND THE PALE-

OECOLOGY OF MAKAPANSGAT LIMEWORKS CAVE, SOUTH AFRICA: A COMPARISON OF FIVE PALEODIETARY PROXY MEASURES

5:00 **Beatty, B** MIOCENE-PLIOCENE PALEOECOLOGICAL SHIFTS IN THE AQUATIC HERBIVORE ADAPTIVE ZONE USING DENTAL WEAR

5:15 **Bell, C**. USE OF AN EXTANT PHYLOGENETIC BRACKET FOR PALEOECOLOGICAL RECONSTRUCTIONS

5:30 **Feranec, R., Hadly, E., and Paytan, A**. MAMMALIAN RESOURCE USE STABILITY ACROSS GLACIAL-INTERGLACIAL CYCLES DURING THE PLEISTOCENE IN COLORADO

5:45 **Martin, R., Pelaez-Campomanes, P., Honey, J., Fox, D., Marcolini, F., and Crockett, C**. PRELIMINARY REPORT OF RODENT COMMUNITY CHANGE AND MORPHOLOGICAL EVOLUTION THROUGH THE LAST FIVE MILLION YEARS IN SOUTHWESTERN KANSAS

POSTERS ASSOCIATED WITH MAMMALIAN EVOLUTION SYMPOSIUM

Booth

1. **Davis, E**. TESTING THE TURNOVER PULSE HYPOTHESIS WITH FAMILIES OF MAMMALIAN UNGULATES IN THE MIOCENE OF THE WESTERN USA
2. **Desantis, L., and Wallace, S**. ANOMALOUS PALEOECOLOGY OF A NEOGENE FOSSIL SITE, GRAY, TN: UTILIZING STABLE ISOTOPE ANALYSES OF FOSSIL TOOTH ENAMEL TO RECONSTRUCT PAST ENVIRONMENTS
3. **Janis, C., and Seckel, L**. CONVERGENCES IN SCAPULA MORPHOLOGY AMONG SMALL BOUNDING MAMMALS
4. **Roberts, K**. NEW INFORMATION ON THE EVOLUTION OF THE RINGTAIL POSSUM FAMILY (*PSEUDOCHEIRIDAE*: *MARSUPIALIA*), REVEALED BY THE FOSSIL GENUS *MARLU*
5. **Shabel, A**. THE PALEOBIOLOGY OF THE ROBUST AUSTRALOPITHECINES (*PARANTHROPUS*): A TEST OF THE DUROPHAGE MODEL WITH CARBON ISOTOPE ANALYSIS

THURSDAY MORNING, OCTOBER 20, 2005

PLENARY ROMER PRIZE SESSION
ARIZONA BALLROOM A-D
MODERATOR: RYOSUKE MOTANI

8:15 **Bader, K**. THE USE OF FORENSIC ENTOMOLOGY IN DINOSAUR TAPHONOMY AT A QUARRY IN THE UPPER JURASSIC MORRISON FORMATION IN NORTHEASTERN WYOMING
8:30 **Butler, R**. THE PHYLOGENY AND EVOLUTIONARY HISTORY OF THE ORNITHISCHIAN DINOSAURS
8:45 **Chew, A**. MAMMALIAN FAUNAL TURNOVER IN THE EARLY EOCENE OF THE CENTRAL BIGHORN BASIN, WYOMING
9:00 **Claessens, L**. THE SKELETAL RESPIRATORY PUMP AND ARCHOSAURIAN PULMONARY EVOLUTION
9:15 **Decherd, S**. FEEDING DINOSAURIAN HERBIVORES: THE NUTRITIVE VALUE AND DIGESTIBILITY OF MESOZOIC FOLIAGE
9:30 **Delmer, C**. PHYLOGENETIC RELATIONSHIPS BETWEEN PALEOGENE PROBOSCIDEANS: NEW DATA AND IMPACT ON TETHYTHERIAN SYSTEMATICS
9:45 **Goswami, A**. MAJOR SHIFTS IN MORPHOLOGICAL INTEGRATION AND MODULARITY IN THE EVOLUTION OF THE MAMMALIAN SKULL
10:00 **BREAK**
10:15 **Holliday, C**. EVOLUTIONARY PATTERNS OF THE ORBITOTEMPORAL REGION OF ARCHOSAURS: IMPLICATIONS FOR NEUROANATOMY AND INTRACRANIAL MOBILITY
10:30 **Joyce, W**. PHYLOGENY AND ECOLOGY OF BASAL TURTLES
10:45 **Ladeveze, S**. METATHERIAN PETROSAL BONES FROM THE PALEOCENE OF ITABORAI (BRAZIL), AND AN ATTEMPT TO ASSIGN ISOLATED PETROSALS TO DENTAL REMAINS
11:00 **Moreno, K**. PEDAL MORPHOLOGY AND BIOMECHANICS FROM DIGITIGRADY TO SUBUNGULIGRADY
11:15 **Robinson, J**. THE EARLY TETRAPOD *KYRINION* AND THE TRANSITION TO HEARING AIRBORNE SOUND
11:30 **Schwartz, L**. MAXIMISING THE EVIDENCE: WHAT THE 'LEFTOVERS' TELL US ABOUT AUSTRALIA'S MID-TERTIARY
11:45 **Tsuihiji, T**. PRIMARY HOMOLOGIES OF THE DORSAL AND CERVICAL AXIAL MUSCLES IN SAURIA (CROWN DIAPSIDA) AND THEIR EVOLUTIONARY IMPLICATIONS

THURSDAY AFTERNOON, OCTOBER 20, 2005

TECHNICAL SESSION V
ARIZONA BALLROOM A-D
MODERATORS: FRANCOIS THERRIEN AND ANDREW LEE

1:30 **Witmer, L., and Ridgely, R**. TYRANNOSAUR BRAIN AND EAR STRUCTURE: ONTOGENY AND IMPLICATIONS FOR SENSORY FUNCTION AND BEHAVIOR
1:45 **Therrien, F., Ali, F., and Weishampel, D**. OLFACTORY BULB SIZE AS AN INDICATOR OF OLFACTORY ACUITY IN NON-AVIAN THEROPODS
2:00 **Lee, A., Bybee, P., and Lamm, E.-T**. ONTOGENETIC HISTOLOGY OF *ALLOSAURUS* (DINOSAURIA: THEROPODA): ASSESSING GROWTH TRAJECTORY AND EVOLUTION OF ONTOGENETIC LIMB ALLOMETRY
2:15 **Carr, T., and Williamson, T**. A REAPPRAISAL OF TYRANNOSAUROIDS FROM IREN DABASU, INNER MONGOLIA, PEOPLE'S REPUBLIC OF CHINA
2:30 **Brusatte, S., and Sereno, P**. A NEW SPECIES OF *CARCHARODONTOSAURUS* (DINOSAURIA: THEROPODA) FROM THE CENOMANIAN OF NIGER AND ITS IMPLICATIONS FOR ALLOSAUROID PHYLOGENY
2:45 **Prieto-Marquez, A., Gignac, P., Joshi, S., and Erickson, G**. TESTING THE UTILITY OF OSTEOLOGICAL CORRELATES PURPORTED TO REFLECT GENDER IN NON-AVIAN DINOSAURS
3:00 **Padian, K., Horner, J., and Lee, A**. SEXUAL DIMORPHISM IN DINOSAURS?: A REVIEW OF THE EVIDENCE

TECHNICAL SESSION VI
ARIZONA BALLROOM E-G
MODERATOR: KAREN SEARS

1:30 **Yule, J., Ginzburg, L**. TRANSPARENCY AND MINIMALISM: ECOLOGICAL MODELING OF LATE PLEISTOCENE EXTINCTIONS
1:45 **Jass, C**. A RE-EVALUATION OF THE AGE ASSIGNMENT OF CATHEDRAL CAVE, NEVADA
2:00 **Kraatz, B., and Geisler, J**. THE AGE OF THE HSANDA GOL FORMATION, MONGOLIA AND IMPLICATIONS FOR TIMING OF THE MONGOLIAN REMODELLING
2:15 **McCullough, G**. ENVIRONMENTAL RECONSTRUCTION OF THE RED SHIRT TABLE FOSSIL LOCALITY IN BADLANDS NATIONAL PARK, SOUTHWESTERN SOUTH DAKOTA
2:30 **Sears, K**. MORPHOLOGICAL INNOVATION VIA HETEROCHRONY: AN EXAMPLE IN THE EVOLUTION OF THE GIANT EXTINCT KANGAROOS (MACROPODIDAE: STHENURINAE) OF AUSTRALIA
2:45 **Miller, J., and Behrensmeyer, A**. SKELETAL DISTRIBUTIONS ACROSS TIME: A MULTIVARIATE APPROACH TO THE CHANGING TAPHONOMY OF AMBOSELI PARK, KENYA
3:00 **Lansing, S., and Behrensmeyer, A**. ANALYSIS OF FAUNAL REMAINS FROM SPOTTED HYENA (*CROCUTA CROCUTA*) DENS IN AMBOSELI NATIONAL PARK, KENYA

TECHNICAL SESSION VII
PALO VERDE BALLROOM
MODERATOR: JOHN HUNTER

1:30 **Martin, T**. THE POSTCRANIAL SKELETON OF THE DOCODONT MAMMAL *HALDANODON*
1:45 **Luo, Z.-X., and Wible, J**. CONVERGENT EVOLUTION OF MYRMECOPHAGAN AND FOSSORIAL ADAPTATIONS OF *FRUITAFOSSOR* AND ECOMORPHOLOGICAL DIVERSIFICATION OF MAMMALS OF THE LATE JURASSIC AND EARLY CRETACEOUS
2:00 **Morlo, M., and Gunnell, G**. COMPARISON OF CARNIVORE GUILD STRUCTURE ACROSS THE PALEOCENE-EOCENE BOUNDARY IN NORTH AMERICA
2:15 **Macrini, T., Rougier, G., and Rowe, T**. A DIGITAL CRANIAL ENDOCAST OF *VINCELESTES* AND A DISCUSSION OF THE EVOLUTION OF ENDOCRANIAL SPACE IN MAMMALS
2:30 **Archibald, J. D., and Averianov, A**. MAMMALIAN FAUNAL SUCCESSION IN THE CRETACEOUS OF THE KYZYLKUM DESERT, UZBEKISTAN
2:45 **Chinsamy-Turan, A., and Hurum, J**. BONE MICROSTRUCTURE AND GROWTH PATTERNS OF EARLY MAMMALS
3:00 **Hunter, J**. SIX YEARS LATER AND A DEEP CRETACEOUS RADIATION OF CROWN PLACENTAL MAMMALS IS STILL UNLIKELY

POSTER SESSION A
Authors must be present from 3:30-5:00
Posters must be removed by 6:00

Booth
1. **Hall, P., and Elliott, D**. NEW OSTEOLEPIFORMS FROM THE MIDDLE DEVONIAN OF NORTHERN UTAH
2. **Rust, D., Elliott, D., and Irmis, R**. ADDITIONS TO THE VERTEBRATE FAUNA OF THE PENNSYLVANIAN (DESMOINESIAN) NACO FORMATION, CENTRAL ARIZONA
3. **Everhart, M**. NEW STRATIGRAPHIC RECORDS (ALBIAN-CONIACIAN) OF THE GUITARFISH, *RHINOBATOS INCERTUS* (CHONDRICHTHYES: RAJIFORMES), FROM THE CRETACEOUS OF CENTRAL AND WESTERN KANSAS
4. **Shimada, K**. SKELETAL AND DENTAL ANATOMY OF THE LATE CRETACEOUS LAMNIFORM SHARK, *CRETALAMNA* (=*CRETOLAMNA*) *APPENDICULATA*
5. **Gonzalez-Barba, G., and Goedert, J**. THE CONTRASTING EOCENE-OLIGOCENE RECORD OF *CARCHAROCLES* (*CARCHARODON*) FROM WASHINGTON-OREGON AND BAJA CALIFORNIA SUR
6. **Morales, M**. PRELIMINARY REPORT ON A NEW SPECIES OF *PAROTOSUCHUS* (TEMNOSPONDYLI: CAPI-

TOSAUROIDEA) FROM THE EARLY TRIASSIC OF UTAH

7. **Henrici, A., and Haynes, S**. NEW PELOBATID ANURAN FROM THE EOCENE ELKO FORMATION OF NEVADA
8. **Evans, S., Barrett, P., Hilton, J., Jones, M., Parrish, J., and Rayfield, E**. THE MIDDLE JURASSIC VERTEBRATE ASSEMBLAGE OF SKYE, SCOTLAND
9. **Hall, M**. ACTIVITY PATTERN AND MORPHOLOGY OF THE VISUAL SYSTEM IN LIZARDS
10. **Leggitt, V. L., Buchheim, H. P., and Cushman Jr., R**. TURTLE SHELLS AS NUCLEI FOR CADDISFLY-DOMINATED MICROBIAL CARBONATE MOUNDS: WILKINS PEAK MEMBER, EOCENE GREEN RIVER FM.
11. **Hirayama, R**. SYSTEMATIC POSITION OF *PROTOSPHARGIS VERONENSIS* CAPELLINI, AN ENIGMATIC SEA TURTLE FROM THE LATE CRETACEOUS OF ITALY
12. **Bever, G**. *ECHMATEMYS* AND THE EVOLUTION OF THE BRAINCASE IN TESTUDINOID TURTLES
13. **Sato, T., and Wu, X**. PLESIOSAURS (REPTILIA: SAUROPTERYGIA) FROM THE CANADIAN ARCTIC: A PRELIMINARY REPORT ON THEIR SYSTEMATICS AND BIOSTRATIGRAPHY
14. **Martin, J., Case, J., Reguero, M., Sawyer, J. F., Santillana, S., and Moly, J**. A JUVENILE PLESIOSAUR AND ASSOCIATED VERTEBRATES FROM THE LATE CRETACEOUS OF ANTARCTICA
15. **Henderson, D**. FLOATING POINT: A COMPUTATIONAL STUDY OF BUOYANCY, EQUILIBRIUM, AND GASTROLITHS IN PLESIOSAURS
16. **Hemmy, A., and Burnham, D**. A REPORT ON UNGUALS IN THE HIND PADDLE OF A POLYCOTYLID PLESIOSAUR
17. **King, L., Foster, J., and Scheetz, R**. *MESADACTYLUS* AND OTHER NEW PTEROSAUR SPECIMENS FROM THE MORRISON FORMATION (UPPER JURASSIC) OF WESTERN COLORADO
18. **Fox, S**. THE AERODYNAMIC PROPERTIES OF RHAMPHORHYNCHID TAIL FINS
19. **Franz, R., Morgan, G., Franz, S., and Albury, N**. SPECTACULAR NEW QUATERNARY FOSSILS OF THE CUBAN CROCODILE AND AN EXTINCT TORTOISE FROM A FLOODED CAVE ON ABACO, BAHAMAS
20. **Chure, D**. CROCODILIANS FROM THE MORRISON FORMATION (UPPER JURASSIC: KIMMERIDGIAN) OF DINOSAUR NATIONAL MONUMENT
21. **Allen, D**. THE INFERRED EVOLUTIONARY HISTORY OF INTEGUMENTARY SENSE ORGANS IN CROCODYLOMORPHS
22. **Peterson, J**. FLUVIAL DISPERSAL OF SHED CROCODILIAN TEETH AND OTHER MICROVERTEBRATE REMAINS
23. **Kirkland, J., and Deblieux, D**. DINOSAUR REMAINS FROM THE LOWER TO MIDDLE CAMPANIAN WAHWEAP FORMATION AT GRAND STAIRCASE—ESCALANTE NATIONAL MONUMENT, SOUTHERN UTAH
24. **Hummel, J., Suedekum, K.-H., and Clauss, M**. EXPERIMENTAL ESTIMATION OF THE NUTRITIONAL VALUE OF POTENTIAL FOOD PLANTS OF HERBIVOROUS DINOSAURS, WITH SPECIAL EMPHASIS ON SAUROPODS
25. **Holtz, T**. IN THE SHADOW OF CASTROPHE: PHYLOGENY, PALEOECOLOGY, AND FAUNAL TURNOVER OF CAMPANO-MAASTRICHTIAN DINOSAURS OF WESTERN NORTH AMERICA
26. **Darrough, G., Fix, M., Parris, D., and Grandstaff, B**. CHRONISTER DINOSAUR SITE INVESTIGATIONS: NEW INFORMATION ON THE CRETACEOUS OF MISSOURI
27. **Fiorillo, A., Triplehorn, D., Layer, P., and Ferguson, K**. FIRST EVIDENCE OF CENOMANIAN DINOSAURS IN ALASKA: FURTHER INSIGHT INTO THE CRETACEOUS ORIGIN OF BERINGIA
28. **Hohloch, A., and Mallison, H**. DIGITIZING DINOSAURS: NEW TECHNIQUES FOR THE MICROSCRIBE 3D DIGITIZER
29. **DiCroce, T., Carpenter, K., and Kinneer, B**. RECONSTRUCTION OF THE PELVIC AND HIND LIMB MUSCULATURE IN THE ANKYLOSAUR *GASTONIA*
30. **Farke, A., and Williamson, T**. A CHASMOSAURINE CERATOPSID PARIETAL FROM THE NAASHOIBITO MEMBER, OJO ALAMO FORMATION OF NEW MEXICO, WITH IMPLICATIONS FOR CERATOPSID SYSTEMATICS AND BIOGEOGRAPHY
31. **Dalman, S**. A SMALL ORNITHISCHIAN DINOSAUR FOOTPRINT ASSEMLAGE FROM THE EARLY JURASSIC, HOLYOKE, MA
32. **Guenther, M**. TAXONOMIC UTILITY OF HADROSAURID POSTCRANIAL MATERIAL ANALYZED USING MULTIPLE MORPHOMETRIC TECHNIQUES
33. **Balanoff, A., Ikejiri, T., and Bever, G**. THE ENDOCRANIAL MORPHOLOGY OF DIPLODOCID SAUROPODS
34. **Bonnan, M., Parrish, J. M., Stevens, K., Graba, J., and Senter, P**. SCAPULAR POSITION AND FUNCTION IN

THE SAUROPODOMORPHA (REPTILIA: SAURISCHIA)

35. **Corfe, I., and Wilkinson, M**. CLASH OF THE TITAN(OSAUR)S: INVESTIGATING SAUROPOD PHYLOGENY
36. **Hartman, S., Lovelace, D., and Wahl, W**. PHYLOGENETIC ASSESSMENT OF A MANIRAPTORAN FROM THE MORRISON FORMATION
37. **Grillo, O., Azevedo, S**. RECONSTRUCTION OF THE SKELETON OF *STAURIKOSAURUS PRICEI* COLBERT, 1970 (DINOSAURIA, THEROPODA): USE OF 3D LASER SCANNER AND THREE-DIMENSIONAL VIRTUAL MODELING TO RECONSTRUCT FOSSIL VERTEBRATES
38. **Buckley, L., McCrea, R., and Currie, P**. THEROPOD TEETH FROM THE UPPER CRETACEOUS KASKAPAU (MIDDLE TURONIAN) AND THE WAPITI (UPPER CAMPANIAN-LOWER MAASTRICHTIAN) FORMATIONS OF NORTH-EASTERN BRITISH COLUMBIA, CANADA
39. **Schmeisser, R., and Flood, T**. RECOGNITION OF PALEOGASTROLITHS FROM THE CEDAR MOUNTAIN FORMATION OF NORTHERN UTAH, USING A SCANNING ELECTRON MICROSCOPE
40. **Rees, P., Noto, C., and Weishampel, D**. A NEW ONLINE DATABASE OF DINOSAUR DISTRIBUTIONS
41. **Hayward, J**. DINOSAUR EGGSHELL FRAGMENT ORIENTATIONS AS TAPHONOMIC SIGNATURES
42. **Gatesy, S., Brown, C., Wallace, S., Cantor, G., Shubin, N., and Jenkins, F**. HIGH-RESOLUTION 3-D SCANNING OF DINOSAUR FOOTPRINTS: HOW HIGH IS HIGH ENOUGH?
43. **Fechner, R**. NEW VERTEBRATE REMAINS FROM THE UPPER JURASSIC/LOWER CRETACEOUS OF PORTUGAL
44. **Connely, M., and Talbot, B**. TRACE FOSSILS IN MARINE SEDIMENTS OF THE MOWRY SHALE (EARLY CRETACEOUS) OF WYOMING ARE POSSIBLY VERTEBRATE IN ORIGIN
45. **Brett-Surman, M., Jabo, S., Kroehler, P., Carrano, M., and Kvale, E**. A NEW MICROVERTEBRATE ASSEMBLAGE FROM THE UPPER JURASSIC MORRISON FORMATION, INCLUDING MAMMALS, THEROPODS, AND SPHENODONTIANS
46. **Bird, J**. NEW FINDS AT THE PRICE RIVER II SITE, CEDAR MOUNTAIN FORMATION IN EASTERN UTAH
47. **Bonde, J., and Varricchio, D**. PRELIMINARY INVESTIGATION OF THE WILLOW TANK FORMATION (ALBIAN) OF SOUTHERN NEVADA
48. **Henriques, D., Azevedo, S., Capilla, R., and Suarez, J**. THE PIRAPOZINHO SITE—A TAPHOFACIES STUDY
49. **Heckert, A., and Lucas, S**. THE TRIASSIC-JURASSIC NON-EVENT: PATTERNS AND PROCESS OF TETRAPOD EXTINCTIONS ACROSS THE TR/J BOUNDARY
50. **Freedman, E., and Wilson, L**. FAUNAL COMPARISON OF MICROVERTEBRATE ACCUMULATIONS IN THE JUDITH RIVER FORMATION (CAMPANIAN) AND HELL CREEK FORMATION (MAASTRICHTIAN) OF MONTANA WITH CONSIDERATION OF COLLECTION METHOD BIASES
51. **Ikegami, N., and Tomida, Y**. A THERIZINOSAURID DINOSAUR FROM THE UPPER CRETACEOUS MIFUNE GROUP IN KYUSHU, JAPAN
52. **Chatterjee, S., and Templin, R**. BIPLANE WING PLANFORM AND THE FLIGHT PERFORMANCE OF *MICRORAPTOR GUI*
53. **Kim, K. S., Kim, J. Y., Kim, S. H., Kim, J. S., Park, T. W., Han, T. H., and Lockley, M**. BIRD TRACKS FROM THE CRETACEOUS HAMAN FORMATION OF CHANGSEON AND SINSU ISLANDS, SOUTH KOREA
54. **Lamm, K., Ksepka, D., Georgi, J., and Sipla, J.** A REVISED MASS REGRESSION FOR RATITE BIRDS
55. **Habib, M., and Ruff, C**. FORELIMB TO HINDLIMB STRUCTURAL PROPORTIONS PREDICT LOCOMOTOR BEHAVIOR IN BIRDS
56. **Rogers, R., Fricke, H., Koenig, A., Dwyer, C., HArwood, C., and Williams, J**. A COMPARATIVE STUDY OF DIAGENESIS IN FOSSIL BONES AND TEETH: A CASE STUDY FROM THE UPPER CRETACEOUS TWO MEDICINE AND JUDITH RIVER FORMATIONS OF MONTANA
57. **Moses, R., and Patrick, D**. RARE EARTH ELEMENT (REE) AND TRACE ELEMENT ANALYSIS OF LATE JURASSIC MORRISON FORMATION FOSSIL LOCALITIES IN THE NORTHERN BLACK HILLS: STRATIGRAPHIC AND PALEOENVIRONMENTAL IMPLICATIONS
58. **Daniel, J., and Witmer, L**. HEADS AND SKULLS AS SEDIMENT SORTERS: AN ACTUALISTIC, CT-BASED STUDY IN TAPHONOMY
59. **Maga, M**. WHERE TO LOOK FOR MORE FOSSILS: A GIS APPROACH
60. **Minjin, B., and Geisler, J**. PHYLOGENETIC TESTS FOR THE IDENTIFICATION OF ISOLATED POSTCRANIAL REMAINS: AN EXAMPLE USING NORTH AMERICAN MULTITUBERCULATES
61. **Cifelli, R., Gordon, C**. FIRST NEOCOMIAN (EARLIEST CRETACEOUS) MAMMALS FROM NORTH AMERICA

62. **Clyde, W., Hamzi, W., Finarelli, J., Secord, R., and Wing, S**. A NEW BASIN-WIDE MAGNETOSTRATIGRAPHIC FRAMEWORK FOR THE BIGHORN BASIN, WYOMING
63. **Tucker, S., and Voorhies, M**. A DIVERSE LATE MIOCENE (HEMPHILLIAN) INSECTIVORE FAUNA FROM NORTH-CENTRAL NEBRASKA
64. **Kersting, R., and Moers, T**. WATER MOLES (DESMANINAE, LIPOTYPHLA) FROM THE PLIOCENE REUVER CLAY OF NORTH-WEST GERMANY AND THEIR DISTRIBUTION IN EUROPE
65. **Naples, V., and McAfee, R**. FUNCTIONAL CORRELATES BETWEEN ZYGOMATIC ARCH STRUCTURE AND MASTICATORY STROKE ORIENTATION IN SLOTHS
66. **Gaudin, T**. IS *EUROTAMANDUA* A PANGOLIN? A RECONSIDERATION OF ITS AFFINITIES TO XENARTHRA, PHOLIDOTA AND PALAEANODONTA
67. **Tomida, Y., and Jin, C.-Z**. EVOLUTION AND DIVERSITY OF THE GENUS *PLIOPENTALAGUS* (LEPORIDAE, LAGOMORPHA) IN THE HOLARCTIC REGION
68. **Winkler, A., and Harrison, T**. PLIOCENE LAGOMORPHS AND MACROSCELIDIDS RECENTLY RECOVERED FROM LAETOLI, NORTHERN TANZANIA
69. **Wertheim, J., Croft, D., Flynn, J., and Wyss, A**. NEW RODENT FAUNAS SPANNING SEVERAL SALMAS FROM THE LAGUNA DEL LAJA REGION, ANDEAN MAIN RANGE, CENTRAL CHILE
70. **Zakrzewski, R., and Bever, G**. MICROTIDS FROM THE FIENE LOCAL FAUNA (IRVINGTONIAN), SMITH COUNTY, KANSAS
71. **Johnson, S, and Martin, J**. FUNCTIONAL ANATOMY OF THE BEAVER (*DIPOIDES STIRTONI*) FROM THE LATE MIOCENE OF OREGON
72. **Boardman, G**. *COPEMYS* (RODENTIA, CRICETIDAE) FROM THE MIOCENE FLEMING FORMATION, FORT POLK, LOUISIANA
73. **Humpula, J., Buckley, M., Stafford, T., Voorhies, M., Hunt, R., and Corner, G**. EXTINCT MOOSE-ELK (*CERVALCES*): PHYLOGENETIC INFORMATION REVEALED THROUGH MASS SPECTROMETRY
74. **Scott, E**. *EQUUS IDAHOENSIS* FROM THE PLIO-PLEISTOCENE OF ARIZONA, AND ITS ROLE IN PLESIPPINE EVOLUTION IN THE AMERICAN SOUTHWEST
75. **Walsh, S**. REVISION OF *SIMIMERYX* (ARTIODACTYLA, HYPERTRAGULIDAE)
76. **Wallace, S., and Hulbert, R**. MORPHOLOGY AND SYSTEMATICS OF THE HEMPHILLIAN (MIOCENE) GRAY FOSSIL SITE TAPIR
77. **Chester, S., Bloch, J., Boyer, D., and Wing, S**. ANACHRONISTIC OCCURENCES OF PHENACODONTID SPECIES IN THE CLARKFORKIAN OF THE SOUTHERN BIGHORN BASIN: POSSIBLE EVIDENCE AGAINST TRANSIENT DWARFING IN *ECTOCION* AND *COPECION* DURING THE CIE-PETM INTERVAL
78. **Wood, A., Desilva, J., Eiting, T., Rountrey, A., Whitlock, J., and Zelditch, M**. MULTIVARIATE TESTS OF EVOLUTIONARY MODE IN *ECTOCION* TEETH
79. **Miyata, K., and Tomida, Y**. DENTAL CHARACTERS OF A NEW CORYPHODONTID PANTODONT FROM THE EOCENE AKASAKI FORMATION, KUMAMOTO PREFECTURE, WESTERN JAPAN
80. **Lindenau, C**. HIGHLY DERIVED TOOTH ENAMEL MICROSTRUCTURE OF PYROTHERES (MAMMALIA) COMPARED TO THAT OF DEINOTHERES (PROBOSCIDEA, MAMMALIA)
81. **Churchill, M., Berta, A., and Demere, T**. THE SYSTEMATICS AND BIOGEOGRAPHY OF THE BALAENOIDEA
82. **Christiansen, P., and Harris, J**. BODY MASS ESTIMATES FOR *SMILODON* SPECIES
83. **Benoit, M**. AN ALLOMETRIC ANALYSIS OF FOSSIL AND EXTANT FELIDS
84. **Egi, N., Tsubamoto, T., Takai, M., and Holroyd, P**. CREODONTS FROM THE MIDDLE EOCENE PONDAUNG FORMATION (MYANMAR) AND ITS PALEOBIOGEOGRAPHICAL SIGNIFICANCE
85. **White, J**. OLD TEETH, NEW INTERPRETATIONS: A FUNCTIONAL ANALYSIS OF THE MOLAR MORPHOLOGY OF THE QUERCY ADAPIDS
86. **Kim, J. Y., Kim, K. S., Kim, S. H., Lee, C., and Lim, J. D**. HOMINID AND OTHER VERTEBRATE FOOTPRINTS FROM THE LATE QUATERNARY STRATA OF JEJU ISLAND, KOREA
87. **Carranza-Castañeda, O., Aguirre-Diaz, G., and Alvarado-Ortega, J**. MIOCENE-PLIOCENE PALEO LAKES WITHIN THE CENTRAL SECTOR OF THE MEXICAN VOLCANIC BELT
88. **Marivaux, L., Metais, G., Antoine, P.-O., Baqri, S. R. H., Crochet, J.-Y., and Welcomme, J.-L**. VERTEBRATE REMAINS FROM THE EOCENE OF THE BUGTI HILLS (BALOCHISTAN, PAKISTAN)
89. **Wagner, H**. THE TERRESTRIAL MAMMALIAN ASSEMBLAGE OF THE MARINE PLIOCENE AGE SAN DIEGO FORMATION, SAN DIEGO COUNTY, CALIFORNIA

90. **Hester, P**. MITIGATION OF NATURAL AND HUMAN-INDUCED CHANGES TO NEW MEXICO'S MOST IMPORTANT JURASSIC BONEBED
91. **Southwell, E., Breithaupt, B., and Weege, C**. THE RACE TO RESTORE THE FIRST COMPLETE SAUROPOD SKELETON: THE 1905 AMNH MOUNT OF *APATOSAURUS*
92. **Hunter, K., and Breithaupt, B**. RISING FROM THE DUST: AN *ALLOSAURUS'* JOURNEY TO THE 21ST CENTURY
93. **Martens, T**. FIRST BURROW CASTS OF TETRAPOD ORIGIN FROM THE LOWER PERMIAN (TAMBACH FORMATION) IN GERMANY

STUDENT POSTER SESSION

Posters will be set up by 8:00 on Thursday, November 5 and remain until 6:00

94. **Baziak, B**. INTERSPECIFIC SIMILARITIES IN LINES OF ARRESTED GROWTH IN TIBIAE OF *MAIASAURA PEEBLESORUM*
95. **Bennett, III, G**. TRENDS IN FOSSIL RECORD COMPLETENESS: CORRELATING AGE AND LAND AREA WITH ANCIENT ISLAND HERPETOFAUNAS
96. **Cuthbertson, R**. NEW INFORMATION ON THE HOLOTYPE OF *BRACHYLOPHOSAURUS CANADENSIS* (ORNITHISCHIA: HADROSAURIDAE): ANATOMICAL RECONSTRUCTION AND ANALYSIS
97. **Ehret, D**. THE ROOF IS ON FIRE: FIRE-SCARRING IN PLEISTOCENE BOX TURTLES (*TERRAPENE*) FROM THE SOUTHEASTERN U.S.
98. **Goodchild Drake, B**. A PRELIMINARY ANALYSIS OF CRANIAL SUTURE VARIATION IN *ALLOSAURUS*
99. **Hamm, S**. NEW DATA ON THE OCCURRENCE AND DISTRIBUTION OF *PTYCHODUS* FROM THE UPPER CRETACEOUS OF TEXAS
100. **Hunt, R**. CERATOPSID DINOSAURS FROM THE JAVELINA FORMATION (MAASTRICHTIAN), BIG BEND NATIONAL PARK, TEXAS
101. **Jones, C**. A PALEOCLIMATIC LOOK AT THE EVOLUTION OF TORTOISES (TESTUDINIDAE) IN SOUTHWESTERN NORTH AMERICA
102. **Konishi, T**. SOLVING TAXONOMY OF *PLATECARPUS* (SQUAMATA: MOSASAURIDAE) IN NORTH AMERICA, USING NEW SPECIMENS FROM THE LOWER PART OF THE SMOKY HILL CHALK MEMBER (UPPER CONIACIAN-LOWER SANTONIAN), NEAR UTICA, KANSAS, U.S.A.
103. **Krumenacker, L**. PRELIMINARY REPORT ON NEW VERTEBRATE FOSSILS FROM THE DRANEY LIMESTONE (APTIAN) AND WAYAN FORMATION (ALBIAN) OF EAST IDAHO
104. **Mackenzie, L**. MORPHOLOGY, HISTOLOGY, AND DISTRIBUTION OF TEETH IN EARLY GNATHOSTOMES FROM THE MACKENZIE MOUNTAINS, NORTHWEST TERRITORIES
105. **Maidment, S**. CHINA'S STEGOSAURS: A REVIEW OF UPPER JURASSIC ARMOURED DINOSAURS FROM CHINA
106. **McCormick, K**. TAPHONOMY OF CHONDRICHTHYAN TEETH FROM THE PENNSYLVANIAN OF ILLINOIS
107. **Pobiner, B**. AFRICAN CARNIVORAN TAXON-SPECIFIC BONE MODIFICATION PATTERNS: EXPERIMENTAL EVIDENCE
108. **Redman, C**. RECONSTRUCTING THE PALEOECOLOGY AND DEPOSITIONAL ENVIRONMENT OF THE BISSEKTY FORMATION
109. **Säilä, L**. A NEW SPECIES OF THE SPHENODONTIAN REPTILE *CLEVOSAURUS* FROM THE LOWER JURASSIC OF SOUTH WALES, AND THE TETRAPOD DIVERSITY OF ST. BRIDE'S ISLAND
110. **Suarez, C**. EVIDENCE FOR A VERY COMPLEX TAPHONOMIC HISTORY OF THE EARLY CRETACEOUS CRYSTAL GEYSER DINOSAUR QUARRY, EAST-CENTRAL, UTAH
111. **Suarez, M**. DEPOSITIONAL ENVIRONMENTS OF THE CRYSTAL GEYSER DINOSAUR QUARRY: AN UNUSUAL DINOSAUR IN AN UNUSUAL ENVIRONMENT
112. **Tanoue, K**. POSTCRANIAL SKELETON AND ONTOGENY OF *EUOPLOCEPHALUS TUTUS* (ORNITHISCHIA, ANKYLOSAURIDAE)
113. **Welsh, E**. EGGSHELLS AND BABY DINOSAURS IN THE UPPER AGUJA FORMATION OF BIG BEND NATIONAL PARK, TEXAS
114. **Williams, D**. FOSSIL MOLES OF THE SANTA FE RIVER 1B, FLORIDA
115. **Williams, M**. A NEW LATE MIOCENE (LATE BARSTOVIAN) HERPETOFAUNA FROM FORT POLK, LA
116. **Woodward, H**. BONE HISTOLOGY OF THE TITANOSAURID SAUROPOD *ALAMOSAURUS SANJUANENSI* FROM THE JAVELINA FORMATION, TEXAS

FRIDAY MORNING, OCTOBER 21, 2005

TECHNICAL SESSION VIII
ARIZONA BALLROOM A-D
MODERATORS: MATTHEW LAMANNA AND JULIA CLARKE

8:00 **Larsson, H**. MODULES OF DEVELOPMENTAL EVOLUTION: WHAT REALLY LIES AT THE INTERSECTION OF PALEONTOLOGY AND DEVELOPMENTAL BIOLOGY?

8:15 **Schweitzer, M., and Wittmeyer, J**. DINOSAURIAN SOFT TISSUE TAPHONOMY

8:30 **Wittmeyer, J., and Schweitzer, M**. MANIPULATING DINOSAURIAN SOFT TISSUE: METHODS FOR HANDLING SOFT TISSUES, VESSELS AND CELLS IN FOSSIL SPECIMENS.

8:45 **O'Connor, J., Chiappe, L., and Gao, Q**. A NEW FOSSIL BIRD FROM THE LOWER CRETACEOUS JIUFOTANG FORMATION, LIAONING PROVINCE, NORTHEASTERN CHINA

9:00 **Martin, A**. AVIAN TRACKS AS INITIATORS OF MUDCRACKS: MODELS FOR SIMILAR EFFECTS OF NON-AVIAN THEROPODS?

9:15 **Lamanna, M., You, H., Ji, S., Lü, J., Ji, Q., and Chiappe, L**. A NEW ENANTIORNITHINE PARTIAL SKELETON FROM THE EARLY CRETACEOUS OF NORTHWESTERN CHINA

9:30 **Clarke, J., Tambussi, C., Noriega, J., Erickson, G., and Ketcham, R**. NEW CRETACEOUS FOSSIL EVIDENCE FOR THE TIMING AND PATTERN OF AVIAN DIVERSIFICATION

9:45 **Chiappe, L., O'Connor, J., and Zhou, Z**. EVOLUTIONARY HISTORY OF THE CRETACEOUS ENANTIORNITHES

10:00 **BREAK**

10:15 **Polly, P. D**. AETOSAUR PLATES AND WHALE TEETH: ON RECOGNIZING CHARACTER CORRELATION IN CLADISTIC CHARACTER STATE DISTRIBUTIONS

10:30 **Lee, H.-J., AND Lee, Y.-N**. A NEW PROTOSUCHIAN (ARCHOSAURIA: CROCODYLIFORMES) SKULL FROM THE HASANDONG FORMATION (LOWER CRETACEOUS) OF HADONG COUNTY, SOUTH KOREA

10:45 **Erickson, G., Lappin, A. K., Vliet, K., Brueggen, J., Kledzik, D., and Webb, G**. COMPARATIVE BITE-FORCE PERFORMANCE OF EXTANT AND FOSSIL CROCODYLIANS: A WINDOW INTO EVOLUTIONARY FEEDING BIOMECHANICS

11:00 **Turner, A., Norell, M., and Pol, D**. ANATOMY AND RELATIONSHIPS OF *SHAMOSUCHUS DJADOCHTAENSIS* (CROCODYLIFORMES, NEOSUCHIA) FROM THE LATE CRETACEOUS OF MONGOLIA

11:15 **Brochu, C**. STEALTH DIVERSITY IN THE CRADLE OF HUMANITY: CROCODYLID ENDEMISM IN AFRICA AND THE WESTERN INDIAN OCEAN DURING THE NEOGENE

11:30 **Goehlich, U., Chiappe, L., Clark, J., and Sues, H.-D**. THE BASAL CROCODYLOMORPH *MACELOGNATHUS VAGANS* FROM THE UPPER JURASSIC MORRISON FORMATION: NEITHER A DINOSAUR NOR A CROCODILE

11:45 **MacLeod, N., and Archibald, J. D**. THE DECLINE AND FALL OF THE NON-AVIAN DINOSAURS

12:00 **Britt, B., Dangerfield, A., and Greenhalgh, B**. BURROWED DINOSAUR BONES: EVIDENCE OF CRETACEOUS OSTEOPHAGOUS BEETLES

12:15 **Straight, W., Karr, J., Woodward, H., Barrick, R., Tanke, D., and Dwyer, G**. DINOSAUR FEVER: ISOTOPIC EVIDENCE FOR LOCALLY ELEVATED TEMPERATURE SURROUNDING HEALING INJURIES IN HADROSAUR BONE

MORPHOLOGY, PHYLOGENY AND BIOGEOGRAPHY OF FOSSIL FISHES—
A SYMPOSIUM IN HONOR OF MEEMANN CHANG
ARIZONA BALLROOM E-G
CONVENORS: XIAOBO YU AND JOHN MAISEY

8:00 **Hanke, G., and Wilson, M**. FIN SPINES, SCALES, TEETH, AND PREDICTION OF EARLY JAWED FISH STRUCTURE

8:15 **Karatajute-Talimaa, V., Meredith Smith, M., and Zigaite, Z**. TYPES OF TISSUES IN THE EXOSKELETON OF THE EARLY SILURIAN VERTEBRATES FROM SOUTH SIBERIA AND TUVA (RUSSIA)

8:30 **Burrow, C**. LOWER DEVONIAN ACANTHODIANS OF THE WESTERN U.S.A.
8:45 **Goujet, D**. THE PLACODERM ENDOCRANIUM AND ITS VARIATIONS
9:00 **Elliott, D**. BIOGEOGRAPHIC IMPLICATIONS OF EARLY DEVONIAN HETEROSTRACANS FROM THE WESTERN UNITED STATES
9:15 **Carr, R., and Jackson, G**. THE PATTERN OF DUROPHAGY AMONG THE LATE DEVONIAN ARTHRODIRES (PLACODERMI)
9:30 **Maisey, J., and Janvier, P**. THE DEVONIAN VERTEBRATES OF SOUTH AMERICA AND THEIR PALEOBIOGEOGRAPHICAL RELATIONSHIPS
9:45 **Schultze, H.-P**. THE LATE MIDDLE DEVONIAN FISH FAUNA OF RED HILL, NEVADA, AND ITS PALEOBIOGEOGRAPHIC CONNECTIONS
10:00 **BREAK**
10:15 **Daeschler, E., Elliott, D., Shubin, N., Mark-Kurik, E., and Jenkins, F**. BIOGEOGRAPHY OF THE MIDDLE AND LATE DEVONIAN (LATE GIVETIAN - FRASNIAN) ICHTHYOFAUNA FROM THE OKSE BAY GROUP, NUNAVUT TERRITORY, CANADA
10:30 **Coates, M., and Friedman, M**. SEARCHING FOR SIGNAL IN THE EARLY ACTINOPTERYGIAN RECORD
10:45 **Arratia, G**. IMPACT OF FOSSILS IN ELOPOMORPH/OSTEOGLOSSOMORPH PHYLOGENIES
11:00 **Hilton, E., and Forey, P**. OSTEOLOGY, SYSTEMATICS, AND BIOGEOGRAPHY OF FOSSIL AND LIVING OSTEOGLOSSID FISHES (TELEOSTEI: OSTEOGLOSSOMORPHA), WITH A DESCRIPTION OF NEW FORMS AND A REVIEW OF THE BIOGEOGRAPHIC RELATIONSHIPS OF THE CLADE MEMBERS
11:15 **Long, J**. INTERRELATIONSHIPS OF THE HOLODONTID LUNGFISHES (OSTEICHTHYES, DIPNOMORPHA) BASED ON NEW MATERIAL FROM THE UPPER DEVONIAN GOGO FORMATION OF WESTERN AUSTRALIA
11:30 **Gottfried, M., O'Connor, P., Roberts, E., Stevens, N., and Chami, R**. FIRST CRETACEOUS LUNGFISH FROM TANZANIA—AN ENIGMATIC CERATODONTID FROM THE RUKWA RIFT BASIN
11:45 **Zhu, M., and Zhao, W**. AN ONYCHODONT-LIKE SARCOPTERYGIAN FISH FROM THE MIDDLE DEVONIAN OF YUNNAN, SOUTHWESTERN CHINA
12:00 **Clement, G., and Ahlberg, P**. THE ENDOCRANIAL ANATOMY OF THE EARLY SARCOPTERYGIAN *POWICHTHYS* FROM SPITSBERGEN REVEALED BY HIGH-RESOLUTION CT SCANS
12:15 **CONCLUDING REMARKS**

POSTERS ASSOCIATED WITH FISHES SYMPOSIUM
Posters must be set up by 8:00
Authors will be present from 10:00-10:15

Booth
1. **Imhof, M., and Trujillo, K**. FIRST REPORT OF A LUNGFISH (DIPNOI) TOOTH PLATE FROM THE UPPER JURASSIC MORRISON FORMATION
2. **Mickle, K., Lund, R., and Grogan, E**. THREE NEW PALEONISCOID FISHES FROM THE BEAR GULCH LIMESTONE (SERPUKHOVIAN, MISSISSIPPIAN) OF MONTANA AND THE RELATIONSHIPS OF LOWER ACTINOPTERYGIANS
3. **Purdy, R**. IS *STRIATOLAMIA* A JUNIOR SYNONYM OF *MITSUKURINA*?
4. **Tissandier, S., and Larsson, H**. INSIGHTS FROM MODULAR DISPARITY OF ACTINOPTERYGIAN PECTORAL FINS
5. **Westgate, J., Brown, R., Cope, D., and Stringer, G**. PRELIMINARY SURVEY FOR *CARCHARODON MEGALODON* AND OTHER FISHES FROM THE MIOCENE OF PANAMA
6. **Wilson, M., and Marss, T**. ANATOMY OF THE SILURIAN THELODONT *PHLEBOLEPIS ELEGANS* PANDER

TECHNICAL SESSION IX
PALO VERDE BALLROOM
MODERATORS: EWAN FORDYCE AND KATRINA GOBETZ

8:00 **Barnes, L., Reed, A., Geisler, J., Godfrey, S., and Bohaska, D.** EVOLUTIONARY DIVERSITY AND INNER EAR MORPHOLOGIES OF KENTRIODONTID DOLPHINS, MIOCENE CHESAPEAKE GROUP, MARYLAND AND VIRGINIA

8:15 **Gingerich, P., Zalmout, I., Attia, Y., Antar, M. S., and Abuelkhair, G**. NEW SKELETON OF *BASILOSAURUS ISIS* (MAMMALIA, ARCHAEOCETI) FROM THE MIDDLE-TO-LATE EOCENE OF WADI HITAN, EGYPT

8:30 **Fordyce, E**. NEW SPECIMEN OF ARCHAIC BALEEN WHALE *MAUICETUS PARKI* (LATE OLIGOCENE, NEW ZEALAND) ELUCIDATES EARLY CROWN-MYSTICETI

8:45 **Kondrashov, P., and Agadjanian, A**. A NEARLY COMPLETE SKELETON OF *ERNANODON* (MAMMALIA, ERNANODONTA) FROM MONGOLIA: FUNCTIONAL ANALYSIS

9:00 **MacPhee, R., Steadman, D., and Martin, P**. SIGNIFICANCE OF ASYNCHRONOUS SLOTH EXTINCTIONS ON CONTINENTS AND ISLANDS DURING THE LATE QUATERNARY

9:15 **McAfee, R**. GETTING PC(A) WITH MYLODONTID SLOTHS: SEPARATING *PARAMYLODON* FROM *GLOSSOTHERIUM*

9:30 **Samonds, K., Zalmout, I., and Krause, D**. NEW SIRENIAN FOSSILS FROM THE LATE EOCENE OF MADAGASCAR

9:45 **Zalmout, I., and Gingerich, P**. EOCENE SIRENIA OF EGYPTIAN TETHYS: AQUATIC ADAPTATIONS

10:00 **BREAK**

10:15 **Gobetz, K., and Beatty, B. L**. FRICTION-INDUCED KERATINIZATION AND THE ORIGIN OF BOSSES AND HORN CORES IN EXTINCT FOSSORIAL MYLAGAULIDS (RODENTIA: APLODONTOIDEA: MYLAGAULIDAE)

10:30 **Rybczynski, N., Pabst, D., and McLellan, W**. SOFT-TISSUE STRUCTURE IN TAIL OF *CASTOR*: TOWARD INFERRING TAIL SPECIALIZATIONS IN EXTINCT, SEMIAQUATIC MAMMALS

10:45 **Stevens, N., O'Connor, P., Gottfried, M., Roberts, E., Ngasala, S., and Kapilima, S**. NEW PALEOGENE MAMMALS AND OTHER VERTEBRATES FROM THE RUKWA RIFT BASIN, SOUTHWESTERN TANZANIA

11:00 **Sussman, D., Croxen, F., and Shaw, C**. A REAPPRAISAL OF THE GENUS OF NORTH AMERICAN FOSSIL ERETHIZONTIDS (PORCUPINES)

11:15 **Tseng, J**. CAN MODERN HETEROMYID SPECIES BE IDENTIFIED USING ONLY DENTAL MEASUREMENTS? A TEST USING EXTANT SPECIES WITH IMPLICATIONS FOR FOSSIL IDENTIFICATION

11:30 **Van Tuinen, M., Bell, C., Conroy, C., and Hadly, E**. USING AN EXCEPTIONAL FOSSIL RECORD TO TEST AND CALIBRATE RODENT MOLECULAR CLOCKS

11:45 **Yeakel, J., Dominy, N., Bennett, N., and Koch, P**. THE ISOTOPIC ECOLOGY OF AFRICAN MOLE-RATS: IMPLICATIONS FOR HOMININ EVOLUTION

12:00 **Badgley, C., Nelson, S., Beranek, N., and Zakem, E**. MICROWEAR ANALYSIS OF SQUIRREL TEETH

12:15 **Evans, A., Wilson, G., Fortelius, M., and Jernvall, J**. HOW DIFFERENT ARE CATS AND MICE? NEW 3D METHODS FOR CORRELATING DIETS AND DENTITION FROM DISPARATE DENTAL SYSTEMS

FRIDAY AFTERNOON, OCTOBER 21, 2005

TECHNICAL SESSION X
SUPERSTITION BALLROOM
MODERATORS: WILLIAM PARKER AND JULIA HEATHCOTE

1:30 **Carrano, M**. THE DINOSAUR FOSSIL RECORD

1:45 **Heathcote, J., Barrett, P., and Wills, M**. STRATIGRAPHICAL CONGRUENCE OF THE DINOSAUR FOSSIL RECORD

2:00 **Parker, W., Nesbitt, S., and Irmis, R**. CRITICAL REVIEW OF THE LATE TRIASSIC DINOSAUR RECORD, PART 1: *REVUELTOSAURUS CALLENDERI*

2:15 **Irmis, R. Parker, W., and Nesbitt, S**. CRITICAL REVIEW OF THE LATE TRIASSIC DINOSAUR RECORD, PART 2: ORNITHISCHIA
2:30 **Nesbitt, S., Irmis, R., and Parker, W**. CRITICAL REVIEW OF THE LATE TRIASSIC DINOSAUR RECORD, PART 3: SAURISCHIANS OF NORTH AMERICA
2:45 **Ferigolo, J., and Langer, M**. THE ORIGIN OF THE ORNITHISCHIAN PREDENTARY BONE
3:00 **Noto, C., and Grossman, A**. DINOSAUR FUNCTIONAL MORPHOLOGY AND LATE JURASSIC ECOLOGICAL DIVERSITY

TECHNICAL SESSION XI
ARIZONA BALLROOM E-G
MODERATORS: GARETH DYKE AND DAVID KRAUSS

1:30 **Krauss, D., Petrucelli, J., and Linclon, T**. RESULTS OF AN EXPERIMENT IN AVIAN TAPHONOMIC PROCESSES REVEAL A MECHANISM FOR THE SUB-AQUEOUS DEPOSITION OF BIRD REMAINS
1:45 **Ksepka, D., Bertelli, S., Dyke, G., and Cracraft, J**. THE PHYLOGENY OF THE LIVING AND FOSSIL PALAEOGNATHAE
2:00 **Maxwell, E**. TESTING THE RELATIONSHIP BETWEEN ONTOGENY AND PHYLOGENY USING AVIAN SKELETAL DEVELOPMENT
2:15 **Steadman, D**. FAMILY-LEVEL COMPOSITION OF THE THOMAS FARM AVIFAUNA OF FLORIDA (EARLY MIOCENE: HEMINGFORDIAN LAND MAMMAL AGE)
2:30 **Triche, N**. PENGUIN ANKLES: SYSTEMATIC TREASURE OR MORPHOLOGIC CONVERGENCE?
2:45 **Dyke, G., Bertelli, S., Chiappe, L., and Lindow, B**. NEW RECORDS OF EXCEPTIONALLY WELL-PRESERVED FOSSIL BIRDS FROM THE DANISH LOWER EOCENE
3:00 **Campbell, K., and Bochenski, Z**. THE EXTINCT CALIFORNIA TURKEY, *MELEAGRIS CALIFORNICA*, FROM RANCHO LA BREA

TECHNICAL SESSION XII
PALO VERDE BALLROOM
MODERATOR: LAWRENCE FLYNN

1:30 **Behrensmeyer, A., and Barry, J**. BIOSTRATIGRAPHIC SURVEYS IN THE SIWALIK SEQUENCE OF PAKISTAN: A METHOD FOR STANDARDIZED SURFACE SAMPLING OF THE VERTEBRATE FOSSIL RECORD
1:45 **Flynn, L**. THE MID-CENOZOIC MICROFOSSIL RECORD OF THE INDIAN SUBCONTINENT
2:00 **Townsend, K., and Croft, D**. LOW-MAGNIFICATION MICROWEAR ANALYSES OF SOUTH AMERICAN ENDEMIC HERBIVORES
2:15 **Tsubamoto, T., Egi, N., and Takai, M**. A REVIEW OF MIDDLE EOCENE UNGULATE MAMMALS FROM THE PONDAUNG FORMATION, MYANMAR
2:30 **Williamson, T., and Carr, T**. A PHYLOGENY OF THE MIOCLAENINAE
2:45 **Wyss, A., Flynn, J., and Croft, D**. NEW NOTOHIPPIDS (NOTOUNGULATA, EUTHERIA) FROM THE CENTRAL CHILEAN ANDES
3:00 **Zack, S**. POSTCRANIAL MORPHOLOGY AND THE PHYLOGENY OF "CONDYLARTHRA"

POSTER SESSION B
Authors must be present from 3:30-5:00
Posters must be removed by 6:00

Booth
1. **Ivanov, A**. DENTITION OF LATE PALAEOZOIC XENACANTHOID SHARK *BRANSONELLA*
2. **Scott, K., Sumida, S., and Widerman, N**. NEW CROSSOPTERYGIAN MATERIAL FROM AND NEW THOUGHTS ON THE DEPOSITION OF THE HALGAITO SHALE, CUTLER GROUP, SOUTHEASTERN UTAH

3. **Niedzwiedzki, R**. THE PALEOBATHYMETRY AND PALEOGEOGRAPHICAL DISTRIBUTION OF THE UPPER CRETACEOUS SELACHIANS FROM THE MIDDLE EUROPE (SW POLAND) AND THEIR RELATIONSHIP WITH NORTH AMERICAN ASSEMBLAGES
4. **Grandstaff, B., Smith, J., Lacovara, K., Tumarkin-Deratzian, A., and Abdel-Ghani, M**. POLYPTERIDS (OSTEICHTHYES:POLYPTERIDAE) AS ENVIRONMENTAL PROXIES IN THE CENOMANIAN (LATE CRETACEOUS) OF EGYPT
5. **Fielitz, C., Gonzalez-Rodriguez, K., and Bravo-Cuevas, V**. LATE CRETACEOUS AULOPIFORMS (TELEOSTEI: AULOPIFORMES) FROM THE STATE OF HIDALGO, CENTRAL MEXICO
6. **Demar, Jr., D., and Breithaupt, B**. FAUNAL ANALYSIS AND PALEOECOLOGY OF THE LOWER VERTEBRATE MICROFOSSIL ASSEMBLAGES OF THE MESAVERDE FORMATION (UPPER CRETACEOUS, CAMPANIAN) OF THE WIND RIVER AND BIGHORN BASINS, WYOMING
7. **Wellstead, C**. R. W. WHIPPLE'S SPECIMENS REFERRABLE TO *MEGAMOLGOPHIS AGOSTINI* ROMER, 1952 (AMPHIBIA: LEPOSPONDYLI)
8. **Kissel, R., Reisz, R., and Berman, D**. REVISITING THE TAXONOMY OF DIADECTIDAE (COTYLOSAURIA: DIADECTOMORPHA): A PHYLOGENETIC APPROACH
9. **Barber, L., Bolt, J., and Ruta, M**. NEW FEATURES OF THE LOWER JAW OF THE TEMNOSPONDYL AMPHIBIAN *TRIMERORHACHIS*
10. **Schulp, A., and Vonhof, H**. STABLE ISOTOPE ANALYSIS OF MOSASAUR TEETH FROM THE TYPE MAASTRICHTIAN
11. **Montellano, M., Wilson, G., Alvarez-Reyes, G., Hernandez-Rivera, R., Quintero, E., and Aranda-Manteca, F**. NEW MATERIAL OF *POLYGLYPHANODON BAJAENSIS* FROM EL ROSARIO, BAJA CALIFORNIA, MEXICO
12. **Thompson, W**. THE FIRST RECORD OF *HAINOSAURUS* (REPTILIA: MOSASAURIDAE) FROM THE PIERRE SHALE OF SOUTH DAKOTA, AND IMPLICATIONS FOR DIFFERENTIATING BETWEEN THE TYLOSAURINE GENERA *TYLOSAURUS* AND *HAINOSAURUS*
13. **Schumacher, B., and Liggett, G**. UNIQUE PADDLE MORPHOLOGY OF THE PLIOSAUR (PLESIOSAURIA) *BRACHAUCHENIUS LUCASI*
14. **Sayao, J., Kellner, A., and Paula, L**. ON A NEW PTEROSAUR SKELETON FROM THE CRATO MEMBER (APTIAN), SANTANA FORMATION, ARARIPE BASIN, NORTHEASTERN BRAZIL
15. **Lü, J., and Ji, Q**. A NEW AZHDARCHID PTEROSAUR FROM THE EARLY CRETACEOUS OF LIAONING PROVINCE
16. **Scheyer, T., Sander, P. M., Boehme, W., and Witzel, U**. IS A "BULLETPROOF VEST" LINKED TO THE EVOLUTIONARY SUCCESS OF SOFT-SHELLED TURTLES (TRIONYCHIDAE)?
17. **Romano, P. S., and Azevedo, S. A**. PHYLOGENETIC POSITION OF *BAURUEMYS ELEGANS* AND THE BIOGEOGRAPHY OF PODOCNEMIDID TURTLES (PLEURODIRA: PELOMEDUSOIDES)
18. **Lyson, T., Schachner, E., Tremain, E., and Hanks, H**. SEXUAL DIMORPHISM IN *EUBAENA CEPHALICA* FROM THE LATE CRETACEOUS (HELL CREEK FORMATION) OF SOUTHWESTERN NORTH DAKOTA
19. **Kobayashi, Y., and Tomida, Y**. ANATOMY OF *TOYOTAMAPHIMEIA MACHIKANENSIS* (CROCODYLIA) FROM THE PLEISTOCENE OF JAPAN AND REASSESSMENT OF ITS PHYLOGENETIC STATUS
20. **Hurlburt, G**. *ALLIGATOR* CEREBRUM OCCUPIES LESS THAN HALF OF CORRESPONDING ENDOCAST REGION: IMPLICATIONS FOR RELATIVE FOREBRAIN SIZE IN DINOSAURS INCLUDING *TYRANNOSAURUS REX*
21. **Hill, R., and Lucas, S**. ANATOMY AND PHYLOGENETIC POSITION OF THE PALEOCENE CROCODYLIAN *AKANTHOSUCHUS LANGSTONI*
22. **Foster, J**. EVIDENCE OF SIZE-CLASSES AND SCAVENGING IN THE THEROPOD *ALLOSAURUS FRAGILIS* AT THE MYGATT-MOORE QUARRY (LATE JURASSIC), RABBIT VALLEY, COLORADO
23. **Wolff, E., and Varricchio, D**. ZOOLOGICAL PALEOPATHOLOGY AND THE CASE OF THE *TYRANNOSAURUS* JAW: INTEGRATING PHYLOGENY AND THE STUDY OF ANCIENT DISEASE
24. **Zanno, L., Sampson, S., Roberts, E., and Gates, T**. LATE CAMPANIAN NON-AVIAN THEROPOD DIVERSITY ACROSS THE WESTERN INTERIOR BASIN
25. **Knoll, F., and Ruiz-Omenaca, Jose I**. THEROPOD TEETH FROM THE BERRIASIAN OF ANOUAL (MOROCCO)
26. **Machado, E., Kellner, A. W., and Campos, D**. ON A THEROPOD SCAPULA FROM THE LATE CRETACEOUS (BAURU GROUP) OF BRAZIL
27. **Parsons, W., and Parsons, K**. A COMPARISON OF POSTCRANIAL FEATURES FOUND WITHIN THE ONTO-

GENIES OF THE MANIRAPTORAN THEROPOD DINOSAURS *DEINONYCHUS ANTIRRHOPUS* (SAURISCHIA, THEROPODA) AND *VELOCIRAPTOR MONGOLIENSIS* (SAURISCHIA, THEROPODA)

28. **Rayfield, E., Milner, A**. CRANIAL FUNCTIONAL MORPHOLOGY OF SPINOSAURID "CROCODILE-MIMIC" DINOSAURS
29. **Rinehart, L., Hunt, A., Lucas, S., Heckert, A., and Smith, J**. NEW EVIDENCE OF CANNIBALISM IN THE LATE TRIASSIC (APACHEAN) DINOSAUR, *COELOPHYSIS BAURI* (THEROPODA: CERATOSAURIA)
30. **Smith, N., Hammer, W., and Currie, P**. OSTEOLOGY AND PHYLOGENETIC RELATIONSHIPS OF *CRYOLOPHOSAURUS ELLIOTI* (DINOSAURIA: THEROPODA): IMPLICATIONS FOR BASAL THEROPOD EVOLUTION
31. **Tumarkin-Deratzian, A., and Dodson, P**. A NEW LOOK AT OLD FACES: REVISITING *MONOCLONIUS* AND *BRACHYCERATOPS*
32. **Sealey, P., Smith, J., Williamson, T**. AN UNUSUAL *PENTACERATOPS* FROM NEW MEXICO
33. **Nona, E., MacInnes, S., Gasaway, S., Jamison, M., Mauterer, J., and Sankey, J**. ANKYLOSAURS AND MORE: RECENT DINOSAUR DISCOVERIES IN BIG BEND NATIONAL PARK, TEXAS
34. **Scherzer, B., Varricchio, D**. TAPHONOMY OF A JUVENILE LAMBEOSAUR BONEBED IN THE TWO MEDICINE FORMATION OF MONTANA
35. **Suzuki, D., Saegusa, H., and Furutani, H**. NEWLY FOUND HADROSAUR FOSSIL CO-PRODUCING BROADLEAF FOSSILS FROM SUMOTO, WEST CENTRAL JAPAN
36. **Tweet, J., Chin, K., and Murphy, N**. AN ANALYSIS OF POSSIBLE GUT CONTENTS IN A HADROSAURID DINOSAUR FROM THE UPPER CRETACEOUS (LATE CAMPANIAN) JUDITH RIVER FORMATION OF MONTANA
37. **Rodriguez-de la Rosa, R., Eberth, D., Sampson, S., Brinkman, D., and Aguillen-Martinez, M**. AN UNUSUAL ORNITHOPOD TRACKWAY FROM THE UPPER CRETACEOUS OF THE CERRO DEL PUEBLO FORMATION, COAHUILA, MEXICO
38. **Tidwell, V., Carpenter, K., and Miles, C**. A REEXAMINATION OF *MOROSAURUS AGILIS* (SAUROPODA) FROM GARDEN PARK, COLORADO
39. **Sander, M., and Klein, N**. PATTERNS OF GROWTH AND ONTOGENETIC STATUS IN NEOSAUROPOD DINOSAURS DEDUCED FROM LONG BONE HISTOLOGY
40. **Sankey, J**. LATE CRETACEOUS DINOSAURS, EGGS, BABIES, FIRES, AND DROUGHT IN BIG BEND NATIONAL PARK, TEXAS
41. **Reynolds, R**. MORPHOMETRIC CATEGORIZATION OF CALIFORNIA'S JURASSIC QUADRUPED TRACKS
42. **Novak, S., and Smith, J**. OSTEOHISTOLOGICAL TAXONOMY OF EXTANT AND EXTINCT TETRAPODS USING THE MICROSTRUCTURE OF CORTICAL BONE
43. **Matthews, N., Breithaupt, B., Noble, T., Titus, A., and Smith, J**. A GEOSPATIAL LOOK AT THE MORPHOLOGICAL VARIATION OF TRACKS AT THE TWENTYMILE WASH DINOSAUR TRACKSITE, GRAND STAIRCASE-ESCALANTE NATIONAL MONUMENT, UTAH
44. **Lovelace, D., Hartman, S., and Wahl, W**. REVISED OSTEOLOGY OF *SUPERSAURUS VIVIANAE*
45. **Lockley, M., Yang, S.-Y., Matsukawa, M., and Li, J**. *MINISAURIPUS*—THE TRACK OF A DIMINUTIVE DINOSAUR FROM THE CRETACEOUS OF KOREA: IMPLICATIONS FOR CORRELATION IN EAST ASIA
46. **Li, R., and Lockley, M**. DROMAEOSAURID TRACKWAYS FROM SHANDONG PROVINCE, CHINA
47. **Kukihara, R., Lockley, M., Holbrook, J., and Schumacher, B**. ABUNDANT DINOSAUR TRACKSITES FROM THE MID-CRETACEOUS DAKOTA GROUP PROVIDE A REGIONAL ICHNOFACIES DATABASE IN A HIGH-RESOLUTION STRATIGRAPHIC FRAMEWORK
48. **Kubota, K., Kobayashi, Y., and Barsbold, R**. NEW MATERIAL OF AN IGUANODONTIAN (DINOSAURIA: ORNITHOPODA) FROM THE LOWER CRETACEOUS SHINEKHUDAG FORMATION, CHOIR BASIN, MONGOLIA
49. **Kubarek, S., and Swor, E**. TAPHONOMY, TAXONOMY, AND ANATOMY OF SAUROPOD AND THEROPOD DINOSAUR REMAINS FROM THE MORRISON FORMATION, SHELL, WY
50. **Kozisek, J**. THE NEW AND IMPROVED *CAMARASAURUS LEWISI* (DINOSAURIA: SAUROPODOMORPH) TORS
51. **Sertich, J., Sampson, S., Loewen, M., Gathogo, P., Brown, F., and Manthi, F. K**. DINOSAURS OF KENYA'S RIFT: FOSSIL PRESERVATION IN THE LUBUR SANDSTONE OF NORTHERN KENYA
52. **Trujillo, K., Imhof, M., and Walke, Z**. REPORT ON A COMPREHENSIVE PALEONTOLOGICAL SURVEY OF COLORADO NATIONAL MONUMENT

53. **Watkins, P., Gray, D., Ikejiri, T., and Pohl, B**. WARM SPRINGS RANCH DINOSAUR QUARRIES FROM THE UPPER MORRISON FORMATION OF NORTH CENTRAL WYOMING
54. **Lewis, C., Lucas, S., Dickinson, W., and Heckert, A**. THE TUCSON MOUNTAINS DINOSAUR: A LARGE HADROSAUR FROM THE UPPER CRETACEOUS OF SOUTHERN ARIZONA
55. **Lucas, S., Gierlinski, G., Haubold, H., Klein, H., Lockley, M., Tanner, L, Hunt, A., Heckert, A., and Thulborn, T**. TRIASSIC RECORDS OF THE THEROPOD FOOTPRINT ICHNOGENUS *EUBRONTES*
56. **Marshall Faux, C., and Padian, K**. THE "DEAD BIRD" POSTURE IN DINOSAURS: NOT *RIGOR MORTIS*, BUT DEATH THROES
57. **Main, D., and Scotese, C**. CRETACEOUS PALEOGEOGRAPHY AND THE PALEOBIOGEOGRAPHIC DISPERSAL OF THE HADROSAURS
58. **Vanden Brooks, J**. THE PARTIAL PRESSURE OF OXYGEN AS A FACTOR IN VERTEBRATE DEVELOPMENT AND EVOLUTION
59. **Troop, P., Tovar, D., Cummings, C., Hegman, K., Mammini, J., and Smith, C**. TURTLES AND CROCODILIANS FROM THE LATE CRETACEOUS OF BIG BEND NATIONAL PARK, TEXAS
60. **Tovar-Liceaga, R., and Montellano-Ballesteros, M**. PLEISTOCENE FAUNA FROM SANTA CRUZ NUEVO, PUEBLA, CENTRAL MEXICO
61. **Spielmann, J., Hunt, A., Lucas, S., and Heckert, A**. THE TERRESTRIAL VERTEBRATE FAUNA OF THE UPPER TRIASSIC (RHAETIAN) REDONDA FORMATION
62. **Smith, J., Novak, S., and Issawi, B**. MORE TRAVELS IN STROMER'S FOOTSTEPS: LATE CRETACEOUS VERTEBRATES FROM THE NILE VALLEY, EGYPT
63. **O'Connor, P., Gottfried, M., Roberts, E., Stevens, N., and Ngasala, S**. NEW DINOSAURS AND OTHER VERTEBRATE FOSSILS FROM THE CRETACEOUS RED SANDSTONE GROUP, RUKWA RIFT BASIN, SOUTHWESTERN TANZANIA
64. **Krzyzanowski, S., Heckert, A., Lucas, S., and Boyer, K**. THE MICROVERTEBRATE FAUNA OF THE BLUE HILLS (BLUE MESA MEMBER, PETRIFIED FOREST FORMATION: ADAMANIAN), UPPER TRIASSIC OF EAST-CENTRAL ARIZONA
65. **Schwimmer, D., Bingham, P., and Knight, T**. AN UPPER CRETACEOUS (SANTONIAN) NONMARINE DEPOSIT IN EASTERN USA—WITH FOSSIL FEATHERS
66. **Hinic-Frlog, S**. ALLOMETRIC SCALING OF THE FOOT AND BODY MASS ESTIMATES IN EXTINCT DIVING BIRDS
67. **Bertelli, S., Chiappe, L., and Tambussi, C**. A GIGANTIC PHORUSRHACID (AVES: GRUIFORMES) FROM THE LATE MIOCENE OF PATAGONIA
68. **Bibi, F., Shabel, A., Kraatz, B., and Stidham, T**. FOSSIL RATITE EGGSHELL DISCOVERIES FROM THE LATE MIOCENE OF ARABIA: OOTAXONOMY, BIOSTRATIGRAPHY, AND BIOGEOGRAPHY
69. **Stidham, T**. A NEW LOOK AT OLDUVAI BIRDS (AVES, TANZANIA): A PLEISTOCENE AVIFAUNA IN THE CHANGING LANDSCAPE OF EARLY HOMININ EVOLUTION
70. **Jennings, D., Platt, B., Hasiotis, S., Retrum, J**. DIFFERENTIATING PALEOECOLOGICAL PARTITIONING AND PRESERVATIONAL BIAS AMONG VERTEBRATE TRACE FOSSILS IN THE UPPER JURASSIC MORRISON FORMATION, BIGHORN BASIN, WYOMING: A CASE STUDY
71. **Kaye, T., and Cavigelli, J.-P**. REMOTE DETECTION OF FOSSILS USING INFRARED SPECTROSCOPY
72. **Ludtke, J., Prothero, D., Scott Anderson, J., and Chamberlain, K**. MAGNETIC STRATIGRAPHY AND GEOCHRONOLOGY OF THE BARSTOVIAN-CLARENDONIAN (MIDDLE TO LATE MIOCENE) PART OF THE MOONSTONE FORMATION, CENTRAL WYOMING
73. **Thompson, J., Sugiyama, N., and Morgan, G**. TAPHONOMY AND PALEOECOLOGY OF THE LATE PLEISTOCENE MAMMALIAN FAUNA FROM SANDIA CAVE, NEW MEXICO
74. **Sundell, C., and Martin, L**. RECENT MID AND EARLY PLEISTOCENE VERTEBRATE DISCOVERIES FROM GRAIN VALLEY, MISSOURI AND BELOIT, KANSAS
75. **Schumaker, K., and Kihm, A**. *ECTYPODUS LOVEI* (MULTITUBERCULATA) FROM THE MEDICINE POLE HILLS LOCAL FAUNA (EARLY CHADRONIAN) OF BOWMAN COUNTY, NORTH DAKOTA
76. **Smith, N., Strait, S., and Neff, D**. ACQUIRING 3-D DATA FROM SMALL MAMMALIAN TEETH: LASER SCANNING EOCENE MARSUPIALS
77. **Salton, J**. POSTCRANIAL MORPHOLOGY OF THE WEST INDIAN EULIPOTYPHLA, *SOLENODON* AND *NESOPHONTES* (MAMMALIA)

78. **Bailey, B., Korth, W., and Kalthoff, D**. EOMYIDS FROM THE EARLY ARIKAREEAN RIDGEVIEW LOCAL FAUNA OF WESTERN NEBRASKA AND THEIR BIOGEOGRAPHIC SIGNIFICANCE
79. **Rebar Jr., J., and Wahl, W**. ADDITIONAL POSTCRANIAL MATERIAL OF *HELISCOMYS VETUS* (HELISCOMYIDAE: RODENTIA) FROM THE EARLY OLIGOCENE OF WYOMING
80. **Scott, C**. NEW SPECIES OF *CYRIACOTHERIUM* (MAMMALIA, PANTODONTA) FROM THE PALEOCENE OF ALBERTA, CANADA
81. **St Clair, E., Krause, D., and Boyer, D**. PANTODONTS (MAMMALIA) FROM THE EARLY TIFFANIAN (PALEOCENE) OF THE CRAZY MOUNTAINS BASIN, MONTANA
82. **Holbrook, L**. ON THE SKULL OF *RADINSKYA* (MAMMALIA, ?PHENACOLOPHIDAE) AND ITS AFFINITIES
83. **Ostrom, P., Humpula, J., Strahler, J., Walker, A., Leykam, J., and Gandhi, H**. DEFINING THE LIMITS OF MOLECULAR PHYLOGENY: THE FIRST COMPLETE PROTEIN SEQUENCE OF A 42 KA *EQUUS* FROM WYOMING
84. **Hulbert, R., and Wallace, S**. PHYLOGENETIC ANALYSIS OF LATE CENOZOIC *TAPIRUS* (MAMMALIA, PERISSODACTYLA)
85. **Bravo-Cuevas, V**. ON THE PRESENCE OF THE HIPPARIONINE HORSE *CORMOHIPPARION* FROM THE MIDDLE MIOCENE OF THE STATE OF OAXACA, SOUTHEASTERN MEXICO
86. **Coombs, M., and Semprebon, G**. THE DIET OF CHALICOTHERES (MAMMALIA, PERISSODACTYLA) AS INDICATED BY LOW MAGNIFICATION STEREOSCOPIC MICROWEAR ANALYSIS
87. **Foss, S., Theodor, J**. DECIDUOUS DENTITIONS AND TOOTH ERUPTION SEQUENCES IN FOSSIL AND RECENT ARTIODACTYLA
88. **Cuevas-Ruiz, G**. THE PLEISTOCENE CAMELID RECORD FROM CENTRAL MEXICO
89. **Jimenez-Hidalgo, E., and Carranza-Castaneda, O**. HEMPHILLIAN CAMELIDS AND PROTOCERATIDS FROM SAN MIGUEL DE ALLENDE, GUANAJUATO STATE, CENTRAL MEXICO
90. **Mead, J., Baez, A., Swift, S., Hollenshead, M., and Carpenter, M**. ARRIVAL OF BISON AND THE RANCHOLABREAN IN A NEOTROPICAL SETTING, NORTHERN SONORA, MEXICO
91. **Cabral-Perdomo, M., Bravo-Cuevas, V., and Castillo-Ceron, J**. A YOUNG GOMPHOTHERE SKULL FROM THE STATE OF HIDALGO, CENTRAL MEXICO
92. **Harington, C**. MAMMOTH REMAINS FROM BANKS AND MELVILLE ISALNDS, NORTHWEST TERRITORIES: THE EASTERN LIMIT OF BERINGIA
93. **Sanders, W**. NEW PLIOCENE FOSSIL PROBOSCIDEAN SPECIMENS FROM LAETOLI, TANZANIA
94. **Rothschild, B**. SERIES, EXPERIENCE, LIMITED EXPERIENCE AND SEMANTICS OF PROBOSCIDEAN FOREFOOT AND HINDFOOT EROSIONS: DISTINGUISHING MYCOBACTERIAL INFECTION AND SPONDYLOARTHROPATHY
95. **Pasenko, M**. *RHYNCHOTHERIUM FALCONERI* (PROBOSCIDEA: GOMPHOTHERIIDAE) FROM THE 111 RANCH, SOUTHEASTERN ARIZONA
96. **Browne, I**. A CASE FOR THE REASSIGNMENT OF THE BARSTOVIAN FELID *PSEUDAELURUS MARSHI* TO THE GENUS *NIMRAVIDES*
97. **Jett, K., McKenzie, N. R., Olson, J., Adam, P., and Van Valkenburgh, B**. DIRE CIRCUMSTANCES IN LATE PLEISTOCENE RANCHO LA BREA: ENVIRONMENTAL FLUCTUATIONS REFLECTED IN CARNIVORE CRANIODENTAL MORPHOLOGY AND TOOTH WEAR
98. **Godinot, M., and Gheerbrant, E**. MORPHOLOGICAL CHANGE AND ADAPTIVE SHIFT IN THE EUROPEAN *PLESIADAPIS-PLATYCHOEROPS* LINEAGE (MAMMALIA, PLESIADAPIFORMES)
99. **Ericson, K., Patel, B., and Gilbert, C**. PHYLOGENETIC UTILITY OF CERVICAL VERTEBRAL MORPHOLOGY IN CERCOPITHECOID PRIMATES
100. **Patel, B., Grossman, A., and Su, A**. AN EXACT RANDOMIZATION STUDY OF DENTAL SHAPE VARIABILITY IN MIOCENE HOMINOIDS
101. **Czaplewski, N., and Gordon, C**. RELATIONSHIP OF BODY WEIGHT AND MOLAR SIZE IN BATS AND THE PREDICTION OF BODY MASS IN SOME EXTINCT SPECIES
102. **Austin, C., Springer, K., Scott, E., Manker, C., and Sagebiel, C**. ADDITIONS TO THE LATE PLEISTOCENE VERTEBRATE PALEONTOLOGY OF THE LAS VEGAS FORMATION, CLARK COUNTY, NEVADA
103. **Anemone, R., Grossman, A., Miller, E., and Watkins, R**. BIOCHRONOLOGY AND PALEOECOLOGY OF THE BULUK FAUNA, EARLY MIOCENE OF NORTHERN KENYA
104. **Davis, B., and Davies, K**. FIRST VERTEBRATE FOSSILS FROM THE EAGLE FORMATION (UPPER SANTONIAN), NORTH CENTRAL MONTANA

105. **Dooley, Jr., A., and Fraser, N**. A REVISED FAUNAL LIST FOR THE CARMEL CHURCH QUARRY, CAROLINE COUNTY, VIRGINIA
106. **Evans, G., Evans, A., Pljusnin, I., Fortelius, M., and Jernvall, J**. MORPHOBROWSER—A NEW DATABASE FOR SURFING THE DENTAL MORPHOSPACE
107. **Pappas, J**. TAXONOMIC DIVERSITY OF A MAASTRICHTIAN AGE MICROFAUNAL LOCALITY IN THE LITTLE COTTONWOOD DRAW, CARBON COUNTY, MONTANA
108. **Rector, A., and Reed, K**. THE EFFECTS OF SIMULATED SAMPLING BIAS ON THE APPLICATION OF BIOGEOGRAPHIC ANALYSES TO MODERN AND FOSSIL MAMMALIAN ASSEMBLAGES
109. **Reed, K**. AFRICAN PLIO-PLEISTOCENE MAMMAL COMMUNITIES: DO UNIQUE COMPOSITIONS INDICATE DISTINCT VEGETATION?
110. **Smith, K**. MAMMALS OF THE MONARCH MILL FORMATION AT EASTGATE, CHURCHILL COUNTY, NEVADA
111. **Flemming, C., Norris, C., and Bell, S**. RE-REVEALED: VERTEBRATE PALEONTOLOGY ARCHIVES IN THE AMERICAN MUSEUM OF NATURAL HISTORY
112. **Friedman, V., and Friedman, J**. ICE AGE: MAMMOTHS AND PALEOLITHIC ART, A HISTORICAL PERSPECTIVE
113. **Goodwin, H. T., and Payne, T**. PUBLICATION TRENDS IN THE JOURNAL OF VERTEBRATE PALEONTOLOGY
114. **Jefferson, G., and Marrs, B**. A CONTINUOUS PLIO-PLEISTOCENE VERTEBRATE RECORD FROM THE ANZA-BORREGO DESERT STATE PARK REGION, SOUTHERN CALIFORNIA: AN HISTORIC PRESPECTIVE
115. **Breithaupt, B., Southwell, E., and Matthews, N**. THE EARLIEST DISCOVERIES OF *TYRANNOSAURUS REX* IN WYOMING AND THE WEST: *MANOSPONDYLUS GIGAS*, *ORNITHOMIMUS GRANDIS*, AND *DYNAMOSAURUS IMPERIOSUS*
116. **Caldwell, M., and Bell, Jr., G**. GERMAN PRINCES, LOST SNOUTS AND A RE-DIAGNOSIS OF *MOSASAURUS MISSOURIENSIS* (SQUAMATA: MOSASAURIDAE)

SATURDAY MORNING, OCTOBER 22, 2005

THE EVOLUTION OF GIANTS: TRACING THE EARLY HISTORY OF SAUROPODOMORPH DINOSAURS
ARIZONA BALLROOM A-D
CONVENORS: PAUL BARRETT AND TIM FEDAK

8:00 **Sereno, P**. BASAL SAUROPODOMORPH PHYLOGENY: A COMPARATIVE ANALYSIS

8:15 **Wedel, M**. WHAT PNEUMATICITY TELLS US ABOUT "PROSAUROPODS", AND VICE VERSA

8:30 **Pol, D., and Powell, J**. NEW INFORMATION ON *LESSEMSAURUS SAUROPOIDES* (DINOSAURIA, SAUROPODOMORPHA) FROM THE LATE TRIASSIC OF ARGENTINA

8:45 **Galton, P**. BASAL SAUROPODOMORPH DINOSAUR TAXA *THECODONTOSAURUS* RILEY & STUTCHBURY, 1836, *T. ANTIQUUS* MORRIS, 1843 AND *T. CADUCUS* YATES, 2003: THEIR STATUS RE. HUMERAL MORPHS FROM THE 1834 FISSURE FILL (UPPER TRIASSIC) IN CLIFTON, BRISTOL, UK

9:00 **Langer, M**. *SATURNALIA TUPINIQUIM* AND THE ORIGIN OF SAUROPODOMORPHS

9:15 **Klein, N., and Sander, M**. BONE HISTOLOGY AND GROWTH OF THE PROSAUROPOD DINOSAUR *PLATEOSAURUS ENGELHARDTI* MEYER ,1837 FROM THE NORIAN BONEBEDS OF TROSSINGEN (GERMANY AND FRICK (SWITZERLAND)

9:30 **Upchurch, P., Barrett, P., and Galton, P**. THE PHYLOGENETIC RELATIONSHIPS OF BASAL SAUROPODOMORPHS: IMPLICATIONS FOR THE ORIGINS OF SAUROPODS

9:45 **Barrett, P., Upchurch, P., Xu, X., and Zhao, X.-J**. *CHINSHAKIANGOSAURUS* AND THE EARLY EVOLUTION OF HERBIVORY IN SAUROPOD DINOSAURS

10:00 **BREAK**

10:15 **Loewen, M., Sertich, J., Sampson, S., and Getty, M**. UNUSUAL PRESERVATION OF A NEW SAUROPODOMORPH FROM THE NAVAJO SANDSTONE OF UTAH

10:30 **Fedak, T**. TWO HEADS ARE BETTER THAN ONE: CONSIDERING *ANCHISAURUS* AS A SMALL SAUROPOD

10:45 **Yates, A**. THE SKULL OF THE TRIASSIC SAUROPODOMORPH, *MELANOROSAURUS READI*, FROM SOUTH AFRICA AND THE DEFINITION OF SAUROPODA

11:00 **Reisz, R., Sues, H.-D., Scott, D., Evans, D., and Raath, M**. ARTICULATED EMBRYONIC SKELETONS, DEVELOPMENT, AND GROWTH IN THE EARLY JURASSIC PROSAUROPOD DINOSAUR *MASSOSPONDYLUS* (SAURISCHIA: SAUROPODOMORPHA)

11:15 **Senter, P., and Bonnan, M**. EVIDENCE FOR OBLIGATE BIPEDALITY IN THE BASAL SAUROPODOMORPHS *PLATEOSAURUS* AND *MASSOSPONDYLUS*

11:30 **Parrish, J. M**. EVOLUTIONARY AND PALEOECOLOGICAL ASPECTS OF THE TRIASSIC-EARLY JURASSIC SAUROPODOMORPH RADIATION

11:45 **Wilson, J**. ESTIMATING EARLY SAUROPOD DINOSAUR LOCOMOTOR POSTURE AND SPATIOTEMPORAL DISTRIBUTION WITH ICHNOFOSSILS AND BODY FOSSILS: A STRATOCLADISTIC APPROACH

POSTER ASSOCIATED WITH THE EVOLUTION OF GIANTS SYMPOSIUM

Booth

1. **Codd, J., and Perry, S**. BIRD LUNGS: THE KEY TO GETTING REALLY BIG: THE ALLOMETRY OF RESPIRATORY PARAMETERS IN SAUROPODS.

TECHNICAL SESSION XIII
ARIZONA BALLROOM E-G
MODERATORS: JURGEN KRIWET AND JONATHAN GEISLER

8:00 **Tintori, A., and Lombardo, C**. TETHYAN TRIASSIC FISHES FROM EUROPE TO CHINA
8:15 **Newbrey, M., Wilson, M., and Ashworth, A**. GROWTH CHARACTERISTICS OF NORTH AMERICAN HIODONTIDAE (TELEOSTEI) FROM THE LATE CRETACEOUS TO RECENT
8:30 **Markey, M., Main, R., and Marshall, C**. *IN VIVO* CRANIAL SUTURE FUNCTION AND SUTURE MORPHOLOGY IN EXTANT FISH: IMPLICATIONS FOR INFERRING SKULL FUNCTION IN FOSSIL TAXA
8:45 **Lund, R., and Grogan, E**. THE MORPHOLOGY OF BEAR GULCH INIOPTERYGIANS WITH COMMENTS ON THEIR RELATIONSHIPS TO OTHER FISHES
9:00 **Kriwet, J., and Klug, S**. PHYLOGENY AND FOSSIL RECORD OF SQUALIFORM SHARKS (CHONDRICHTHYES, NEOSELACHII)
9:15 **Friedman, M**. BRAINCASES, BODIES AND BIOGEOGRAPHY: NEW CHARACTERS AND THEIR BEARING ON THE INTERRELATIONSHIPS OF EARLY LUNGFISHES
9:30 **Eiting, T., and Smith, G**. INTERNAL GILL RAKER MORPHOLOGY OF FOSSIL SALMONIDAE USING HIGH-RESOLUTION X-RAY COMPUTED TOMOGRAPHY
9:45 **Claeson, K**. INSIDE THE SKULL OF A PRIMITIVE BONY FISH, *ERPETOICHTHYS CALABARICUS* (ACTINOPTERYGII: CLADISTIA: POLYPTERIDAE), THE ROPEFISH
10:00 **BREAK**
10:15 **Brazeau, M., and Ahlberg, P**. A NEW LOOK AT TETRAPOD MIDDLE EAR ORIGINS: SPIRACLE EVOLUTION IN THE TETRAPODOMORPHA
10:30 **Boisvert, C**. A LOBE-FINNED FISH SHEDS NEW LIGHT ON THE ORIGIN OF THE TETRAPOD PELVIC GIRDLE
10:45 **Anderson, P**. BIOMECHANICS AND ECOMORPHOLOGY OF LATE DEVONIAN ARTHRODIRES FROM THE GOGO FORMATION OF WESTERN AUSTRALIA
11:00 **Preuschoft, H., Hohn, B., Distler, C., Witzel, U., and Sick, H**. RIBS AND RIB CAGES IN TERRESTRIAL VERTEBRATES: THEIR BIOMECHANICAL FUNCTION AND STRESSING, ANALYSED WITH THE AID OF FESA
11:15 **Colbert, M**. TAPHONOMY OF THE VERTEBRATE SKULL AS REVEALED BY HRXCT
11:30 **Geisler, J**. A STRATOCLADISTIC METHOD FOR ASSESSING DIVERGENCE ESTIMATES
11:45 **Fox, D., Marcot, J., and Fisher, D**. THE IMPACT OF VARIABLE PRESERVATION PROBABILITY ON THE ACCURACY OF STRATOCLADISTIC HYPOTHESES
12:00 **Murphey, P., and Townsend, K**. ECOLOGICAL DIVERSITY ANALYSIS APPLIED TO FACIES FAUNAS IN THE TWIN BUTTES MEMBER, MIDDLE EOCENE BRIDGER FORMATION, SOUTHWESTERN WYOMING
12:15 **Buchholtz, E**. MODULAR CONTROL OF VERTEBRAL MORPHOLOGY IN SECONDARILY AQUATIC TETRAPODS

TECHNICAL SESSION XIV
PALO VERDE BALLROOM
MODERATORS: DARIN CROFT AND ERIC DEWAR

8:00 **Flynn, J., Croft, D., Hitz, R., and Wyss, A**. THE TAPADO FAUNA (?CASAMAYORAN SALMA), ABANICO FORMATION, TINGUIRIRICA VALLEY, CENTRAL CHILE
8:15 **Ferrusquia, I**. THE MARFIL LOCAL FAUNA, BRIDGERIAN OF GUANAJUATO, CENTRAL MEXICO: REVIEW AND SIGNIFICANCE. A PROGRESS REPORT ON THE SOUTHERNMOST PALEOGENE TETRAPOD ASSEMBLAGE OF NORTH AMERICA
8:30 **Croft, D., and Townsend, K**. INFERRING HABITAT FOR THE LATE EARLY MIOCENE SANTA CRUZ FAUNA (SANTA CRUZ PROVINCE, ARGENTINA) USING ECOLOGICAL DIVERSITY ANALYSIS
8:45 **Gunnell, G., Simons, E., and Seiffert, E**. PALEOGENE BATS (CHIROPTERA) FROM FAYUM PROVINCE, EGYPT
9:00 **Schwartz, G., Mahoney, P., Godfrey, L., and Jungers, W**. DENTAL DEVELOPMENT AND LIFE HISTORY IN ONE OF THE LARGEST SUBFOSSIL MALAGASY LEMURS, *MEGALADAPIS EDWARDSI*

9:15 **Sargis, E., Bloch, J., Boyer, D., and Silcox, M**. EVOLUTION OF GRASPING IN EUARCHONTA

9:30 **MacLatchy, L., and Rossie, J**. NEW HOMINOID DENTAL SPECIMENS FROM MOROTO II, EARLY MIOCENE, UGANDA

9:45 **Garcia, N., Feranec, R., Arsuaga, J. L., Bermudez de Castro, J. M., and Carbonell, E**. ISOTOPIC INTERPRETATION OF FAUNAL RELATIONSHIPS FROM MIDDLE PLEISTOCENE HOMINID BEARING LOCALITIES IN THE SIERRA DE ATAPUERCA, NORTHERN SPAIN

10:00 **BREAK**

10:15 **Folinsbee, K**. NEW *THEROPITHECUS* FOSSILS FROM COOPER'S CAVE AND PRELIMINARY PHYLOGENETIC ANALYSIS OF BABOONS

10:30 **Beard, K. C., Ni, X., Wang, Y., Gebo, D., and Meng, J**. PHYLOGENETIC POSITION AND BIOGEOGRAPHIC SIGNIFICANCE OF *SUBENGIUS MENGI* (MAMMALIA, CARPOLESTIDAE), THE OLDEST ASIAN PLESIADAPIFORM

10:45 **Asher, R**. THE IMPORTANCE OF SCRAP: HOW INCOMPLETE FOSSILS BIOGEOGRAPHICALLY REDEFINE A LIVING MAMMALIAN RADIATION

11:00 **Hoffman, J., Bloch, J., and Stromberg, C**. DETERMINING THE PRESENCE AND METABOLIC PATHWAYS OF GRASSES IN THE SOUTHEASTERN UNITED STATES DURING THE MIDDLE MIOCENE

11:15 **Dewar, E**. WHAT'S AN OMNIVORE? GENERATING MORE ECOLOGICALLY MEANINGFUL DIETARY CATEGORIES USING DENTAL MICROWEAR

11:30 **Kaiser, T**. THE USE OF TOOTH WEAR EQUILIBRIUMS AS A TOOL IN ASSESSING ON UNGULATE HABITATS AND ENVIRONMENTAL CHANGE

11:45 **Kohn, M, and Fremd, T**. TECTONICS-REGIONAL CLIMATE FORCING OF MIOCENE UNGULATE SPECIES DIVERSITY IN THE WESTERN UNITED STATES

12:00 **Passey, B., and Cerling, T**. EQUID $\delta^{18}O$ IN THE NEOGENE OF NEBRASKA: RELATIONSHIP WITH UNGULATE DIVERSITY, AND DISCUSSION OF MAMMALIAN $\delta^{18}O$ AS A PALEOENVIRONMENTAL PROXY

12:15 **Case, J**. ANTARCTIC MAMMALIAN PALEOFAUNA: BODY SIZE DISTRIBUTION PATTERN INDICATES A RESPONSE TO CLIMATIC COOLING AND SEASONALITY.

SATURDAY AFTERNOON, OCTOBER 22, 2005

TECHNICAL SESSION XV
ARIZONA BALLROOM A-D
MODERATORS: KRISTINA CURRY ROGERS AND DAVID GILLETTE

1:30 **Clauss, M., and Hummel, J**. BASIC ASPECTS OF DIGESTION IN HERBIVORES OF EXTREME BODY SIZE

1:45 **Wings, O**. TAPHONOMY, GASTROLITHS, AND THE LITHOPHAGIC BEHAVIOR OF SAUROPODOMORPH DINOSAURS

2:00 **Remes, K., and Rauhut, O**. NEW INSIGHTS INTO THE ORIGIN AND EVOLUTION OF DIPLODOCOID SAUROPODS

2:15 **McCrea, R., Currie, P., and Pemberton, S. G**. CANADA`S LARGEST DINOSAURS: ICHNOLOGICAL EVIDENCE OF THE NORTHERN-MOST RECORD OF SAUROPODS IN NORTH AMERICA

2:30 **Mallison, H., and Pfretzschner, H.-U**. WALKING WITH SAUROPODS: MODELING DINOSAUR LOCOMOTION IN MSC.VISUALNASTRAN 4D

2:45 **Ikejiri, T., Schwarz, D., and Breithaupt, B**. A NEARLY COMPLETE SKELETON OF A BABY SAUROPOD FROM THE LOWER MORRISON FORMATION OF THE HOWE STEPHENS QUARRY, WYOMING: "LITTLE STEPS" INTO DIPLODOCID ONTOGENY AND TAXONOMY

3:00 **Curry Rogers, K**. THE POSTCRANIAL ANATOMY OF *RAPETOSAURUS KRAUSEI* (SAUROPODA: TITANOSAURIA), WITH COMMENTS ON LIFE HISTORY STRATEGY

3:15 **BREAK**

3:30 **Werning, S**. ONTOGENY AND OSTEOHISTOLOGY OF THE ORNITHOPOD DINOSAUR *TENONTOSAURUS TILLETTI* (CRETACEOUS, NORTH AMERICA)

3:45 **Gates, T., Sampson, S., Eberth, D., Hernandez Rivera, R., Aguillo, M., and Delgado-Jesus, C**. A NEW GENUS AND SPECIES OF LAMBEOSAURINE HADROSAUR (DINOSAURIA: ORNITHOPODA) FROM THE LATE CAMPANIAN CERRO DEL PUEBLO FORMATION, COAHUILA, MEXICO

4:00 **Evans, D., and Reisz, R**. THE FIRST INSIGHTS INTO THE EARLY CREST ONTOGENY OF *PARASAUROLOPHUS* (ORNITHISCHIA: HADROSAURIDAE)

4:15 **Horner, J., and Goodwin, M**. A NEW *TRICERATOPS* CRANIAL GROWTH SERIES

4:30 **Fujiwara, S**. FORELIMB ANATOMY OF *TRICERATOPS* (CERATOPSIA: CERATOPSIDAE) WITH IMPLICATIONS TO SECONDARY QUADRUPEDAL POSTURE

4:45 **Gillette, D., Albright, L. B., Titus, A., and Zanno, L**. OSTEOLOGY OF *NOTHRONYCHUS* SP., A LATE CRETACEOUS (LOWER TURONIAN) THERIZINOSAURID DINOSAUR FROM SOUTHERN UTAH

5:00 **Fremd, T., Smith, M., Dunn, R., Foss, S., and Rickabaugh, S**. IT'S ABOUT TIME: POPULATING A NEW PALEONTOLOGY CENTER WITH ACCURATE MODELS AND PALEOBIOMES

TECHNICAL SESSION XVI
ARIZONA BALLROOM E-G
MODERATORS: MIKE POLCYN AND JUSTIN HALL

1:30 **Blom, H**. INTERRELATIONSHIPS AND EVOLUTIONARY HISTORY OF ANASPID FISHES

1:45 **Snyder, D**. NOTES ON A SPECIES OF RHIZODONT FROM IOWA, AND DIRECTIONS FOR FURTHER RESEARCH IN THE STUDY OF RHIZODONTS AND THE TRANSITION OF VERTEBRATES TO LAND

2:00 **Smith, J., Lucas, S., Hunt, A., and Schneider, J**. FIRST REPORT OF TETRAPOD TRACKS FROM THE MESETA BLANCA MEMBER OF THE LOWER PERMIAN YESO FORMATION, CENTRAL NEW MEXICO

2:15 **Ruta, M., Bolt, J., and Barber, L**. THE LOWER PERMIAN TEMNOSPONDYL *PERRYELLA OLSONI* AND DVINOSAUR INTERRELATIONSHIPS

2:30 **Monks, J**. REASSESSMENT OF THE VALIDITY OF THE GLENOACETABULAR DISTANCE IN TETRAPOD TRACKWAYS

2:45 **Froebisch, J**. A DOUBLE-TUSKED DICYNODONT THERAPSID—PATHOLOGY, VARIABILITY, OR A NEW SPECIES?

3:00 **Njau, J., and Blumenschine, R**. BONE MODIFICATION BY CROCODILIANS IN PLIO-PLEISTOCENE FOSSIL ASSEMBLAGES, OLDUVAI GORGE, TANZANIA

3:15 **BREAK**

3:30 **Farlow, J., Bonnan, M., and Masters, S**. LINEAR AND GEOMETRIC SHAPE CHANGES BETWEEN SEXES IN *ALLIGATOR MISSISSIPPIENSIS* FEMORA: STATISTICAL IMPLICATIONS FOR INFERRING FOSSIL ARCHOSAUR SEX

3:45 **Polcyn, M., and Bell, G**. THE RARE MOSASAUR GENUS *GLOBIDENS* FROM NORTH CENTRAL TEXAS (MOSASAURINAE:GLOBIDENSINI)

4:00 **Hall, J**. USING VARIATION IN MODERN POPULATIONS TO EXAMINE ANCIENT ONES: A MORPHOMETRIC APPROACH TO SPECIES AFFINITY

4:15 **Evans, T., Poole, K., Smith, J., and Novak, S**. A SIMPLE, CHEAP, NON-INVASIVE, AND FAST QUARRY MAPPING SYSTEM, WITH COMPARISONS TO COMMON QUARRY MAPPING TECHNIQUES

4:30 **Murray, L**. DEVELOPMENT OF STRATIGRAPHIC PLACEMENT AND DATING PROTOCOLS FOR FOSSIL LOCALITIES IN THE VALLECITO CREEK-FISH CREEK BASIN, ANZA-BORREGO DESERT STATE PARK, CALIFORNIA

4:45 **Nave, J., and Matney, S**. REFLECTORLESS VERSUS RETRO-REFLECTOR EDM FOR DATA COLLECTION AT THE GRAY FOSSIL SITE: A STATISTICAL ANALYSIS FOR PRECISION

5:00 **Oheim, K., and Hall, J** FINDING FOSSILS: A GIS-BASED SUITABILITY ANALYSIS OF THE TWO MEDICINE FORMATION OF NORTH-CENTRAL, MONTANA

TECHNICAL SESSION XVII
PALO VERDE BALLROOM
MODERATORS: NANCY TODD AND JAELYN EBERLE

1:30 **Libed, S**. A MAMMALIAN BIOSTRATIGRAPHY WITH ADDITIONAL NEW MAMMALS FROM THE TORREJONIAN-TIFFANIAN TRANSITION IN THE NACIMIENTO FORMATION, NORTHWESTERN SAN JUAN BASIN, NEW MEXICO

1:45 **Wood, C., and Rougier, G**. "GIGANTOPRISMATIC" ENAMEL MICROSTRUCTURE IS NOT PLESIOMORPHIC FOR MULTITUBERCULATA

2:00 **Rountrey, A., Fisher, D., Vartanyan, S., and Fox, D**. CARBON AND NITROGEN ISOTOPE EVIDENCE OF WEANING IN A JUVENILE WOOLLY MAMMOTH

2:15 **Fisher, D., and Fox, D**. CALVING HISTORIES OF FEMALE MASTODONS (*MAMMUT AMERICANUM*)

2:30 **Todd, N., Falco, N., Silva, N., and Sanchez, C**. DENTAL MICROWEAR ANALYSIS OF THE EXTANT ELEPHANTS (*LOXODONTA AFRICANA*) AND (*ELEPHAS MAXIMUS*): A NEW QUANTIFICATION METHOD WITH IMPLICATIONS FOR PALEOECOLOGY AND DIETARY INTERPRETATION OF FRAGMENTARY FOSSIL SPECIMENS

2:45 **Biasatti, D., Wang, Y., and Deng, T**. EVIDENCE FOR A PLIO-PLEISTOCENE STRENGTHENING OF THE ASIAN MONSOON AND ITS IMPORTANCE TO THE UNDERSTANDING OF MAMMALIAN EVOLUTION IN NORTHWEST CHINA

3:00 **Clifford, A**. MAJOR TRANSITIONS IN TERRESTRIAL ARTIODACTYL FORELIMBS

3:15 **BREAK**

3:30 **Draus, E., and Prothero, D**. NORTH AMERICAN MUSK DEER (SUBFAMILY BLASTOMERYCINAE) REVISITED

3:45 **Eberle, J**. EARLY EOCENE BRONTOTHERIIDAE (PERISSODACTYLA) FROM THE EUREKA SOUND GROUP, ELLESMERE ISLAND, CANADIAN HIGH ARCTIC—IMPLICATIONS FOR BRONTOTHERE ORIGINS AND HIGH-LATITUDE DISPERSAL

4:00 **Hieronymus, T., and Witmer, L**. REVISED HORN RECONSTRUCTIONS FOR EXTINCT RHINOCEROTID TAXA: SEPARATING THE CONTRIBUTIONS OF DERMIS AND EPIDERMIS TO HORN RUGOSITIES

4:15 **Metais, G., Qi, T., Guo, J., and Beard, C**. EARLY SELENODONTIA (ARTIODACTYLA) FROM THE MIDDLE EOCENE OF CHINA

4:30 **Prothero, D., and Sanchez, F**. CRUSHING AND OVERSPLITTING: STATISTICAL APPROACHES TO A RATIONAL TAXONOMY OF THE OREODONT *LEPTAUCHENIA*

4:45 **Orliac, M**. *LISTRIODON*, *BUNOLISTRIODON* OR *EUROLISTRIODON*? IMPLICATIONS OF THE REEXAMINATION OF THE LISTRIODONT MATERIAL FROM MONTREAL-DU-GERS (FRANCE, GERS) ON THE SYSTEMATICS OF THE SUBFAMILY LISTRIODONTINAE (MAMMALIA, SUIDAE)

Wednesday 10:30

THE ROLE OF INCISORS AND FORELIMBS IN THE SHEAR BITE AND FEEDING OF *SMILODON*

AKERSTEN, William, Idaho State Univ., Pocatello, ID

Two of the many differences between feline cats and *Smilodon* lie in their incisors and in forelimb extension. The incisor batteries of *Smilodon* have been thoroughly described but a review is in order. Unlike the weaker, blunter, non-interlocking incisors of felines, the incisor batteries (including lower canines) of *Smilodon* are piercing teeth, well developed with large, interdigitating upper and lower crowns having sharp apices, and serrate marginal ridges. The posteriorly recurved profile of the teeth is well suited to a posteriad piercing action and their distance anterior to the sabers allows them to be employed separately or simultaneously. Their size, enormous roots, and the heavy bone surrounding the roots reflects the imposition of great stresses, primarily in an anteroposterior direction. Feline incisors are employed primarily in grooming and in stripping flesh from carcasses. The incisors of *Smilodon* were probably used for these purposes and also in the canine shear bite.

The question becomes the source of the forces that the incisor batteries were adapted to withstand. The forelimb of *Smilodon* is well adapted for extension. The origins and insertions of the triceps and the anconaeus are well developed and the olecranon is longer relative to the anterior part of the ulna (measured from the center of the semilunar notch) than in living large felids and even more so relative to *Homotherium*. This combination of increased musculature and the greater inlever/outlever ratio indicates a far more powerful forelimb extension. The extremely robust nature of the radius and ulna, the strongly developed attachments for the interosseous membrane, and the short, stout metacarpals support powerful use of the forelimb.

Powerful forelimb extension is typical of digging mammals but the foot structure of *Smilodon* is unsuited for digging. When the large, sharp, interdigitating, and recurved incisor batteries are locked into a prey animal, strong forelimb extension against the prey would provide substantial posteriad force (relative to the cranial axis) to increase the effectiveness of the shear bite during the kill and of subsequent removal of pieces of flesh during feeding.

Poster Session A

THE INFERRED EVOLUTIONARY HISTORY OF INTEGUMENTARY SENSE ORGANS IN CROCODYLOMORPHS

ALLEN, David, Northern Illinois Univ., DeKalb, IL

A suite of five primary senses enables vertebrate animals to assess the world in which they live. These are sight, hearing, smell, touch and taste, and are facilitated by specialized sense organs. In addition to these senses, many vertebrates have evolved novel sensory mechanisms that convey improved hunting ability, and indirectly lead to enhanced fitness relative to other taxa. Examples include electroreception in the platypus, infrared detection in snakes, and echolocation in bats.

Extant crocodilians possess small domed structures known as Integumentary Sense Organs (ISOs) that are hypothesized to have a mechanosensory role. They are restricted to the head in alligatorids, but are also present on postcranial regions in other crocodilians. These structures have also been referred to as Dome Pressure Receptors (DPRs), although the mechanism of reception is not well understood.

The distribution of ISOs on the faces of extant crocodilians corresponds well with the distributions of foramina within the jawbones. These foramina today supply ISOs with nerves and blood vessels, and may be used as indicators for the presence of these structures in extinct forms.

It has been hypothesized that crocodilian ISOs first evolved during the Jurassic period, and were only present in genera that adopted a semi-aquatic lifestyle. It is unwise to assume that that the first crocodilians to possess these structures would have exhibited the complex ISO distributions seen in extant taxa. An alternative explanation is that these structures appeared earlier, in more primitive crocodylomorph taxa. I predict that these earlier forms would have shown a more modest distribution of ISOs along jaws, and would have had fewer foramina. Several phases in crocodylomorph evolution are identified, leading up to the modern distribution.

It is possible and likely that ISOs in their current form have undergone significant evolutionary modifications since their first appearance. It is suggested that these ISOs are modified versions of much more ancient structures that first appeared late in the Triassic, perhaps being adapted for a different purpose.

Wednesday 2:00

ECOLOGICAL SPECTRA THROUGH THE CRETACEOUS AND CENOZOIC TETRAPOD FOSSIL RECORD

ALROY, John, Paleobiology Database VP Working Group, The Univ. of California, Santa Barbara, Santa Barbara, CA

Ecological spectra summarize the number of species within assemblages that fall into ecological categories. They have been used extensively in studies of Cenozoic mammals, and shown to relate to environmental factors. For example, the presence of many medium-sized (1-10 kg) species indicates warm, wet, equable habitats. However, it is not clear whether the ecomorphology of entire tetrapod assemblages can be interpreted in the same way. We compiled data on Campanian and middle Eocene assemblages to contrast periods of similar durations with similar, near-greenhouse global climates, but very different evolutionary situations: in the Cretaceous, mammals were a relatively minor component of the tetrapod biota. However, because the middle Eocene started >15 million years after the Cretaceous-Tertiary boundary mass extinction, enough time had elapsed for vertebrate communities to recover and evolve into equilibrium with the environment. Thus, for example, mammals had an opportunity to reoccupy the high end of the body mass spectrum that was opened up by the extinction event. The Paleobiology Database was used to store and analyze the faunal and ecomorphological data. Key assemblages are found in Mongolia (Khulsan, Ukhaa Tolgod) and North America (Clambank Hollow, Los Alamitos, Terlingua) in the Campanian, but mostly Europe (Geiseltal, Le Bretou) and North America (San Diego County, Uinta Basin) in the middle Eocene. Data were hard to recover for small (<1 kg) vertebrates, but were informative where available, because (for example) small amphibians and squamates likely comprised a large fraction of the living vertebrate faunas. Analyses focused on three main categories: body mass, diet, and locomotion. Minimum and maximum body mass were recorded in half-$\log_{10}$ units. The employed diet categories were standard (frugivore, browser, insectivore, etc.), as were the locomotion categories (fossorial, scansorial, etc.). Ecomorphology data were recovered hierarchically from the Database: for example, since Primates was scored as arboreal, all primates were tallied automatically as arboreal unless individually scored otherwise. The comparisons of tetrapod ecological spectra highlight the roles of history, phylogeny, and ecology in the assembly of communities.

Wednesday 8:30

A NEARLY COMPLETE AMPHIBAMID SKULL FROM RICHARD'S SPUR, OKLAHOMA, AND ITS IMPLICATIONS FOR INTERPRETATION OF DENTAL CHARACTERS RELATED TO THE ORIGIN OF MODERN AMPHIBIANS

ANDERSON, Jason, Western Univ. of Health Sciences, Pomona, CA; BOLT, John, Field Museum of Natural History, Chicago, IL

The Lower Permian fissure fill deposits at the Dolese Quarry of Oklahoma are renowned for high quality preservation of terrestrial vertebrate remains. We report the discovery of a nearly complete and undistorted skull of an amphibamid temnospondyl probably referable to the genus *Tersomius*. The dermocranium is intact and articulated. Both lower jaws are in place, somewhat obscuring the lateral margins of the broad interpterygoid vacuities. The neurocranium, including the parasphenoid, is absent except for an element associated with the left orbit which we identify as the sphenethmoid, and a portion of the otic capsule, probably the prootic, apparently bearing part of the fenestra ovalis. Most significantly, on the left vomer two fangs are in situ, with a replacement fang growing into place. This replacement fang is conical and bicuspid, with labiolingually oriented cuspules.

Tooth morphology is important to the discussion of the origins of modern amphibians. Among the few hard-tissue synapomorphies of lissamphibians (frogs, salamanders, and caecilians) are bicuspid, pedicellate teeth; however, the presence of mono- and multicuspid teeth and pedicelly are ontogenetically and taxonomically variable in lissamphibians. Another character that has been discussed in the neontological literature is teeth of a bladed morphology, which could describe the morphology of lepospondyls like *Bolterpeton* and *Cardiocephalus*. Complicating the use of this feature is the fact that the first teeth to develop in frogs are bladed, while those of salamanders are conical. The fact that pedicelly, mono- vs. multicuspid, and conical vs. bladed teeth vary independently of one another permits us to use each as a separate character in phylogenetic analysis. Preliminary results support the PH, with salamanders and albanerpetontids constituting a sister group to frogs, and *Triadobatrachus* as outgroup to this clade. This assemblage in turn is sister group to *Doleserpeton*, contrary to hypotheses that salamanders are sister group to branchiosaurs. Caecilians are found as sister group to brachystelechid microsaurs, with *Rhynchonkos* as outgroup to this clade.

Saturday 10:45

BIOMECHANICS AND ECOMORPHOLOGY OF LATE DEVONIAN ARTHRODIRES FROM THE GOGO FORMATION OF WESTERN AUSTRALIA

ANDERSON, Philip, Univ. of Chicago, Chicago, IL

Arthrodires (and placoderms in general) show a great deal of morphological diversity by the late Devonian. Much of this diversity is seen in the skulls and jaws, indicating a wide variety of possible feeding niches, from freshwater durophagous bottom dwellers to marine piscivorous cruisers. Current phylogenies place the Placodermi as sister-group to all other jawed vertebrates. This makes the organization and function of placoderm jaw systems vital to understanding early gnathostome evolution. The goal of this study is to understand the relationship of late Devonian arthrodire skull diversity to ecology and feeding ability. The Gogo Formation of Western Australia is a Frasnian fossil reef deposit known for beautifully preserved placoderm skulls. Numerous species have been described along with other fossil fishes and invertebrates. The quality of preservation and high diversity make it a good setting to analyze biomechanical diversity.

Functionally relevant morphological and mechanical data were collected from 9 placoderms from the Gogo Formation. These skulls were analyzed using Placodermodel 1.0, a dynamic computer model based on lever and linkage mechanics that calculates skull kinetics and mechanical feeding metrics in fossil vertebrates. This model has already produced original and realistic results for a North American species, *Dunkleosteus terreli*. Here it is used to compare several Gogo arthrodire species to each other and to modern groups. Results reveal a range of Kinematic transfer coefficients (KT) and mechanical advantage values that change

during the feeding cycle. Resultant KT values (3.2-3.4) are generally higher then a subset of modern labrid oral linkages (0.45-1.5), but near the high end of the range of modern hyoid linkages (0.07-4.7), indicating that arthrodires utilized suction as part of their feeding mechanism. The high range of mechanical advantage measurements (0.1-0.68) indicates a great deal of diversity in feeding ability. Such results lend strong support to the possibility of obtaining quantified hypotheses of ecological diversity within a phylogenetically remote and long extinct basal gnathostome taxon.

Wednesday 9:45

JURASSIC PTEROSAURS FROM XINJIANG, CHINA: THE EARLIEST PTERODACTYLOID AND THE ORIGINS OF THE GROUP

ANDRES, Brian, Yale Univ., New Haven, CT; CLARK, James, George Washington Univ., Washington, DC

Fossil vertebrates collected from the Wucaiwan area in the Junggar Basin of Xinjiang, China, by joint expeditions from the Institute of Vertebrate Paleontology and Paleoanthropology and George Washington Univ. have extended the temporal and geographic ranges of various taxa. Another taxon is the Pterosauria after the discovery of three pterosaur specimens in the Jurassic Shishugou Formation. These are the earliest and only Jurassic records of pterosaurs from Xinjiang. These specimens include a mostly complete nonpterodactyloid (rhamphorhynchoid) pterosaur and an isolated wing phalanx from the Upper Shishugou Formation as well as a fragmentary pterodactyloid from the Lower Shishugou Formation. Because the Lower Shishugou Formation is considered Middle Jurassic in age, this is the oldest definite occurrence of the Pterodactyloidea, which do not appear again until the Upper Jurassic (Kimmeridgian).

Phylogenetic analysis of the Pterosauria and the two more complete specimens places the nonpterodactyloid in a monophyletic group with *Dorygnathus* and *Angustinaripterus*. The pterodactyloid is placed as the sister group to all other pterodactyloids and is termed a pterodactyloid using the most recent definition of the group. This analysis also identifies a number of pterosaurs on the stem to the Pterodactyloidea. These pterosaurs, the Wucaiwan pterodactyloid, and nearly all of the Kimmeridgian pterodactyloids are found in terrestrial sediments. Mapping terrestrial versus marine occurrence of pterosaur species on the cladogram results in terrestrial occurrence optimizing to the base and over most of the Pterodactyloidea. Marine occurrence appears at least five separate times in the Pterodactyloidea and typically is associated with a number of closely related species from the same lagerstatten. The origins of the Pterodactyloidea are discussed with respect to a terrestrial origin and different hypotheses are addressed that may explain this pattern.

Poster Session B

BIOCHRONOLOGY AND PALEOECOLOGY OF THE BULUK FAUNA, EARLY MIOCENE OF NORTHERN KENYA

ANEMONE, Robert, Western Michigan Univ., Kalamazoo, MI; GROSSMAN, Ari, Stony Brook Univ., Stony Brook, NY; MILLER, Ellen, Wake Forest Univ., Winston Salem, NC; WATKINS, Ron, Curtin Univ. of Technology, Perth, Australia

Renewed fossil collection at the early Miocene site of Buluk in the Turkana Basin of northern Kenya was conducted during the summer of 2004. Here we discuss new fossil finds that include more maxillary material of the fossil ape *Afropithecus turkanensis* and a complete cranium of the rhinocerotid *Aceratherium*. We compare the fossil assemblage from Buluk with other Afro-Arabian sites from the early Miocene to address their biogeographical, temporal, and ecological relationships.

In addition to descriptions from the literature, material from all the Kenyan sites was examined by the authors in Nairobi. We apply Simpson's Index and some ecological indices to the various faunas to examine overall similarity and to reconstruct the environments at various sites.

The sites of Fejej in southern Ethiopia and Buluk in northern Kenya share faunal elements with sites in western Kenya, eastern Uganda, Libya, Egypt and Saudi Arabia. The fauna from Buluk is most similar to those recovered from Locherangan and Muruarot Hill in the West Turkana region of Kenya. The cercopithecoid monkey *Prohylobates* is found both at Buluk and at sites in Uganda, Libya and Egypt but not at sites west of Lake Turkana or in western Kenya. Buluk does however share the hominoid *Afropithecus* with Locherangan and Kalodirr in West Turkana, and perhaps with Moroto (*Morotopithecus*) in Uganda, and most likely with Ad-Dabtiyah (*Heliopithecus*) in Saudi Arabia.

Buluk does not share any primates with sites from the Lake Victoria region of Kenya such as Rusinga Island, Songhor or Koru. The large mammals from Buluk such as *Prodeinotherium* and *Cynelos* are found in nearly all of the sites looked at in this study. In spite of significant collecting effort by our team and others, there are no small mammals known from Buluk. In lieu of this evidence the relationships of the Buluk fauna to other sites is somewhat enigmatic. Biogeographic, ecological, and temporal explanations for the differences in the primates of Buluk and the Lake Victoria sites are discussed.

Wednesday 3:00

AN INTEGRATIVE APPROACH TO DISTINGUISHING THE DICYNODONT SPECIES *OUDENODON BAINI* AND *TROPIDOSTOMA MICROTREMA* (THERAPSIDA; ANOMODOMTIA)

ANGIELCZYK, Kenneth, California Academy of Sciences, San Francisco, CA; BOTHA, Jennifer, National Museum, Bloemfontein, South Africa

The dicynodonts *Oudenodon baini* and *Tropidostoma microtrema* are remarkably similar in most aspects of their cranial and postcranial morphology. The most obvious distinguishing feature is the presence of tusks and postcanine teeth in *T. microtrema* and their absence in *O. baini*. However, some specimens of *T. microtrema* lack tusks or postcanine teeth, and others display intermediate conditions such as possessing an erupted tusk on only one side of the skull. This variability raises the question of whether *O. baini* and *T. microtrema* truly are distinct species, or simply endpoints on a morphological continuum. Resolution of this uncertainty is necessary because both species play important roles in Upper Permian terrestrial biostratigraphy. Here we address this issue using several types of data.

Our results show that variability in most discrete characters of the skull preclude them from being completely diagnostic of either species. However, both a geometric morphometric analysis of snout shape and a traditional morphometric analysis of skull dimensions can reliably differentiate tuskless specimens from those with tusks and/or postcanine teeth. The histology of several *T. microtrema* limb bones was also examined. The primary bone tissue consists of moderately vascularized fibro-lamellar bone, which becomes parallel-fibered with annuli and/or LAGs towards the periphery. A free medullary cavity is usually absent or if present, very small. These bone tissue characteristics are notably similar to those of *O. baini*.

Stratigraphic range data and the nature of ontogenetic changes in snout shape suggest that the two morphotypes are best regarded as distinct species, not sexual dimorphs or other variants. Moreover, given the high level of phenotypic similarity between the two species, as well as recent phylogenetic results, we propose that it is taxonomically most conservative to treat both species as members of a single genus-level clade (*Oudenodon*). This taxonomic change will require minor alterations to the names, but not the substance, of the biostratigraphic assemblage zones of the Karoo Basin, South Africa.

Thursday 2:30

MAMMALIAN FAUNAL SUCCESSION IN THE CRETACEOUS OF THE KYZYLKUM DESERT, UZBEKISTAN

ARCHIBALD, J. David, San Diego State Univ., San Diego, CA; AVERIANOV, Alexander, Zoological Institute, Saint Petersburg, Russian Federation

Both metatherians and eutherians are known from the Early Cretaceous (Barremian, 125 Ma) of China, while eutherian-dominated mammalian faunas appeared in Asia at least by the earliest Late Cretaceous (Cenomanian, 95 Ma). The approximately 99-93 Ma (Cenomanian) Sheikhdzheili l. f. (local fauna) from western Uzbekistan is a small sample of only eutherians, including three zhelestids and a possible zalambdalestoid. The much better known 90 Ma (Turonian) Bissekty l. f. at Dzharakuduk in central Uzbekistan includes 15 named and unnamed species, based on ongoing analyses. Of these, 12 are eutherians represented by at least the three groups: asioryctitheres, zalambdalestids, and zhelestids, plus an eutherian of uncertain position *Paranyctoides*. Zalambdalestids and zhelestids have been argued to be related to the origin of the placental gliriforms (Euarchontoglires) and ferungulates (Laurasiatheria), respectively, although recent analyses cast doubt on the first relationship. Although there are four previously recognized metatherians, we believe three are referable to the deltatheroid *Sulestes karakshi* and the fourth, *Sailestes quadrans*, may belong to *Paranyctoides*. There is one multituberculate and one symmetrodont in the Bissekty l. f. While comparably aged (Turonian) localities in North America have somewhat similar non-therians, they have more metatherians and no eutherians. The next younger localities (early Campanian, ~80 Ma) in North America have both a zhelestid and *Paranyctoides*, suggesting dispersal of eutherians from Asia. At Dzharakuduk, the approximately 85 Ma (late Turonian /Coniacian) Aitym l. f. is less well represented than the Bissekty l. f., but yields nearly identical taxa, with two non-therians, one metatherian, and six eutherians.

Friday 10:45

IMPACT OF FOSSILS IN ELOPOMORPH/OSTEOGLOSSOMORPH PHYLOGENIES

ARRATIA, Gloria, The Univ. of Kansas, Lawrence, KS

During the last 30 years, phylogenetic studies of teleosts have followed different approaches. The most generalized one includes morphological data of only living forms. A second approach is based on morphological data of only living forms, but fossils are placed into the cladogram (the phylogenetic position of the fossil taxa is assumed). A third approach includes morphological data of living and fossil teleosts as part of the ingroup. And a fourth, recently available, is based only on molecular data of living teleosts. The positions of the osteoglossomorphs and of the elopomorphs as most basal groups among the crown-group Teleocephala are strongly biassed by the selection of fossil or living taxa or by inclusion of both. Hypotheses based on molecular and morphological data of living teleosts show the osteoglossomorphs as the most primitive teleocephalans. However, the elopomorphs occupy the basal position among teleocephalans when fossil and recent elopomorphs and osteoglossomorphs are included in the phylogenetic analysis. The living elopomorph and osteoglossomorph species are the

terminal taxa of the groups. Both groups have a long evolutionary history with their largest radiations in the past. The elopomorph fossil record can be traced back to the early Late Jurassic (about 159 Ma), about 35 million years earlier than the earliest record of osteoglossomorphs. Both elopomorphs and osteoglossomorphs are very well represented in the fossil record, so that their fossil representatives should not be ignored. The study of the fossil species leads to new interpretations of certain characters and of character distribution. That affects, consequently, the topology of cladograms based only on living forms. By including only living species in phylogenetic analyses, the results represent the relationships among species living at the present time; conclusions about possible ancestors are only speculations.

Saturday 10:45

THE IMPORTANCE OF SCRAP: HOW INCOMPLETE FOSSILS BIOGEOGRAPHICALLY REDEFINE A LIVING MAMMALIAN RADIATION

ASHER, Robert, Museum für Naturkunde, Humboldt Universität zu Berlin, Berlin, Germany

There are four major extant radiations of terrestrial mammals on Madagascar: primates, tenrecs, carnivorans, and rodents. Tenrecs (Afrotheria) consist of 8 living genera on Madagascar, and occupy terrestrial, semiaquatic, arboreal and fossorial niches; the two mainland African genera are both semiaquatic. With the notable exception of primates, the fossil record of Recent Malagasy mammals is poor; but over the past 50 years fragmentary craniodental material has been assigned to three tenrecid genera from the Miocene of Kenya.

Newly collected data support the interpretation that living Malagasy tenrecs comprise a monophyletic clade to the exclusion of their mainland sister taxa, as has also been argued for living Malagasy primates and carnivorans. Based on this phylogenetic structure, it has been argued that a single dispersal event across the Mozambique channel can explain the present-day distribution of the Tenrecidae. However, a combined morphology-DNA dataset, with the three recognized fossil tenrecs sampled for morphology, places the Kenyan fossils within the Malagasy radiation. This signal is supported by both parsimony and Bayesian techniques with moderate to strong confidence intervals. If accurate, it demonstrates that a biogeographic pattern inferred from living mammals alone may change considerably with the inclusion of fossils, even incomplete ones. In this presentation I explore how the limited morphological character sample for tenrecs, particularly the fossils, disagrees with nodes strongly supported by sequence data, and discuss the extent to which morphology contributes in inferring phylogeny for both living and fossil tenrecid mammals.

Poster Session B

ADDITIONS TO THE LATE PLEISTOCENE VERTEBRATE PALEONTOLOGY OF THE LAS VEGAS FORMATION, CLARK COUNTY, NEVADA

AUSTIN, Chris, SPRINGER, Kathleen, SCOTT, Eric, MANKER, Craig, SAGEBIEL, Chris, San Bernardino County Musem, Redlands, CA

Studies from the 1930s through the 1960s documented one of the most significant late Pleistocene faunas from the Mojave Desert in the Tule Springs area of North Las Vegas. Recent field investigations in North Las Vegas by the San Bernardino County Museum have broadened our knowledge of this fauna across the Las Vegas Wash.

Seven units, designated A through G, have been defined in the section of the Las Vegas Wash near Tule Springs State Park. Units B, D, and E have proven fossiliferous in the area of the Tule Springs State Park, and date to >40,000 ybp, approximately 25,500 ybp, and about 14,500 to 9,300 ybp, respectively. Research across the Las Vegas Wash has resulted in the discovery of several hundred new fossil localities. In describing the geology at these localities and geologic exposures in the wash, the SBCM has expanded the definition and mapping of the subunits of the Las Vegas Formation to include lateral facies changes outside of the park. Newly recognized faunal components include the microvertebrates *Rana* sp., *Masticophis* sp., cf. *Arizona* sp., *Marmota flaviventris*, *Neotoma* cf. *N. lepida*, and cf. *Onychomys* sp.. The list of megafauna has also been expanded to include a large bovid similar in size to *Euceratherium*, and the first definitive fossils of *Bison antiquus* from Unit E. The density of sampling in North Las Vegas has allowed for a more detailed demographic analysis of this important fauna than was previously possible.

Romer Prize Session, 8:15

THE USE OF FORENSIC ENTOMOLOGY IN DINOSAUR TAPHONOMY AT A QUARRY IN THE UPPER JURASSIC MORRISON FORMATION IN NORTHEASTERN WYOMING

BADER, Kenneth, Univ. of Kansas, Lawrence, KS

Forensic entomology, commonly used in criminal investigations, is the study of necrophagous arthropods on carcasses to determine the amount of time lapsed since the death of the organism. A carcass with flesh clinging to the bones must be exposed for an extended period of time to attract insects. Most of these insects feed exclusively on soft tissues, while very few modify bone. The larvae of dermestid beetles feed on desiccated carcasses and etch feeding traces and bore pupation chambers into the bone surface. The size, shape, and type of trace vary with temperature, light, food availability, moisture level inside the carcass, and amount of time the carcass was exposed after death.

Two distinct types of insect traces are found on dinosaur bones from the Upper Jurassic Morrison Formation of northeastern Wyoming. Concepts of forensic entomology are used to determine which insects created the traces on the bones, and how long the dinosaurs were exposed prior to burial. The most common trace on the dinosaur bones is from an unidentified insect. This trace is a narrow, looping groove etched into the bone surface. The second trace, interpreted as a dermestid beetle pupation chamber, is a shallow, spherical boring that varies in diameter and density between individual skeletons. The absence of insect traces on a skeleton suggests that the carcass was rapidly buried, submerged in water, or was exposed to a moist climate that prevented desiccation. Skeletons with larger dermestid borings likely had more available flesh and a prolonged exposure of the carcass during favorable environmental conditions compared to skeletons where the borings are small or absent. Skeletons with the longest subaerial exposure are expected to have the highest number and diversity of insect traces.

Friday 12:00

MICROWEAR ANALYSIS OF SQUIRREL TEETH

BADGLEY, Catherine, Univ.of Michigan, Ann Arbor, MI; NELSON, Sherry, Harvard Univ., Cambridge, MA; BERANEK, Natasha, and ZAKEM, Emily, Univ. of Michigan, Ann Arbor, MI

Small mammals are abundantly represented in mammalian fossil assemblages but have contributed few insights about paleocommunities because their ecomorphology is not well understood. We adapted methods of dental microwear analysis developed for study of large mammals to molars of modern and fossil squirrels (Sciuridae). Microwear analysis has been used to infer the diets of extinct mammals through comparison of microscopic pits and scratches on fossil teeth with those on teeth of living mammals with known diets. Living squirrels occur in diverse terrestrial habitats and eat a range of herbivorous to omnivorous diets, and fossil squirrels have a substantial Cenozoic record.

Using the light microscope, we documented microwear features on casts of upper molars from 31 species of extant squirrels. The extant species occur in tropical rainforest, tropical seasonal forest, temperate deciduous forest, grassland, and desert habitats. We also examined fossil sciurids from the Miocene Siwalik sequence of Pakistan and Pliocene localities from the central plains of the United States. Microwear features were present on the majority of specimens from living species. We found significant differences in microwear features among modern squirrels of different diets and habitats, suggesting that microwear features can be used to infer the diets or preferred habitats of extinct species. Microwear features were preserved on some of the fossil specimens. A comparison of Pliocene *Spermophilus rexroadensis* to modern *Spermophilus* suggested a diet similar to that of the modern species of *Spermophilus* examined. Microwear of Miocene *Eutamias* differed from the pattern in any of the living squirrels examined. The approach holds strong potential for illuminating the trophic ecomorphology of small-mammal fossils.

Poster Session B

EOMYIDS FROM THE EARLY ARIKAREEAN RIDGEVIEW LOCAL FAUNA OF WESTERN NEBRASKA AND THEIR BIOGEOGRAPHIC SIGNIFICANCE

BAILEY, Bruce, Univ.of Nebraska, Lincoln, NE; KORTH, William, Rochester Institute of Vertebrate Paleontology, Rochester, NY; KALTHOFF, Daniela, Universitat Bonn, Bonn, Germany

Four eomyid taxa have been recognized in the early Arikareean Ridgeview local fauna (c. 29 Ma; ≈MP 24) based on 106 partial to complete maxillaries and mandibular rami and with cheek teeth; consenquently, the mandibular morphology is known for all species. Three taxa represent an endemic radiation of the North American *Adjidaumo* clade. *Leptodontomys douglassi* (N=88), is transitional between *Adjidaumo* and later North American species of *Leptodontomys*. A new genus of mesodont eomyid that probably arose from *Metadjidaumo* is well represented in the fauna (N=12). It resembles the European late Oligocene species *Eomys huerzeleri* (MP29). A new species of the European genus *Pentabuenomys* is rare in the fauna (N=3) and appears to share common ancestry with *Leptodontomys*. The common microstructure in the lower incisors of these species is a strong argument for a phylogenetic relationship of the *Adjidaumo/Eomys* clades. The last taxon is a mesodont form (N=2) with similarities to the European genus *Apeomys*; a possible Asian immigrant at this time, whose ancestry remains enigmatic.

Leptodontomys was successful in North America remaining virtually unchanged into the Hemphillian. The remaining three genera have not been recognized in younger deposits in North America; however, similar forms have been described from Europe. This suggests emigration of *Pentabuneomys*, which is reported from the early Miocene (MN 3) in central Europe, the mesodont *Apeomys* species, which is first recognized in the European MN4, and possibly the mesodont *Eomys*-like new genus. This diverse eomyid fauna and the first appearance of the immigrants *Ocajila*, Talpinae and Limnoecinae in the Ridgeview local fauna indicate far greater Eurasian faunal interchange at this time, ca. 29 Ma, than previously reported.

Poster Session A

THE ENDOCRANIAL MORPHOLOGY OF DIPLODOCID SAUROPODS

BALANOFF, Amy, The Univ. of Texas at Austin, Austin, TX; IKEJIRI, Takehito, Fort Hays State Univ., Hays, KS; BEVER, Gabe, Univ. of Texas at Austin, Austin, TX

The complex morphology of the ossified neurocranium and endocranial space makes this anatomical region a potentially rich source of data for addressing a wide variety of biological questions including phylogeny, taxonomy, and even physiology. The construction of datasets

that can address such questions in sauropod dinosaurs is of significant interest considering that this group includes the largest known terrestrial animals. Articulated braincases of sauropods are rarely recovered and are often difficult to study due to infilling of the cranial cavity with sediment. One result is that the braincase traditionally has played a limited role in sauropod systematics and taxonomy. High-resolution computed tomography (HRCT) circumvents many of the traditional preservational restrictions to morphological description and has been used to study a wide variety of taxonomic groups. However, HRCT has yet to be widely applied to the study of sauropods.

We describe a sauropod braincase from the Morrison Formation, Mesa County, Colorado. Although the braincase is well preserved, it is diagnosable only to Diplodocidae based on rounded and 'tongue-like' paroccipital processes. Unfortunately, the lack of characters relating to an isolated braincase makes it difficult to diagnose this specimen to a less inclusive clade. Through the use of HRCT we are able to construct a digital endocast of the endocranial cavity. These digital renderings differ from natural endocasts in that they reflect the major features of the brain and the bony signature of the cranial nerves through the braincase (e.g., the path of the abducens nerve through the dorsum sellae). Other features, such as extracranial spaces as well as sutural contacts, also are visible in the CT imagery. The lack of characters within the braincase of sauropods not only makes a diagnosis for this specimen difficult, but also restricts our knowledge of cranial evolution within this clade. Increasing our understanding of sauropod braincase morphology using HRCT should allow us to identify new phylogenetically informative characters that will elucidate patterns of cranial evolution in this large and interesting group.

Poster Session B

NEW FEATURES OF THE LOWER JAW OF THE TEMNOSPONDYL AMPHIBIAN *TRIMERORHACHIS*

BARBER, Lorie, BOLT, John, RUTA, Marcello, Field Museum of Natural History, Chicago, IL

Exquisite preparation of assorted lower jaws of the Lower Permian temnospondyl *Trimerorhachis* shows unusual and previously unrecorded features. Given the relatively basal placement of this taxon in temnospondyl phylogeny, and the patchy information for early tetrapod lower jaws in general, our data supply potentially useful new cladistic information for this often neglected part of tetrapod osteology. Among the main jaw features (not always co-occuring) are: 1) extensive bony 'curtain' descending from the articular dorsal surface on the posterior wall of the adductor fossa (as in *Eryops*); 2) a dorsally convex stout process rising from the angular internal surface (presumably homologous with a similar process *Dvinosaurus*); 3) a distinct groove on the surangular dorsal internal surface; 4) alternating depressions and thickenings on the anterodorsal part of the prearticular internal surface; 5) highly elaborated symphysial and adsymphysial regions, with a large mandibular depression straddling the splenial, dentary, and anterior coronoid, and occupied by a set of subparallel ridges, keels, foramina and fossae; 6) a raised dentigerous platform on the posterior coronoid. Some of these characters vary in individuals of different sizes (e.g. more robust process rising from angular internal surface and absence of coronoid dentigerous platform in larger specimens), but there is individual or ontogenetic variation in others (e.g. number of foramina adjacent to prearticular foramen, course of sutures, extension of adsymphysial keels). Primitively, the symphyseal articulation surface displays a finely tuberculated and ridged pattern. In other respects (e.g. proportions of Meckelian foramina), *Trimerorhachis* shows advanced features. A cladistic analysis of lower jaw characters resolves *Trimerorhahchis* at a post-edopoid and pre-eryopoid level of mandibular structural organization.

Friday 8:00

EVOLUTIONARY DIVERSITY AND INNER EAR MORPHOLOGIES OF KENTRIODONTID DOLPHINS, MIOCENE CHESAPEAKE GROUP, MARYLAND AND VIRGINIA

BARNES, Lawrence, Natural History Museum of LA County, Los Angeles, CA; REED, Allen, Naval Research Laboratory, SSC, MS; GEISLER, Jonathan, Georgia Southern Univ., Statesboro, GA; GODFREY, Stephen, Calvert Marine Museum, Solomons, MD; BOHASKA, David, National Museum of Natural History, Washington, DC

Small to mid-size, echolocating, pelagic toothed whales of the family Kentriodontidae are basal members of the Delphinoidea, a diverse group that includes living belugas, narwhals, harbor porpoises, and pelagic dolphins. In middle Miocene time, kentriodontids reached their greatest diversity as they replaced other more archaic odontocete groups that had originated in the Oligocene. Varying body sizes, ear morphologies, and dentitions of kentriodontids indicate that they occupied various trophic levels, and they became equally as diverse as the Recent Delphinidae. In the North Atlantic Basin, the Miocene Chesapeake Group of Maryland and Virginia yields the best fossil record of kentriodontids. Six named species, and at least five unnamed species, range from the large killer whale-sized *Macrokentriodon morani* and *Hadrodelphis calvertense* to diminutive species of *Delphinodon* and *Kentriodon*. Most kentriodontids had symmetrical cranial vertices and symmetrical air sacs around the nasal passages, suggesting that their abilities to produce sounds for echolocation vocalization were not as sophisticated as those of Recent Delphinidae. Hearing abilities possibly evolved more rapidly, because high-resolution 'industrial' micro-CT scans of kentriodontid petrosals suggest their ability to hear high frequency sounds was comparable to that of extant delphinids. The bony cochlea of *Macrokentriodon* is very similar to that of extant delphinoids; it has about two complete turns with a well-developed secondary lamina that extends for approximately one full turn. In the basal turn, the scala tympani is not greatly expanded, and the vestibule is narrow and curved. The holotype petrosal of *M. morani* was imaged with a voxel resolution of 57 mm, and a referred petrosal of H. calvertense with a voxel resolution of 82 mm. The high quality 3D reconstructions we developed, and the morphologies they display, emphasize the utility of this nondestructive technology.

Wednesday 1:30

REMOVING THE SPECIES-AREA EFFECT FROM PALEODIVERSITY ESTIMATES

BARNOSKY, Anthony, CARRASCO, Marc, DAVIS, Edward, TAUSCZIK, Yla, Univ.of California Berkeley, Berkeley, CA

Investigators have long recognized that the species-area effect, whereby more species accumulate in a regular manner as the geographic sampling area increases, can provide a powerful bias in estimating species richness through time. However, it has been difficult, in some cases impossible, to correct for the species-area effect in time-series of paleodiversity estimates because (1) the requisite geographic information is hard to draw out of paleontological databases as they are traditionally compiled and presented; and (2) the databases are seldom linked to mapping software that allows easy calculation of the geographic area encompassed by samples in each time bin. In turn, this complicates understanding the relationship between mammalian evolution, biogeography, and climate change. We used the MIOMAP database of western North American mammals to overcome these difficulties and as a case study to assess the extent to which species-area considerations might influence estimates of paleodiversity changes through time. For each of 15 time bins ranging in age from earliest Arikareean to latest Hemphillian, species lists were compiled for the whole western USA and for subsets of geographic areas within the USA, and rarefied to standardize for sample size. We also calculated diversity using boundary-crossing algorithms. The geographic area encompassed by each set of samples was calculated by plotting the points using the MIOMAP mapping facility, and then using Arc/Info and ImageJ to determine the area of the smallest polygon that would surround all of the samples per time bin. Counts of rarefied species as compared to the geographic areas from which the samples were obtained revealed a strong species-area bias; when that was accounted for, only a few of the peaks and valleys in the diversity curves that might signify a biotic event remained. Diversity-counts based on boundary-crossing methods are more difficult to compare in a straightforward way with sampling areas, but the rarefaction results suggest boundary-crossing estimates also are subject to species-area considerations.

Saturday 9:45

***CHINSHAKIANGOSAURUS* AND THE EARLY EVOLUTION OF HERBIVORY IN SAUROPOD DINOSAURS**

BARRETT, Paul, The Natural History Museum, London, United Kingdom; UPCHURCH, Paul, Univ. College London, London, United Kingdom; XU, Xing, American Museum of Natural History, New York, NY; ZHAO, Xi-Jin, IVPP, Beijing, China

Cranial material of the earliest sauropods is rare, marring investigations into the early evolution of the group and obscuring the transformation of the generalised 'prosauropod' skull, suited to omnivory/herbivory, into that of basal eusauropods reliant on high-fibre herbivory. The holotype and only specimen of *Chinshakiangosaurus chunghoensis* (Fengjiahe Formation; Lower Jurassic; Yunnan, China) includes a well-preserved dentary (with unerupted teeth) that offers new information on the sequence of character acquisition in the origin of the basal sauropod feeding mechanism. Re-examination of the dentary reveals that it possesses an unusual combination of 'prosauropod' and 'sauropod' character states. Previous workers regarded *Chinshakiangosaurus* as a melanorosaurid prosauropod, but cladistic analysis places this taxon as one of the most basal sauropods known currently. Mapping of dentary and dental characters onto the most parsimonious topologies indicates that basal sauropodomorphs (traditional prosauropod taxa) possessed a fleshy cheek that attached to the mandible along a marked ridge, and that the same structure was present in the most basal sauropods. The early sauropod skull developed a lateral plate that reinforced the bases of the tooth crowns labially, had wrinkled tooth enamel, and a concavity on the mesial portion of the lingual part of each crown, while retaining a fleshy cheek and a relatively weak symphysis. More advanced sauropods (eusauropods) lost the cheek, perhaps in order to increase the gape of the jaws in response to a change in feeding style that involved collection of larger quantities of poor quality foliage, and stabilised the symphysis in concert with greater reliance on tooth occlusion during food processing.

Student Poster Session

INTERSPECIFIC SIMILARITIES IN LINES OF ARRESTED GROWTH IN TIBIAE OF *MAIASAURA PEEBLESORUM*

BAZIAK, Brian, Museum of the Rockies, Bozeman, MT

The camposaur bone bed of the upper middle Two Medicine Formation (mid-Campanian) near Choteau, Montana, has yielded elements of many individuals of the Late Cretaceous hadrosaurid *Maiasaura peeblesorum*. Previous histological studies of these bones have shown that the number of lines of arrested growth (LAGs) varies between skeletal elements in the body. Sub-adults around 4.7 meters in length show four to five in the humerus, three in the ishi-

um, two in the ulna, two in the metatarsal, one or two in the femur, one in the fibula, and two in the tibia. Other research has shown that the number of LAGs can even vary longitudinally along the bone. This evidence has been used to suggest that LAGs, while they can be used for comparative age assessments, are not reliable in giving exact ages in dinosaurs.

Histological sections were taken at the same three spots (the proximal, mid-shaft, and distal regions of the diaphysis) of two sub-adult *Maiasaura* right tibiae of the same size (670 and 680mm long, 200 and 205 mm mid-shaft circumference). This was done to compare how similar the microstructures, especially the LAGs, might be. It was found that the two bones are histologically similar. Both individuals showed two LAGs which show signs of resorption. The spacing between the LAGs, and the spacing between the last LAG and the surface of the bone are very similar. Most areas of the bones have circumferential osteons, with primarily longitudinal osteons immediately periostial to a LAG before switching back to circumferential osteon growth. In the most recent growth, they both showed longitudinal osteons on the anterior side, and radial osteons on the posterior side in the mid-shaft region.

Saturday 10:30

PHYLOGENETIC POSITION AND BIOGEOGRAPHIC SIGNIFICANCE OF *SUBENGIUS MENGI* (MAMMALIA, CARPOLESTIDAE), THE OLDEST ASIAN PLESIADAPIFORM

BEARD, K. Christopher, Carnegie Museum of Natural History, Pittsburgh, PA; NI, Xijun, and WANG, Yuanqing, Inst. Vertebrate Paleontology & Paleoanthropology, Beijing, China; GEBO, Daniel, Northern Illinois Univ., DeKalb, IL; MENG, Jin, American Museum of Natural History, New York, NY

Plesiadapiforms are relatively common and diverse components of early Cenozoic mammal faunas from North America and Europe. In contrast, the Asian record for this group remains fairly meager. By far, the most thoroughly documented Asian plesiadapiform clade is the otherwise North American family Carpolestidae. Three taxa of Asian carpolestids, *Chronolestes simul*, *Carpocristes oriens*, and *Subengius mengi*, have been described to date. *Chronolestes* and *Carpocristes* co-occur as part of the Bumbanian Wutu local fauna from Shandong Province, China. *Subengius* is known only from the Gashatan Subeng local fauna of the Erlian Basin, Inner Mongolia. Although the carpolestid status of *Carpocristes* and *Subengius* is uncontested, the phylogenetic position of *Chronolestes* as a very basal member of this clade has been disputed.

In contrast to *Chronolestes* and *Carpocristes*, which are documented by relatively complete upper and lower dentitions, the anatomy of *Subengius* remains poorly known because its published hypodigm is limited to eight isolated teeth. Additional specimens of *Subengius* were recovered by early IVPP expeditions to the type locality and as a result of our fieldwork during 2004. The enhanced hypodigm now includes further examples of tooth loci that were previously poorly known and a maxilla fragment preserving P3-M1 in serial association.

Phylogenetic analysis of all known North American and Asian carpolestids and appropriate outgroups reveals that none of the Asian forms is particularly closely related to each other. Accordingly, there is no correlation between geographic provenance (at the continental scale) and the phylogenetic position of individual carpolestid species. These data imply that carpolestids dispersed repeatedly (at least three times) across Beringia during the Paleocene (and perhaps during the earliest Eocene). These intercontinental dispersal events have the potential to refine biostratigraphic correlation between Asian and North American Paleocene land mammal ages. They may also serve as useful proxy data for tracking climatic warming episodes during this part of the Paleogene.

Wednesday 5:00

MIOCENE-PLIOCENE PALEOECOLOGICAL SHIFTS IN THE AQUATIC HERBIVORE ADAPTIVE ZONE USING DENTAL WEAR

BEATTY, Brian, Univ. of Kansas Natural History Museum, Lawrence, KS

In the late Miocene, faunal shifts have been noted among the few aquatic mammalian herbivores, the Sirenia and Desmostylia. Most notable are the Atlantic/Caribbean faunal turnover from dugong-dominated to trichechid-dominated and the Pacific faunal turnover from desmostylian-dominated to hydrodamaline-dominated faunas. While this faunal composition has been well-documented, the reasons for their occurrence have primarily cited shifts in climate, currents, competition, and dietary constraints all as likely reasons. In an effort to assess the evidence these causes, dental microwear analyses of a sample of key fossil sirenian (*Metaxytherium*, *Corystosiren*, *Trichechus*) and desmostylian taxa (*Desmostylus*) were conducted. These were further compared to an ongoing study of microwear of wide variety modern marine mammals to assess signs of suction feeding, inclusion of food-associated grit in the oral cavity, and benthic substrate composition.

Though this preliminary study does not permit rigorous analysis of all taxa in question (particularly problematic with hydrodamalines to date), results suggest that diets among sympatric dugongids in the Atlantic/Caribbean may have had some dietary niche differentiation permitting their sympatry, as suggested previously by Domning. This suggests that marine plant communities and dugongid utilization of them were more complex than that of the generalized dietary patterns seen with modern *Trichechus*. The dietary differences between Miocene dugongids and Pleistocene trichechids and the overall rarity of sirenian specimens from Florida from 5 Ma to 2 Ma suggests that this represents not a case of competitive exclusion but an early effect of the change of floral communities and water temperature with the closing of the Isthmus of Panama.

The desmostylian/hydodamaline data is still lacking the necessary sample size to make safe conclusions, though at present it appears that by the late Miocene *Desmostylus hesperus* was likely feeding on kelp and occasional hard-bodied invertebrates, which limited its geographic range as climate change drove kelp distribution northward.

Wednesday 5:45

PATTERNS OF LIMB EVOLUTION IN THE NON-MAMMALIAN SYNAPSIDS

BECK, Allison, Univ. of Chicago, Chicago, IL

The Synapsida encompasses living mammals and all of their extinct ancestors, and the fossil record of this group documents numerous changes reorganizing the primitive tetrapod skeleton. In particular, the limbs and girdles of these taxa went from obligate sprawling posture to something much more upright, similar to what we see in the modern opossum. This change was most likely accomplished by a series of increasingly upright intermediates. According to some, the forelimb was morphologically stagnant throughout much of synapsid evolution, showing significant changes only at the level of advanced cynodonts. Phylogenies based predominantly on craniodental characters indicate a large morphologic gap between the postcranial skeletons of the most primitive synapsids, the pelycosaurs, and the first therapsids. Additionally, it appears that synapsids showed a reduction in size as they became more advanced, but current methods of quantifying trends have not been applied to this question. I tested these hypotheses by examining morphologic variation in a temporal context, using clade rank as well as relative age to track change.

Linear measurements of 64 variables were collected on the limb and girdle bones of 169 non-mammalian synapsids. Because associated material is rare among Permo-Triassic material, limb elements were analyzed individually. There were 5-12 linear variables for each limb element. Principal components analysis was used to identify morphologically similar taxa for each limb element, and then taxa were binned by clade rank and age rank. The results show that forelimb morphology (represented by the humerus) was changing more rapidly than previously thought, but a slight lag relative to the hindlimb (represented by the femur) is affirmed. These results also support the concept of a morphologic gap between the earliest synapsid groups. Pelycosaurs are significantly more sprawled and have more robust and stocky limbs than the early therapsids. Finally, both humerus length and femur length exhibit an overall size decrease correlated with phylogenetic rank.

Friday 1:30

BIOSTRATIGRAPHIC SURVEYS IN THE SIWALIK SEQUENCE OF PAKISTAN: A METHOD FOR STANDARDIZED SURFACE SAMPLING OF THE VERTEBRATE FOSSIL RECORD

BEHRENSMEYER, Anna, Smithsonian Institution, National Museum of Natural History, Washington, DC; BARRY, John, Harvard Univ., Cambridge, MA

A significant proportion of the vertebrate record consists of fragmentary specimens that are widely dispersed across eroding outcrops. Standardized surface sampling of these fossil assemblages can provide information on biostratigraphy, taphonomy and paleoecology that may not be available from more traditional approaches to paleontological collecting. These surveys have been used in the Miocene Siwalik sequence of northern Pakistan since 1979 to better define important faunal appearance and extinction events and to learn more about the taphonomy and overall productivity of highly fossiliferous fluvial deposits. The surveys recorded all bones encountered on walking transects in superimposed, well-exposed stratigraphic intervals delimited by strike valleys between tilted sandstones. High quality or informative specimens were collected, and dense patches of fossils were designated as formal localities and treated separately. The resulting survey data permit analysis through time of variables such as fossil productivity per search hour, proportions of different skeletal parts and vertebrate groups, and ratios of abundant mammal families such as Equidae and Bovidae. Survey data compliment other types of paleontological information about faunal evolution in the Siwalik sequence and provide new insights on biotic vs. environmental correlates of change in the abundances of particular groups through time. This approach compliments and expands upon other field sampling strategies used to address questions such as change in dinosaur diversity near the end of the Cretaceous. The methodology can be adapted for different geological contexts, outcrop topographies and fossil frequencies. Increased application of this approach could help reveal relationships of depositional systems and taphonomic processes in the vertebrate record and provide a basis for comparing fossil productivity, skeletal part ratios, and faunal patterns in widely different sequences and time periods throughout the Phanerozoic.

Wednesday 5:15

USE OF AN EXTANT PHYLOGENETIC BRACKET FOR PALEOECOLOGICAL RECONSTRUCTIONS

BELL, Christopher, Univ. of Texas Austin, Austin, TX

The use of an Extant Phylogenetic Bracket as an approach to anatomical reconstructions of extinct organisms provides powerful insights into soft-anatomical features that otherwise would be difficult or impossible to elucidate. Use of the bracket for paleoecological reconstructions is less common, especially among Quaternary paleontologists working with fossils that share close phylogenetic and temporal affinity with the extant biota.

Traditional approaches to Quaternary paleoecology rely predominantly on the assumption that modern behaviors, habitat tolerances, and other parameters observed in the living species have been effectively unchanged throughout the evolutionary stem leading to extant populations. Indeed, it is sometimes stated that paleoecological reconstructions in the Quaternary would be difficult or impossible without making such assumptions of stability. In many cases these assumptions amount to insufficiently justified attempts to apply basic precepts of uniformitarianism in inappropriate biological contexts.

The use of an extant phylogenetic bracket for paleoecologic reconstructions reduces some of the assumptions of stability, replacing them with inferences derived from interpretation of homologous behaviors and tolerances inherited from common ancestors. Preliminary exploration of the potential benefits and limitations of this approach for Quaternary faunas suggests that it holds some promise, but that it will not provide a universal panacea for potential problems arising from the traditional approach.

Examples of the application of this technique for paleoecological reconstructions derived from mustelid carnivorans, ochotonid lagomorphs, and arvicoline rodents serve to demonstrate the extremes of benefits and limitations of this approach.

Wednesday 4:45

AN EXCEPTIONALLY CONSERVATIVE MOSASAUR FROM THE SANTONIAN OF KANSAS AND ITS PHYLOGENETIC RELEVANCE WITHIN MOSASAURIDAE

BELL, Gorden, National Park Service, Salt Flat, TX; POLCYN, Mike, Southern Methodist Univ., Dallas, TX

In 1876, B. F. Mudge collected a well-preserved mosasaur possibly in Gove County, Kansas. The specimen preserves a partial skull missing the mandibles and also preserves a considerable portion of the vertebral column but no girdle or limb elements. It was originally cataloged in the Yale Peabody Museum collection as *Clidastes?* sp. but has now been prepared for study, revealing an unusual suite of plesiomorphic and apomorphic characters that challenge referral to any know sub-family of mosasaur. The narrow elongate skull possesses 23 teeth in the maxillae, 16 smaller pterygoid teeth, and 5 tooth positions in the fused premaxillae. All teeth possess smooth enamel surfaces lacking carinae and are slender and slightly to moderately recurved. The internarial bar of the fused premaxillae is separated from the frontal by paired nasal bones. The septomaxillae enclose the anterior portion of the external nares, forming a continuously exposed lateral surface with the maxillae and the internarial bar and extending posteriorly to at least the 13th tooth position. The parietal rami terminate in a loose vertical contact with the supratemporal indicating retention of the plesiomorphic metakinetic joint. The quadrate possesses a well-developed suprastapedial process, deeply bowled conch, thin walled ala, posteroventral ascending tympanic rim, and convex mandibular articulating surface. Phylogenetic analysis indicates a basal position in Mosasauridae. Calcareous microfossils preserved in the matrix with the specimen are of Middle Santonian age. The suite of morphological characters present in the new taxon and its apparent rarity relative to the numerous finds of other Santonian mosasaurs in Kansas and elsewhere suggests exploitation of an ecological niche different from these more numerous forms and potentially represents a new clade of mosasaurs.

Student Poster Session

TRENDS IN FOSSIL RECORD COMPLETENESS: CORRELATING AGE AND LAND AREA WITH ANCIENT ISLAND HERPETOFAUNAS

BENNETT, III, G., Shenandoah Valley Discovery Museum and George Mason Univ., Winchester, VA

The species-area curve expresses the observation that taxonomic diversity generally increases with geographic area. When anthropogenically introduced species are accounted for, the insular nature of islands and other refugia offer a relatively uncontaminated picture of faunal richness within specific boundaries. Log-log plots of species richness against land area of islands with specific climatic regimes yield regressions with slopes approaching 0.30. Elevation is poorly correlated to diversity.

The herpetofaunas from nearly 100 modern islands with tropical, seasonal climatic regimes were tabulated to create a species-area curve of slope 0.29. A second set of nine ancient island herpetofaunas from analogous climates was compiled ranging in age from 65 Ma to 500 years BP. Published area estimates for these islands range from 7 to 75,000 sq km. The species-area equation was applied by using the slope of the analogous modern island species-area curve, and the resulting expected herp richness ranges from 9 species on ancient Aguiguan, Marianas Islands (7 sq km), to >100 species on ancient Hateg island (~75,000 sq km).

Completeness indices (CI) for each island were calculated as a ratio of known fossil taxa to expected diversity. The completeness of the paleoherpetofaunal record on the selected islands was found to decrease with age, thereby quantifying a general paleontological and geologic trend of poorer data with age. Additionally, the CI is inversely correlated to island size, likely indicating a collecting bias caused by the prohibitive nature of exhaustive collecting over large areas. As exemplified by a single study of early Holocene sites on several of the Marianas Islands which yielded an average CI of 0.82, more recent localities of limited geographic extent can produce a clearer picture of ancient faunal structure. Thus, completeness indices can suggest the extent to which further collecting efforts will increase paleofaunal diversity numbers, and can be particularly helpful in the case of large islands and refugia. Future applications may include determining the CI of continental lithostratigraphic units of established geographic extent.

Poster Session A

AN ALLOMETRIC ANALYSIS OF FOSSIL AND EXTANT FELIDS

BENOIT, Matthew, Yale Univ., New Haven, CT

Evolutionary morphological change can occur through shifts in development, resulting in changes to allometries that are discernible through morphometric measurements. These allometric shifts reveal clues about how the ontogenies of different taxa have changed throughout their evolutionary history.

Members of Felidae show both conservative and highly variable morphological features, making them ideal for an examination of allometric shifts through evolutionary history. Morphometric measurements of craniodental features were obtained from over one thousand fossil and extant felid specimens with a broad taxonomic range (including several machairodont taxa). These measurements were gathered using 3D digitization. Using skull length as the allometric baseline, bivariate regressions (major axis and reduced major axis) were performed to discover the robust and informative allometric relationships.

This analysis revealed character-specific allometric relationships. While some of these allometric relationships remained consistent throughout the Felidae, others indicated ontogenetic shifts. When mapped onto an independently generated cladogram, some allometric relationships are strongly conserved phylogenetically, while others appear in phylogenetically disparate groups, indicating convergence.

Wednesday, Preparator Poster

MUSEUM COLLECTION MANAGEMENT-IS IT REALLY WORTH DIGGING IN A NATIONAL PARK?

BENTON, Rachel, Badlands National Park, Interior, SD; ELDER, Ann, Dinosaur National Monument, Dinosaur, CO

National Parks and Monuments often preserve some of the best examples of fossil producing strata in the world. Yet researchers are sometimes leery of pursuing collecting within these Federal borders. Because park areas were established to protect fossil resources for all citizens and for future generations, some researchers wonder if adhering to the well defined guidelines necessary to collect or store specimens from park lands in their repositories is worth the effort. The National Park Service (NPS) Research Permit and Reporting System provides a link between the Research Community and NPS management by providing access to scientifically significant specimens collected on NPS lands. NPS permitting guidelines and museum policy require proper curation and storage of specimens for a research project, which creates an important connection between NPS Management and the associated collections storage facility. Some of these requirements include: entering specimen data into the NPS curatorial database, completing annual inventories, and archiving field notes. This mutually beneficial partnership between the NPS and the cooperating museum requires open communication and understanding in order to be successful. Case studies involving Badlands National Park, the South Dakota School of Mines and Technology and the Pine Ridge Indian Reservation provide important examples on developing a positive relationship between National Park Service Units and cooperating museums. Specific NPS tools and procedures will be discussed including the computerized collection management system ANCS+, accessioning and cataloging procedures and the annual inventory of museum property.

Wednesday, Preparator Poster

TRAVELING WITH ELMER

BERGWALL, Lisa, SHINYA, Akiko, The Field Museum, Chicago, IL

Specimen exhibition in traveling exhibits is becoming a staple of museum operations. These exhibits are developed to appear at many venues over a period of a few years. Because specimens will be subjected to repeated packing and unpacking and transported to multiple locations, special considerations need to be made when dealing with fragile and rare fossils. The Field Museum's 'Elmer' a tyrannosaurid specimen was recently slated to join one such exhibition. In considering this loan, it was important to come up with a method to stabilize this fragile specimen and provide it with a casing that would serve as both transport cradle and exhibition display.

This specimen includes the posterior half of the skeleton and is unmounted. It was first cleaned up and consolidated to provide the best exhibit quality and stability for travel. Various methods were then devised in order to provide a solid cradle that would provide some cushion to shock and vibration, while also having an aesthetic quality suitable for display. This necessitated experimentation before a practical and acceptable solution was reached.

Poster Session B

A GIGANTIC PHORUSRHACID (AVES: GRUIFORMES) FROM THE LATE MIOCENE OF PATAGONIA

BERTELLI, Sara, American Museum of Natural History, New York, NY; CHIAPPE, Luis, Natural History Museum of Los Angeles County, Los Angeles, CA; TAMBUSSI, Claudia, Museo de La Plata, La Plata, Argentina

We report the discovery of a new, large phorusrhacid (Aves: Gruiformes) from the Late Miocene of northwestern Patagonia (Argentina). The new specimen consists of a partial skull

and a left tarsometatarsus recovered from continental deposits of the Collon Cura Formation at Comallo, a small village in the Argentine province of Rio Negro. Preliminary comparisons indicate that the new specimen is morphologically most similar to taxa included within Phorusrhacinae but that it is also a new taxon. Because complete skulls of phorusrhacine birds are very rare, the study of the nearly complete skull of the new "terror bird" is crucial for understanding the evolution of these gigantic birds. Based on the size of the skull and tarsometatarsus, the new fossil is the largest known phorusrhacid—even larger than the massive brontornithines—and yet one with a lightly built skeleton, well specialized for active hunting. The new specimen also represents the only late Miocene occurrence of Phorusrhacidae from Patagonia and the southernmost record of the group for this time.

Poster Session A

ECHMATEMYS AND THE EVOLUTION OF THE BRAINCASE IN TESTUDINOID TURTLES

BEVER, Gabe, Univ.of Texas Austin, Austin, TX

The ossified neurocraniun and closely associated structures of the basicranium long have been the subject of considerable interest among anatomists because of their close association with the central nervous and circulatory systems. This area of the skull traditionally is an important source of character data for diagnosing the major clades of turtles, but is rarely the subject of detailed study between more closely related taxa. Complicating investigations at more refined taxonomic levels is intraspecific variation and the difficulty of examining potentially informative characters in articulated and fossil specimens where internal details largely are obscured.

The recent publication of a series of cladistic hypotheses based on morphological, molecular, and behavioral characters marks a significant increase in the interest among researchers regarding the phylogenetic relationships and evolutionary history of the Testudinoidea, a diverse group of cryptodiran turtles that includes the pond turtles (Emydidae and Bataguridae) and the tortoises (Testudinidae). These recent studies fail to consider the implications of fossil specimens, and the only morphological character that regularly is drawn from the braincase is the batagurid process, a commonly misunderstood structure that initially was used to separate batagurids and emydids. I used high-resolution x-ray CT in combination with detailed studies of intraspecific variation in extant turtles, to investigate the implications of braincase structure in *Echmatemys*, a common pond turtle in the Paleogene of North America, for our understanding of testudinoid history. *Echmatemys* represents one of the best-preserved early testudinoids and therefore an important taxon for understanding early clade divergences and morphological diversification within the Testudinoidea. The study of Echmatemys reveals the importance of fossils to our understanding of testudinoid history and that the braincase is a largely untapped resource for testudinoid systematics.

Saturday 2:45

EVIDENCE FOR A PLIO-PLEISTOCENE STRENGTHENING OF THE ASIAN MONSOON AND ITS IMPORTANCE TO THE UNDERSTANDING OF MAMMALIAN EVOLUTION IN NORTHWEST CHINA

BIASATTI, Dana, WANG, Yang, Florida State Univ. and National High Magnetic Field Laboratory, Tallahassee, FL; DENG, Tao, Chinese Academy of Sciences, Beijing, China

The uplift of the Tibetan Plateau during the Cenozoic Era is considered to be the driving force in the development of the Asian monsoons, and the timing of this development is crucial to the understanding of mammalian evolution in China. The physical barriers created by the plateau are also important to the understanding of the migrations of mammals in the region. Linxia Basin, located on the northeastern margin of the Tibetan Plateau, has produced an abundance of well-preserved horse fossils. Bulk and serial stable carbon and oxygen isotopic analyses of tooth enamel carbonate from 15 individuals within the genera *Equus* and *Hipparion*, ranging in age from 11.5 to 0.05 Ma, have allowed reconstruction of the ancient climates and ecologies of those individuals. The bulk $\delta^{13}C$ values of tooth enamel carbonate from all individuals indicate a primary diet of C3 grasses, with the exception of one individual from 1.2 Ma, that incorporated a considerable amount of C4 grasses in its diet. The serial $\delta^{13}C$ and $\delta^{18}O$ values of tooth enamel from 0.05 and 1.2 million-year-old horses show strong seasonality, while the δ values of all individuals between 2.5 and 11.5 Ma do not exhibit similar evidence of seasonality. This apparent seasonality after 2.5 Ma may be related to the strengthening of the summer monsoon in northwest China, which would suggest that the Tibetan Plateau did not reach its current elevation until at least the late Pliocene. The development of this high barrier at a time much later than generally accepted may help to explain why the Miocene-aged *Hipparion* fauna that lived between 500 and 1000 m elevations in China is also found at 4200 m in the high Himalayas.

Poster Session B

FOSSIL RATITE EGGSHELL DISCOVERIES FROM THE LATE MIOCENE OF ARABIA: OOTAXONOMY, BIOSTRATIGRAPHY, AND BIOGEOGRAPHY

BIBI, Faysal, Yale Univ., New Haven, CT; SHABEL, Alan, KRAATZ, Brian, Univ. of California, Berkeley, Berkeley, CA; STIDHAM, Thomas, Texas A&M Univ., College Station, TX

Fossil ratite eggshell fragments recovered from upper Miocene Baynunah Formation, United Arab Emirates, are assigned to *Diamantornis laini* and an aepyornithid-type. *D. laini* has only been previously described from the late Miocene of Namibia, while aepyornithid-type eggshell has been reported from many Neogene deposits in Eurasia and Africa. The new fossils are the first eggshells of this age to be described from the Arabian Peninsula, and they constitute an informative addition to the faunal assemblage recovered from the Baynunah Formation. The biostratigraphic utility of certain forms of fossil eggshell has been proposed and, to some degree, demonstrated. The discovery of *D. laini* from the Baynunah Formation constitutes the first report of this ootaxon outside Africa, and its presence supports the concept of an Afro-Arabian eggshell biostratigraphy. Fossil mammals recovered from the Baynunah Formation have suggested an age of somewhere between 6 and 8 Ma. A probable occurrence of *D. laini* from the Upper Member of the Nawata Formation, Lothagam, is dated to somewhere between 6.5 and about 5 Ma. Confirmation of the diagnosis of the Lothagam eggshell specimens would imply the Baynunah fauna may be younger than was previously thought. Both the Baynunah and Lothagam records suggest a younger age assignment than that defined for *D. laini* on the basis of the biostratigraphy of the Tsondab sequence of Namibia (8-10 Ma). The addition of *D. laini* to the Arabian late Miocene faunal list strengthens this region's biogeographical affinity to Africa, specifically sub-Saharan Africa, to the exclusion of Europe and Asia. The aepyornithid-type is a less well-known eggshell grade that in morphology resembles *Aepyornis*, the recently-extinct Malagasy elephant bird. Aepyornithid-type eggshell has been reported throughout Miocene and Pliocene sequences in Africa and Asia and its first occurrence may be as old as the Eocene of China. Eggshells grouped on the basis of aepyornithid-type morphologies most likely represent a non-monophyletic assortment united on the basis of characters plesiomorphic for ratite eggshell.

Poster Session A

NEW FINDS AT THE PRICE RIVER II SITE, CEDAR MOUNTAIN FORMATION IN EASTERN UTAH

BIRD, John, CEU Prehistoric Museum, Price, UT

The Price River II site (PR2) has yeilded parts of six individual brachiosaurs and two large nodosaurs over the last 10 years. The PR2 bone-bed was slightly less than 2 meters thick and could be divided into three bone bearing layers. During the 2004 dig season a new layer was discovered above the previously recorded levels bringing the total thickness of the bonebed to 2.5 meters. Initial excavation of the new upper layer produced skeletal material from at least two dinosaurs not found in the lower layers.

Bones of a large (*Sauroposeidon*?) sauropod are represented by a 128cm cervical vertebra and a 153 cm scapula that's missing part of the distal end. The dorsal surface of the vertebra has been eroded but it is nearly double the length of the sixth brachiosaur cervical found in the lower layers. The acromian process of the scapula is less expanded relative to scapulae from the lower levels of the bone-bed. An ornithopod is represented by a 47 cm femur from the very top of the new bone layer. The femur resembles iguanatontid rather than hadrosaur shape.

Wednesday 12:00

PALEOCENE VERTEBRATES FROM THE CERREJON FORMATION, GUAJIRA PENINSULA, NORTHEASTERN COLOMBIA

BLOCH, Jonathan, Univ. of Florida, Gainesville, FL; CADENA, Edwin, Micropaleontologia, Instituto Colombiano del Petro, Bucaramanga, Santander, Colombia; HERRERA, Fabiany, Universidad Industrial de Santander, Bucaramanga, Santander, Colombia; WING, Scott, National Museum of Natural History, Smithsonian, Washington, DC; JARAMILLO, Carlos, Smithsonian Tropical Research Institute, Balboa, Ancon, Panama

Recently collected fossil plants and vertebrates from the Cerrejon Formation, in the Cerrejon coal mine of northeastern Colombia, are the first known from the Paleocene Neotropics. Analysis of pollen and spores indicates a late Paleocene age for the deposit. Exquisitely preserved plants were recovered from mudstones and sandstones at several levels. The flora is composed of many angiosperm tropical lineages including Leguminosae, Moraceae, Euphorbiaceae, Lauraceae, Sapotaceae, Araceae, and Palmae. Leaf shape and size are also consistent with a tropical forest. Well-preserved vertebrates were recovered from three levels in the mine, all on large dip-slopes that represent the under-clay of previously excavated economic coal seams.

Most of the vertebrates found to date have been turtles. These include thirty individuals, represented in part by nearly complete carapace and plastron, of at least two new taxa of pelomedusoid side-necked turtles. A lower jaw and a number of forelimb elements (including coracoid, humerus, and scapula) have also been recovered. The sample represents a range of sizes with 6 very large (150-170 cm at the midline of the shell), 18 medium (50-150 cm), and 6 smaller (<50 cm) individuals. While most of the turtle specimens seem to belong to the extinct family Bothremyidae (known to span the Cretaceous through Miocene of North and South America, Africa, Europe, and Asia), the lower jaw and two of the carapaces are most-likely attributable to the extant family Podecnemidae (upper Cretaceous-Recent of South America, Europe, Africa, and Madagascar). Also recovered from the same localities are five individuals of a new dyrosaurid crocodyliform. The specimens include two relatively complete crania, several lower jaws (two with teeth), isolated teeth, and numerous postcrania.

These specimens not only allow for important insights into the phylogeny and paleobiogeography of side-necked turtles and dyrosaurs, but also demonstrate a strong potential for recovery of more vertebrate fossils, including mammals, with future fieldwork allowing for

insights into the vertebrate fauna of the oldest known Neotropical rainforests 60 million years ago.

Saturday 1:30

INTERRELATIONSHIPS AND EVOLUTIONARY HISTORY OF ANASPID FISHES

BLOM, Henning, Subdepartment Evolutionary Organismal Biology, Uppsala, Sweden

Very few attempts have been made to evaluate the interrelationships of anaspid fishes. No satisfactory phylogenetic analysis has been undertaken using adequate data matrices consisting of a wide range of informative characters. This is the result of a poor fossil record with few well-preserved articulated specimens. In fact, beautifully preserved specimens of well-known taxa such as *Birkenia* and *Rhyncholepis*, respectively from the Silurian of Scotland and Norway, yield very few anatomical details.

Recent studies on the dermal skeletons of anaspids have established a taxonomic framework based on both articulated material and disarticulated scales and platelets. This has dramatically increased our knowledge of the taxonomy and morphology of the anaspids as well as greatly refined ideas on the stratigraphical distribution of these agnathan fishes.

The lack of knowledge of a sister-group to anapids is one of the main difficulties in reconstructing anaspid phylogenies. It prevents all accurate out-group comparisons which is a necessary condition to understand the polarity of character changes. This problem is related to the scarcity of variable and well-understood characters present in both the Anaspida *sensu stricto* and other potential taxa or groups of taxa among stem-group gnathostomes.

A new hypothesis of anaspid interrelationships is here proposed. It includes all genera known from body fossils and some genera only known from disarticulated material. This new phylogeny, improved by recent data and based on an adequate out-group, is more consistent with the refined stratigraphical record than previous attempts.

Poster Session A

***COPEMYS* (RODENTIA, CRICETIDAE) FROM THE MIOCENE FLEMING FORMATION, FORT POLK, LOUISIANA**

BOARDMAN, Grant, Louisiana State Univ., Baton Rouge, LA

Over 1800 catalogued specimens of *Copemys* have been recovered from the nine Miocene (Barstovian) sites in the Fleming Formation of Fort Polk, Louisiana. This material includes all upper and lower molars (M1-3/m1-3). Though numerous incisors are present they are not included in this number as they cannot reliably be distinguished from those of other similar-sized rodents at this time. Distribution of morphological variation and size clustering support the hypothesis of a single species throughout Fort Polk. Statistics show low variability in confirmed terrestrial sites and more heterogeneity in the single marine site (TVOR SE). At TVOR SE, the statistics support the idea of a storm contributing both marine and terrestrial components to the deposit. On average Fort Polk *Copemys* are smaller than others previously documented, such as *C. pagei* and *C. tenuis*, and may represent a new species.

Saturday 10:30

A LOBE-FINNED FISH SHEDS NEW LIGHT ON THE ORIGIN OF THE TETRAPOD PELVIC GIRDLE

BOISVERT, Catherine, Uppsala Univ., Uppsala, Sweden

One of the most important morphological transformations required for the transition to land is the transformation of paired fish fins into tetrapod limbs. The evolution of the distal part of the appendage, more specifically the digits, has recently received a lot of attention. However, the study of the evolution of its support structure has been largely ignored.

The review of a Devonian lobe-finned fish sheds light on the transformation of the pelvic girdle from a small unipartite element (in sarcopterygian fishes) to a tripartite weight-bearing structure associated with the vertebral column in tetrapods.

Elpistostegalian fishes are uncontestably the sister-taxon to tetrapods. They make the link between tristichopterid sarcopterygian fish like *Eusthenopteron* and early tetrapods such as *Acanthostega* and *Ichthyostega*. They are only known from two Frasnian genera: *Panderichthys* from the East European platform and *Elpistostege* from the Escuminac formation of Canada. Here, I describe the only known partial pelvis and articulated pelvic fin endoskeleton of *Panderichthys rhombolepis*. The pelvic girdle is very small in comparison to the pectoral girdle and to the rest of the body. The pelvic girdle is very fish-like, especially when comparing it to *Eusthenopteron*. The pelvic fin is well preserved and the presence of muscle scars as well as processes for muscle attachment allow comparison with *Eusthenopteron*, *Acanthostega*, *Ichthyostega* as well as modern animals such as salamanders, lungfishes and the coelacanth *Latimeria*. This not only gives insight into the locomotion and function of fins in *Panderichthys* but also helps in a mechanistic interpretation of the evolution of the tetrapod pelvic girdle from sarcopterygian fish ancestors.

Poster Session A

PRELIMINARY INVESTIGATION OF THE WILLOW TANK FORMATION (ALBIAN) OF SOUTHERN NEVADA

BONDE, Joshua, VARRICCHIO, David, Montana State Univ., Bozeman, MT

The Willow Tank Formation of southern Nevada was deposited in the Sevier foreland during the Early Cretaceous. Presence of the tree-fern *Temskya* and radiometric dates from the 1970s established an Albian age for the formation. The Willow Tank Formation consists of two members, a basal conglomerate and a fluvial/lacustrine mudrock. Initial finds include several taxa of freshwater turtles (*Naomichelys*, baenid, trionychid?), crocodilian scutes and teeth, two theropod tooth morphotypes, Iguanodontid teeth, ornithopod teeth, fish scales, a lung fish tooth plate and a number of coprolites, some of which contain fish scales. Further investigations are in progress in this region in order to study the taphonomy and microvertebrate remains of the formation.

The terrestrial Albian record of western North America is principally known from the Cedar Mountain Formation of Utah and the Cloverly and related formations of Montana and Wyoming. Cretaceous vertebrates of Nevada are poorly represented, with the exception of a few elements collected from the Newark Canyon Formation of northeastern Nevada. The Willow Tank Formation adds new data to this poorly known period of time. These new finds extend the Albian terrestrial record farther south and closer to the Sevier fold-thrust front. This fauna along with the depositional context in which they are found will aid in the ecologic reconstruction of southern Nevada during the Early Cretaceous.

Poster Session A

SCAPULAR POSITION AND FUNCTION IN THE SAUROPODOMORPHA (REPTILIA: SAURISCHIA)

BONNAN, Matthew, Western Illinois Univ., Macomb, IL; PARRISH, J. Michael, Northern Illinois Univ., DeKalb, IL; STEVENS, Kent, Univ. of Oregon, Eugene, OR; GRABA, Jeanne, Northern Illinois Univ., DeKalb, IL; SENTER, Phil, Lamar State College at Orange, Orange, TX

The feeding range of sauropod dinosaurs was constrained by the height of the base of the neck, which was itself constrained by the nature of the articulation between the scapulocoracoid and the trunk. Sauropod scapulocoracoid orientation and mobility remain controversial because no tight, bony articulations were present between these bones and the vertebral column, and few osteological markers are available to constrain shoulder orientation. Previous hypotheses of scapulocoracoid position in sauropods were inferred from death poses or through simple goodness-of-fit criteria, but were not developed within a phylogenetic context. We examined the scapulocoracoids, ribcage, and sterna of several neosauropods, basal sauropodomorphs, extant archosaurs, and lepidosaurs in order to: 1) assess the soft tissue contributions to scapulocoracoid orientation and mobility; and 2) determine osteological correlates associated with shoulder position. Archosaurian scapulae vary in position from nearly parallel to the vertebral column (birds) to nearly vertical (crocodylians) but in all cases the scapular blade is nearly parallel to the top of the neural spines along its distal extent, suggesting a similar orientation in dinosaurs. Positions and homologies of the musculature supporting the scapulocoracoid were conservative within extant taxa. Scapulocoracoid movements against the sternum, affected by the Mm. serratus, levator scapulae, and sternocoracoideus groups, become more restricted in archosaurs, particularly in birds. Flattened areas on the external surfaces of the dorsal ribs ("facets") are present in birds, sauropods, and other dinosaurs but are absent in crocodylians. Dissection and CT-scan data show that the scapular blade bows away from the dorsal ribs in Alligator whereas it lies in close contact with the dorsal ribs in birds, which may explain the lack of "facets" in crocodylians. Rib facets correlate with the neutral orientation of the scapular blade in birds. We suggest that the presence of rib "facets" and the more restricted movements of the scapulocoracoid in diapsid outgroups support a constrained, sub-vertical orientation of the pectoral girdle in sauropods.

Poster Session B

ON THE PRESENCE OF THE HIPPARIONINE HORSE *CORMOHIPPARION* FROM THE MIDDLE MIOCENE OF THE STATE OF OAXACA, SOUTHEASTERN MEXICO

BRAVO-CUEVAS, Victor, Universidad Autonoma del Estado de Hidalgo, Pachuca, Mexico

For North America the genus *Cormohipparion* ranges from latest Barstovian to late Blancan (*ca.* 12 to 2 Ma), it was widespread in the Great Plains and Gulf Coastal Plain during the Clarendonian, but rare through the Hemphillian and Blancan.

Paleontological work carried on the late Early Barstovian El Camaron Formation K-Ar dated 15 Ma in the Subisthmian Region of the State of Oaxaca, allowed to recover a set of isolated upper and lower horse teeth. These specimens display the diagnostic dental character combination of *Cormohipparon* as follows: estimated upper tooth row length about 135 mm, unworn molar crown height about 45 mm, thick layer of cement on permanent molariforms, long axis of the protocone orientated approximately anteroposteriorly, elongate oval protocone, protocone connection to protoloph during late wear stage, well developed pli caballin branched on premolares and single on molars, complex internal fossette plications, metastyle very well developed, ectoflexid moderately deep, protostylid well developed and initially isolated from the protoconid, rounded labial borders of protoconid and hypoconid.

The recognition of *Cormohipparion* in geocronologically former late Early Barstovian age in Southeastern Mexico, represents the earliest known record of the genus and leads to reinterpret the time and place where occurred part of the hipparionine horse diversification and differentiation. The available information suggests that these evolutionary processes also took place in southern North American tropical regions.

Saturday 10:15

A NEW LOOK AT TETRAPOD MIDDLE EAR ORIGINS: SPIRACLE EVOLUTION IN THE TETRAPODOMORPHA

BRAZEAU, Martin, Dept of Evolutionary Organismal Biology, Uppsala, Sweden; AHLBERG, Per, Evolutionary Biology Centre, Uppsala, Sweden

The stapes of Devonian stem tetrapods traverses a deep and expansive spiracular space homologous with the crown tetrapod middle ear space. These Devonian tetrapods exhibit highly specialized middle ear morphologies, including early adaptations for hearing in *Ichthyostega*. No morphological intermediates are known between the middle ears of Devonian tetrapods and the plesiomorphic condition typified by *Eusthenopteron*. *Panderichthys*, the immediate sister taxon of tetrapods, had previously been dismissed from studies of this problem because its braincase and hyomandibula were believed to be fish-like. A re-examination of *Panderichthys* and Devonian tetrapods shows that substantial modifications to the palatoquadrate accompanied the re-shaping of the spiracular tract of osteolepiforms into the middle ear space of tetrapods. Previous investigations had assumed conservation of these aspects across the fish-tetrapod transition. *Panderichthys* has an essentially tetrapod-like palatoquadrate in which a deepened, flattish metapterygoid region forms a straighter and more expansive lateral wall to the spiracular tract than in *Eusthenopteron.* The hyomandibula has lost its distal portion in an early advance towards a more stapes-like morphology. The expansion of the spiracular space and the modification of the palatoquadrate in *Panderichthys* indicate that the evolution of the tetrapod middle ear morphology began prior to the origin of digited limbs. This further suggests that the early evolution of the tetrapod middle ear space was not related to auditory function. Instead, *Panderichthys* and *Elpistostege* were likely specialized spiracular breathers. This interpretation agrees with their flattened body profile, dorsally directed eyes, and subterminal mouths, a character combination shared convergently with many species of benthic condrichthyans that also employ spiracle breathing.

Poster Session B

THE EARLIEST DISCOVERIES OF *TYRANNOSAURUS REX* IN WYOMING AND THE WEST: *MANOSPONDYLUS GIGAS*, *ORNITHOMIMUS GRANDIS*, AND *DYNAMOSAURUS IMPERIOSUS*

BREITHAUPT, Brent, SOUTHWELL, Elizabeth, Univ.of Wyoming Geological Museum, Laramie, WY; MATTHEWS, Neffra, National Science and Technology Center, Denver, CO

The history of discovery of *Tyrannosaurus rex* dates back to 1874 when A. Lakes found a "Fossil Saurian Tooth" from the Denver Fm. near Golden, Colorado. From this site, G. L. Cannon mentioned a large theropod jaw in 1888. While collecting in the Cretaceous units of eastern Wyoming, J. B. Hatcher found a partial right metatarsal in the Lance Fm. of Lance Creek, Niobrara Co. in 1890. The following year, he found a left femur, tibia, and partial fibula along Alkali Creek, as well as a right ilium also in this area. Marsh identified these Wyoming specimens as *Ornithomimus grandis* in 1896. While E. D. Cope was collecting in the "Laramie Beds" of South Dakota in 1892, he discovered some large "agathaumid ceratopsian" vertebral fragments, which he named *Manospondylus gigas*. *O. grandis* and *M. gigas* represent some of the earliest discoveries of *T. rex*. While prospecting for Wyoming *Triceratops* skulls in 1900, B. Brown and crew found a partial skeleton of a large theropod (AMNH Field #12) on a tributary of Sevenmile Creek. This specimen consisted of the lower jaws and teeth, various cervical and dorsal vertebrae, ribs, and parts of the hips and limbs, as well as numerous dermal plates. Mixed in with this skeleton were the remains of hadrosaurs, ceratopsians, and ankylosaurs. Osborn named this 13% complete skeleton *Dynamosaurus imperiosus* in 1905, in particular because of the osteoderms (which belong to an ankylosaur). Osborn also named *Tyrannosaurus rex* in this paper, based on a preliminary description of a partial skeleton found in the Hell Creek Fm. of Montana by Brown in 1902. Osborn published this paper on Cretaceous carnivorous dinosaurs prior to complete collection and preparation of the *T. rex* specimen, as the Carnegie Museum was also working on a skeleton of a large theropod. This specimen which included the skull, lower jaws, and various vertebrae, ribs, hip and limb bones was found in the Lance Fm. of Niobrara Co., Wyoming along Snyder Creek by O. A. Peterson in 1902. In 1906, Osborn synonymized *D. imperiosus* with *T. rex*. The type specimen of *T. rex* was sold to the Carnegie Museum in 1941 and the skeleton of *D. imperiosus* was sent to London in 1960.

Poster Session A

A NEW MICROVERTEBRATE ASSEMBLAGE FROM THE UPPER JURASSIC MORRISON FORMATION, INCLUDING MAMMALS, THEROPODS, AND SPHENODONTIANS

BRETT-SURMAN, Michael, JABO, Steven, KROEHLER, Peter, CARRANO, Matthew, Smithsonian Institution, Washington, DC; KVALE, Erik, Indiana Geological Survey, Bloomington, IN

In 1997, a new microvertebrate site was discovered in the upper part of the Upper Jurassic Morrison Formation near Shell, Wyoming. The site occurs in a highly weathered, floodplain succession of red and green mottled silty claystone near the top of a ravine. Fossils are concentrated within two distinct layers. The primary layer is dominated by dinosaur eggshell fragments and contains the majority of the vertebrate material. Teams from the Smithsonian Institution began working the site in 1999, and have since excavated a number of matrix blocks from a 2 x 3 m quarry. Numerous specimens were removed directly from the quarry face in the field, and loose samples were dry-screened at the site. Manual and dissolution preparation continues on the collected samples, and has already revealed a rich vertebrate fauna.

Although no intact eggs have been found, the presence of large eggshell pieces, some in close contact with one another, suggest that their source was nearby. Based on eggshell morphology and microstructure, the eggs appear to derive from ornithopod dinosaurs. The well-preserved bone remains are dominated by teeth, limb shafts, and vertebrae. Teeth from a multituberculate, a symmetrodont, and a possible eupantothere hint at a diverse mammalian fauna. Several dinosaur taxa are present, including one theropod tooth with troodontid-like denticles. A sphenodontian is indicated by the presence of associated jaws and cranial elements.

Microvertebrate remains are not common in the Morrison Formation, and this site brings important new information about Late Jurassic mammals and reptiles. The likelihood that little transport has occurred strengthens inferences of taxon associations within at least one type of Morrison environment, and holds the potential for elucidating new paleoecological information as well.

Friday 12:00

BURROWED DINOSAUR BONES: EVIDENCE OF CRETACEOUS OSTEOPHAGOUS BEETLES

BRITT, Brooks, DANGERFIELD, Anne, GREENHALGH, Brent, Brigham Young Univ., Provo, UT

Over 20% of the dinosaur bones at the Lower Cretaceous Dalton Wells site have been burrowed by invertebrates. The burrows occur only on the surfaces of bones and are constructed half in matrix and half in bone. Burrow diameters range from 0.5-18 mm and occur primarily as 1) linear traces following cracks in the bone, 2) isolated sinuous traces, and 3) galleries of intersecting traces. Burrows occur preferentially on articular or broken surfaces. They are less common on laminar bone, where they usually follow cracks. Many burrows are filled with fine bone fragments which we interpret as frass (excrement). The galleries and small bone fragments indicate the bone was used as a source of nutrition.

Some 8% of the bones exhibit planar bioerosive features, or 'facets'. The undulatory surfaces of these facets preserve burrows and frass, demonstrating the facets were produced by consumptive burrowing. Faceting accounts for a substantial loss of bone, in some cases over 6 cm. Multiple faceting may occur, but only on one side of a bone, such as the anterior or posterior surfaces of a femur or humerus. We propose that the facets developed by extensive burrowing of subaerially exposed bone at the bone-substrate contact.

Pairs of fine, convergent grooves (<11 mm long) on burrow walls are interpreted as mandible marks. The length of mandible marks suggests the maker had a contractile body. The burrow networks are similar to the galleries made by extant bark beetles (Coleoptera, Scolytidae) on the woody outer surfaces of timber. Because beetles (coleopterids) are one of the few insects with strongly scleritized mandibulae that could incise bone, it is likely the burrowers were beetle larvae. Likely candidates are members of Silphidae, Scarabaeidae, or Histeridae but non-coleopteran larvae cannot be ruled out. The Dalton Wells traces differ substantially from those ascribed to dermestid beetles (simple pits) and dung beetles (borings filled with large bone fragments). Thus, the Dalton Wells burrows represent a hitherto unrecognized taxon of osteophagous beetle.

Friday 11:15

STEALTH DIVERSITY IN THE CRADLE OF HUMANITY: CROCODYLID ENDEMISM IN AFRICA AND THE WESTERN INDIAN OCEAN DURING THE NEOGENE

BROCHU, Christopher, Univ.of Iowa Dept of Geosciences, Iowa City, IA

Phylogenetic evidence suggests that the Nile crocodile *(Crocodylus niloticus)* is a comparatively recent immigrant to Africa and that some Mio-Pliocene fossils from the region, including those long thought ancestral to *C. niloticus*, are closer to the living African dwarf crocodile *(Osteolaemus)*. The endemic clade (Osteolaeminae) includes the horned crocodile *'C.' robustus* from the Holocene of Madagascar; *Rimasuchus lloidi*, based on material from Libya but referred (with varying levels of certainty) to fossils from throughout Africa; and the long-snouted *Euthecodon*. Recent work indicates much higher extinct and extant osteolaemine diversity, much of which has been obscured by essentialist systematic approaches, the view that crocodylians as slowly-evolving forms with low standing diversity, and an overemphasis on nonreptilian fossils from the region. '*Crocodylus' pigotti* from the Miocene of Kenya belongs to the group. The same is also probably true for a miniature horned crocodile from the Quaternary of Aldabra Atoll that, although small and from an island, is not an island insular 'dwarf' taxon, as it is found in deposits that formed shortly after Aldabra emerged. Another possible member of the group, based on molecular evidence, is the living African sharp-nosed crocodile *(C. cataphractus)*, suggesting that the narrow-snouted condition arose twice independently among osteolaemines. The presence of a morphologically diverse endemic crocodylian clade in the African Neogene mirrors the situation in Australasia, South America, and possibly the Greater Antilles at the same time and contrasts with the presence of geographically widespread clades of morphologically similar crocodylians in the Paleogene.

Wednesday, Preparator Poster

MOLDING AND CASTING OF *IN SITU* ARTICULATED SKELETONS IN SOFT MATRIX: A CASE STUDY FROM THE ASHFALL FOSSIL BEDS, NEBRASKA

BROWN, Gregory, Univ.of Nebraska State Museum, Lincoln, NE

Due in part to their excellent release properties and variable viscosities, modern silicone molding materials have greatly simplified the process of molding and casting well-prepared fossil specimens in the laboratory. Porous bone and, in particular, bone still partially embedded in a soft and porous matrix, however, still present serious challenges to successful molding. In addition, uncontrolled environmental conditions, lack of access to standard laboratory equipment, and unique conservation concerns multiply these challenges significantly when molding specimens remaining *in situ*.

In 2004, we began a project to mold several complete, articulated Clarendonian rhino (*Teleoceras*) and horse (*Cormohipparion*) skeletons preserved *in situ* in soft volcanic ash at the Ashfall Fossil Beds near Orchard/Royal, Nebraska. Although the overall design of the one-piece molds is relatively straightforward, achieving a flawless mold and assuring safe, stress-free demolding in this situation requires subtle but important variations to our standard molding procedures including: 1) the use of cyclododecane to seal porous matrix and bone, 2) control of molding compound viscosities using fumed silica rather than liquid thixotropic additives, 3) incorporation of fabric reinforcement into mold perimeter, and 4) choice of addition-cure, platinum-catalyzed silicone RTV molding compound for its superior release properties, long mold life, and chemical resistance.

During casting, the use of talc-extended polyester resin provides an ideal consistency for brush application and results in a high-resolution, bubble-free cast that readily accepts acrylic paints and stains.

Maintaining substrate and specimen integrity while minimizing alterative chemical treatments is an important goal in all molding projects, but is essential to the long-term survival of specimens being maintained *in situ* under minimal environmental control.

Poster Session B

A CASE FOR THE REASSIGNMENT OF THE BARSTOVIAN FELID *PSEUDAELURUS MARSHI* TO THE GENUS *NIMRAVIDES*

BROWNE, Ian, San Diego Natural History Museum, San Diego, CA

Remains of a small saber-toothed felid have been recovered by field crews of the San Bernardino County Museum from late Barstovian-age strata of the Barstow Formation that crop out northwest of Barstow, California. These specimens consist of fragmentary maxillae and rami that display features considered diagnostic of the genus *Nimravides*. Features observed in the Barstow Formation specimens that support identification as *Nimravides* include: an angular chin; crowding of the lower incisors into a triangular arrangement, with I1 located slightly anterior to I2; and laterally compressed upper canines bearing incipient serrations that are variably present on the anterior edge and consistently present on the posterior edge of the tooth. These characters were not observed in a well-preserved specimen of *Pseudaelurus intrepidus* recovered from the same quarry.

The Barstow Formation specimens identified as *Nimravides* are approximately 20% smaller than the *P. intrepidus* specimen, placing them within the typical size range of *Pseudaelurus marshi*. *P. marshi* was described from a partially restored left and right ramus recovered in Nebraska from Barstovian strata of the Valentine Formation. The holotype of *P. marshi* possesses an angular chin and lower incisors that are arranged in a triangular pattern. There appear to be no significant morphological differences between the rami of the Barstow Formation specimens of *Nimravides* and the holotype of *P. marshi*, strongly suggesting that these specimens represent individuals of a single species. The characters of the lower jaw observed in the holotype of *P. marshi* and the Barstow Formation specimens in conjunction with the characters of the upper dentition observed in the Barstow Formation specimens present a strong argument in favor of reassigning *P. marshi* to the genus *Nimravides*.

Thursday 2:30

A NEW SPECIES OF *CARCHARODONTOSAURUS* (DINOSAURIA: THEROPODA) FROM THE CENOMANIAN OF NIGER AND ITS IMPLICATIONS FOR ALLOSAUROID PHYLOGENY

BRUSATTE, Stephen, SERENO, Paul, Univ.of Chicago, Chicago, IL

Recent fieldwork in Africa has begun to fill in major gaps in the Cretaceous vertebrate faunal record. *Carcharodontosaurus saharicus*, a gigantic allosauroid theropod, is now represented by teeth and cranial bones from across the Sahara, from Egypt to Morocco. Here we show that more than one species of *Carcharodontosaurus* was present in Africa during the Late Cretaceous. The new species, from the Echkar Formation (Cenomanian) of Niger, is based on a large maxilla that differs most notably from *C. saharicus* by the absence of the apomorphic swollen ventral margin of the antorbital fossa, as well as the presence of several other autapomorphies, such as a robust medial ridge. Material that was found near the holotypic locality and tentatively referred to the new species includes isolated teeth, a well-preserved braincase, and the anterior end of a dentary. The braincase, with its more slender laterally-divergent laterosphenoid alae, also differs from that of *C. saharicus*, as do details of the endocast.

A review of character evidence among allosauroids provides support for a monophyletic Carcharodontosauridae that includes *Carcharodontosaurus*, *Giganotosaurus*, *Acrocanthosaurus*, *Neovenator*, and new Late Cretaceous carcharodontosaurids from South America. Pneumaticity of the axial column varies considerably within the group, with some members showing well developed camellate internal structure comparable to that in titanosaurian sauropods. However, little support is found for a close relationship between carcharodontosaurids and abelisauroids, as has been proposed by some authors. The Jurassic age of several allosauroids outside the Carcharodontosauridae and the distribution of members on both Laurasia and Gondwana suggest that carcharodontosaurids originated no later than the Early Jurassic, when there was amble connection between major landmasses.

Saturday 12:15

MODULAR CONTROL OF VERTEBRAL MORPHOLOGY IN SECONDARILY AQUATIC TETRAPODS

BUCHHOLTZ, Emily, Wellesley College, Wellesley, MA

Recent advances in developmental biology indicate that morphology is the product of hierarchical developmental processes, and is therefore also hierarchical in organization. Modularity in development and structure is used here to address a paradox in the paleontological record: the existence of three tetrapod groups (Ichthyosauria, Sirenia, Delphinidae) that have secondarily adapted to the selection pressures of an obligate aquatic lifestyle with highly convergent external anatomy but highly divergent vertebral anatomy.

Hierarchical development predicts that vertebral modules and submodules can be recognized by integrated patterns of scale, shape, and / or count. Interspecific patterns of variations in vertebral count across all three groups and intraspecific patterns of ontogenetic variation in vertebral shape and scale of *Ophthalmosaurus icenicus* (Ichthyosauria), *Trichchus manatus* (Sirenia) and *Lagenorhynchus acutus* (Delphinidae, Cetacea) were used to identify column modules. These data indicate that lumbar vertebrae were developmentally linked with thoracic vertebrae in ichthyosaurs, that they form an independent module in sirenians and early cetaceans, and that they have been evolutionarily re-associated with prefluke caudal vertebrae in delphinid cetaceans. As a result, different morphological responses to similar selection pressures may have been preferentially available in each taxon. The hierarchical control of morphology thus appears to be a major determinant in the evolution of unique solutions to similar selective pressures.

Wednesday 4:00

AN AIGIALOSAUR (SQUAMATA: ANGUIMORPHA) WITH SOFT-TISSUE PRESERVATION FROM THE UPPER CRETACEOUS OF NUEVO LEON, MEXICO

BUCHY, Marie-Celine, Staatliches Museum fur Naturkunde, Karlsruhe, Germany; SMITH, Krister, Yale Univ., New Haven, CT

Aigialosaurs are a group, if not a clade, of aquatic squamates whose relationships have received increased scrutiny of late as a result of their proposed propinquity to the origin of snakes. Thus far they have only been described from the Upper Cretaceous of the Mediterranean region (the Adriatic coast and Jordan), although a specimen has been reported from Texas. Recent work in Nuevo Leon State, Mexico, has unearthed a new aigialosaur of exceptional preservation from the Turonian (Upper Cretaceous) Agua Nueva Formation. The specimen is accessioned at the Universidad Autonoma de Nuevo Leon, Facultad de Ciencias de la Tierra, Linares, Nuevo Leon.

The hind half of the animal is preserved in articulation. Short distal presacral ribs contrast with the long anterior ones, and the last presacral rib appears to be absent. Small pebble-like structures strewn throughout the posterior abdominal region represent gut contents. The tibia and fibula are distinctly shorter than the femur. The astragalus and calcaneum are fully coossified; a large fourth distal tarsal is present. The phalangeal formula, 2-3-4-5-4, is the ancestral one. In the long tail nearly 70 vertebrae are preserved, and certainly more were present; all vertebrae possess long, posteriorly inclined neural and haemal arches. Scales or their impressions are preserved over much of body.

The specimen evinces several features—for instance, the long, inclined neural and haemal arches and reduced caudal postzygapophyses—that link it with Mosasauroidea (including aigialosaurs and mosasaurs), but it lacks features diagnostic of Mosasauridae. This specimen presents the best-preserved soft tissue and one of the best hind feet of any described aigialosaur and suggests that the squamation preserved in isolated portions of the body of other aigialosaurs may have bedecked the whole body. This Mexican specimen broadens our understanding of the palaeobiogeography and palaeobiology of aigialosaurs.

Poster Session A

THEROPOD TEETH FROM THE UPPER CRETACEOUS KASKAPAU (MIDDLE TURONIAN) AND THE WAPITI (UPPER CAMPANIAN-LOWER MAASTRICHTIAN) FORMATIONS OF NORTH-EASTERN BRITISH COLUMBIA, CANADA

BUCKLEY, Lisa, McCREA, Richard, Peace Region Palaeontology Research Centre, Tumbler Ridge, BC, Canada; CURRIE, Philip, Univ. of Alberta, Edmonton, AB, Canada

British Columbia has an extensive terrestrial vertebrate ichnological record for the Cretaceous Period, but few terrestrial vertebrate skeletal remains have previously been recognized or recovered. Isolated theropod teeth were recently discovered during the 2003 and 2004 excavations of British Columbia's first dinosaur bones in the Quality Creek canyon near the town of Tumbler Ridge. Two isolated theropod tooth crowns were recovered from a terrestrial wedge in the predominantly marine Kaskapau Formation (middle Turonian) and are currently under preparation. These teeth represent the oldest record of theropods in western Canada, and

possibly the northern most occurrences of Turonian age theropods to date.

Surface collecting during the exploration of the Wapiti Formation (upper Campanian-lower Maastrichtian) in northeastern British Columbia also yielded isolated theropod teeth. A single complete tooth crown of *Saurornitholestes* sp. and a partial tooth crown of a tyrannosaurid (c.f. *Albertosaurus*) have been recovered. This is the first occurrence of *Sauronitholestes* sp. and tyrannosaurids in British Columbia and the western most occurrences of these taxa in Canada. *Saurornitholestes* sp. and *Albertosaurus* sp. teeth have been previously recovered from other northern late Campanian age localities in Alberta and Alaska.

Wednesday 8:30

MAMMALIAN FAUNAL CHANGE IN THE PALEOCENE-EOCENE BOUNDARY SPANNING DEBEQUE FORMATION, NORTHERN PICEANCE CREEK BASIN, WESTERN COLORADO: PRELIMINARY STUDY OF FOSSIL UNGULATES

BURGER, Benjamin, EBERLE, Jaelyn, HONEY, Jim, Univ.of Colorado Boulder, Boulder, CO

The Piceance Creek Basin is a north-south oriented structural basin lying primarily between the towns of Meeker and Grand Junction in western Colorado. The DeBeque Formation in the northern Piceance Creek Basin preserves a diverse assemblage of fossil mammals bracketing the Paleocene-Eocene boundary transition. Tiffanian, Clarkforkian and Wasatchian North American Land Mammal Ages (i.e., NALMA) are represented. Specifically with regard to the ungulates, Tiffanian faunas are dominated by archaic ungulates, including the artocyonid *Thryptacodon australis*; the hyopsodontids *Litomylus, Aletodon, Phenacodaptes*; the mesonychid, *Dissacus*; and the phenacodontids *Ectocion* and *Phenacodus*. Stratigraphically above the Tiffanian localities, a probable Clarkforkian faunal assemblage is identified, based upon the occurrence of *Haplomylus* and *Copecion* and absence of *Hyopsodus, Diacodexis,* and *Hyracotherium,* the latter three of which are index taxa for Wasatchian (earliest Eocene) time. A rapid and dramatic faunal change is evident between Clarkforkian (late Paleocene) and Wasatchian (early Eocene) localities in the northern Piceance Creek Basin, with the first appearances of rodents, euprimates, perissodactyls and artiodactyls at early Wasatchian localities. The unusual apparent absence of rodents from the Clarkforkian locality may be a sampling bias, and due to the fact that fieldwork has just begun in this area. Preliminary comparisons of ungulate taxa from late Tiffanian-early Wasatchian strata with coeval faunas in the Bighorn Basin indicate a similar general pattern of faunal change across the Paleocene-Eocene boundary transition. However, Tiffanian faunas in Piceance Creek Basin also share affinities to more southern faunas, including that of the Animas Formation. More concentrated sampling of this key temporal interval is underway in the Piceance Creek Basin, and should provide further insight into the Paleocene-Eocene mammalian faunal transition in western Colorado.

Wednesday 4:15

TRANSFER PREPARATION OF AN *ICTHYORNIS* SPECIMEN FROM THE NIOBRARA FORMATION

BURNHAM, David, The Univ. of Kansas, Lawrence, KS; HINES, Charles, Astoria, NY

The Univ. of Kansas Vertebrate Paleontology Laboratory has utilized the transfer preparation technique for a specimen of *Icthyornis*, a fossil bird from western Kansas. The fossil consists mostly of disarticulated skeletal elements closely associated in chalk part and counterpart slabs. The main slab contains most of the delicate skeletal elements and occurred as a jackstraw pile. The fossil bones were prepared using a surgical microscope. Rather than removing the delicate bones individually, they were embedded in optically clear plastic while on the main slab. This allowed preparation of the underside of the fossil bones as well as molding and casting. The casts were used for reconstruction of the skeleton.

The transfer technique stabilized the delicate fossil bones that otherwise would have remained embedded in the chalk slab. This essentially allows full view of the specimen for research and allows casting for museum exhibits.

Friday 8:30

LOWER DEVONIAN ACANTHODIANS OF THE WESTERN U.S.A.

BURROW, Carole, Univ. of Queensland, Brisbane, Australia

Isolated spines and scales from acanthodian fishes are common elements in vertebrate assemblages from the Early Devonian (Emsian) of Nevada, Utah, Wyoming, and Arizona. Material from unit 4 of the Sevy Dolomite and the lower Grassy Flat Member, Water Canyon Formation includes one part-articulated specimen plus isolated fin spines and dermal plates of a new climatiid, spines and shoulder girdle elements of ?climatiid *Nodocosta* n. sp., dentigerous jaw bones from at least two ischnacanthids *Ischnacanthus* sp. and a new taxon, fin spines from ?diplacanthid *Onchus peracutus*, and scales of ?diplacanthid *Ptychodictyon* n. sp. Most of the taxa appear endemic, although some show a close relationship with older cosmopolitan species (*Ischnacanthus* spp.) and younger species from the East Baltic (*Ptychodictyon rimosum*, *Nodocosta pauli*).

Romer Prize Session, 8:30

THE PHYLOGENY AND EVOLUTIONARY HISTORY OF THE ORNITHISCHIAN DINOSAURS

BUTLER, Richard, Univ. of Cambridge, Cambridge, United Kingdom

Few analyses have tested the global phylogeny of Ornithischia. In order to reassess prevailing views of ornithischian phylogeny and evolution a 'total-evidence' approach was taken. Nine higher-level and 42 species-level taxa were selected, representing all known valid ornithischians. Taxon incompleteness was not used as justification for a priori exclusion. The validity of all previously utilised characters was assessed, and direct examination of taxa allowed the identification of further characters. Safe taxonomic reduction was carried out on an initial matrix (51 taxa, 228 characters) allowing removal of three taxa prior to analysis. Heuristic analysis recovered 622424 MPTs of 502 steps. Reduced consensus techniques identified the four most unstable (wildcard) taxa, and the matrix was reanalysed with these taxa excluded. This analysis (44 taxa, 228 characters) identified 216 MPTs with a highly resolved strict consensus.

The general structure of ornithischian phylogeny is supported; however, positions of certain taxa differ significantly from previous analyses. The Heterodontosauridae form the sister group to Genasauria and may represent the basalmost known ornithischians, a position concordant with stratigraphy. Strong evidence supports hysilophodontid paraphyly, with some Middle Jurassic taxa (*Agilisaurus*, '*Yandusaurus*' *multidens*) clading as sister-taxa to Cerapoda (Marginocephalia + Ornithopoda). Previous conceptions of Ornithopoda appear, therefore, to have created a polyphyletic grouping of small-bodied bipedal taxa.

Far greater congruence with stratigraphy is present than in previous phylogenetic hypotheses, suggesting that the early ornithischian record may be better than generally believed. New time-constraints are placed on evolutionary events. For example, previous hypotheses require a Late Triassic date for the Ornithopoda-Marginocephalia split; this phylogeny predicts a Mid-Late Jurassic date for the same event, obviating the need for an extensive marginocephalian ghost-range. This analysis highlights both the necessity of rigorously testing the ornithischian tree, and the areas in which efforts should be concentrated.

Poster Session B

A YOUNG GOMPHOTHERE SKULL FROM THE STATE OF HIDALGO, CENTRAL MEXICO

CABRAL-PERDOMO, Miguel, BRAVO-CUEVAS, Victor, CASTILLO-CERON, Jesus, Universidad Autonoma del Estado de Hidalgo, Pachuca, Mexico

A young gomphothere partial skull was found during the quarrying of a sand mine near Chilcuahutla, in the state of Hidalgo, Central Mexico. The workers that made the discovery tried to collect it, but due to their lack of experience in the subject, partially destroy the specimen. Latter they donated the fossil to the Museum of Paleontology at the Universidad Autonoma del Estado de Hidalgo where it is housed at present.

The specimen consists of 85% of the parietal, parts of the occipital and the squamosal with the zigomatic branches, the palatal region, parts of both maxillas with M2 and M3, as well as the distal part of the premaxillas and fragments of the tusks. The molar morphology is typical of the gomphotheres: M2 trilophodonts and M3 tetralophodonts, both with secondary trefoil on the posttrites. The specimen shows both M2s in late wear stage, while the M3s were not in use and only the first two pairs of hemilophs were coming out from the alveolus. The tusk cross-section is subcircular in shape and no enamel band is shown on them due to their poor preservation.

Two considerations make the taxonomic status of the specimen confusing: the upper molar morphology is close to *Rhynchotherium* or *Gomphotherium*, and the lack of a well preserved tusk with enamel band. There is no stratigraphic control of the site where the fossil was recovered; nevertheless, there are other fossil localities from the area with similar sediments that has been assigned as Late Pliocene-Early Pleistocene.

Poster Session B

GERMAN PRINCES, LOST SNOUTS AND A RE-DIAGNOSIS OF *MOSASAURUS MISSOURIENSIS* (SQUAMATA: MOSASAURIDAE)

CALDWELL, Michael, Univ.of Alberta, Edmonton, AB, Canada; BELL, JR., Gorden, Dell City, TX

We report here on our rediscovery of the lost snout of Richard Harlan's specimen of *Mosasaurus missouriensis* in the vertebrate palaeontology collections of the Museum national d'Histoire Naturelle (MNHN) in Paris, France, and confirm that it is indeed the missing snout tip from the Goldfuss specimen he described as *M. maximiliani*. The snout specimen (MNHN 9587) was a gift to the museum prior to 1860, likely gifted from Harlan's estate after his death. We examine the history of the specimen and present a description of the rediscovered snout and synonimize the junior synonym *M. maximiliani* Goldfuss, 1845. with *M. missouriensis* (Harlan, 1834). A revised diagnosis of the taxon is as follows: plotosaurine mosasaur with very small premaxillary/predental rostrum; dorsally, premaxilla prismatically contoured, with five facets including central, flattened facet, dorsolateral pair of facets, and lateral pair; both dorsolateral and lateral pairs extend short distance onto maxillaries; posterior end of premaxillary internarial bar is laterally expanded forming tridentate suture with anterior end of frontal; external nares begin anteriorly above fourth maxillary tooth and extend posteriorly to point above eleventh maxillary tooth; 14 tooth positions in maxilla; frontals dorsal surface is triangular, with sides converging anteriorly as straight edges with anteriormost portion being relatively wide and essentially parallel-sided; posterior frontal prongs deeply invade parietal and extend well posterior of parietal foramen; nine tooth positions in pterygoid with pterygoid tooth row ending posteriorly at point approximately even with middle of ectopterygoid process; marginal teeth distinctly facetted with carinae being finely and uniformly serrated;

minimum of 11 pygal vertebrae. Future descriptive work on the Goldfuss specimen can now confidently refer the specimen to *Mosasaurus missouriensis*, and then accurately characterise other locally and globally distributed mosasaurines against the features of both the Bonn (RFWUIP 1327) and Paris specimens (MNHN 9587).

Friday 3:00

THE EXTINCT CALIFORNIA TURKEY, *MELEAGRIS CALIFORNICA*, FROM RANCHO LA BREA

CAMPBELL, Kenneth, Natural History Museum, Los Angeles, CA; BOCHENSKI, Zbigniew, Institute of Systematics and Evolution of Animals, Cracow, Poland

An extensive study of the comparative osteology of turkeys (Aves: Meleagridae) confirms the validity of the extinct California Turkey, *Meleagris californica*. The study included all major and many minor skeletal elements of adult specimens of *M. californica*, best known from the asphalt deposits at Rancho La Brea, California, and both modern turkeys: *M. gallopavo* and *M. ocellata*. The study also revealed that *M. californica* is more closely related to *M. gallopavo* than it is to *M. ocellata*. A review of turkey remains from localities other than Rancho La Brea confirmed the presence of *M. californica* in California within a relatively small range extending from Orange County in the south, through Los Angeles County, to Santa Barbara County in the north. Other, unconfirmed, records of fossil turkeys in the western United States suggest that the species might have been more widespread. The close osteological similarity between *M. californica* and *M. gallopavo* suggests that the ancestors of *M. californica* became isolated in California only after nearing the *M. gallopavo* grade, but certain osteological features suggest different adaptations in the two species following divergence of their respective lineages. The high incidence of entrapment in the La Brea asphalt seeps is linked to the species' social behavior. The end Pleistocene extinction of *M. californica* might have resulted from the coincidental occurrence of two factors: a dramatic, long term drop in precipitation to well below modern precipitation levels beginning about 11,500 yr BP, which would have concentrated local populations of turkeys around limited water supplies and roost sites, and the arrival of paleoindians in California, who could easily have hunted the concentrated birds to extinction.

Friday 9:15

THE PATTERN OF DUROPHAGY AMONG THE LATE DEVONIAN ARTHRODIRES (PLACODERMI)

CARR, Robert, Ohio Univ., Athens, OH; JACKSON, Gary, Cleveland Museum of Natural History, Cleveland, OH

Durophagous feeding has been inferred within several Late Devonian arthrodire (Placodermi) groups: the Mylostomatidae, Selenosteidae, Pholidosteidae, Leptosteidae, Bungartiidae, and a number of Australian taxa of uncertain affinity. This estimate of feeding strategy is based on the form of the gnathal elements; however, the nature of durophagy among arthrodires has not been critically reviewed. Comparison of North American and Moroccan durophagous arthrodires demonstrates distinct forms and orientations for the gnathal elements.

Arthrodires possess anterior (ASG) and posterior (PSG) superognathals (paired upper elements). The two elements are aligned longitudinally in occlusion with the inferognathal (IG, paired "lower jaw"). There are five distinct patterns of durophagy: a plesiomorphic orientation with 1, crushing ASG (*Tafilalichthys*); 2, fused crushing ASG (*Bungartius*); 3, crushing ASG and PSG (plesiomorphic form, *Paramylostoma*); 4, crushing ASG and PSG (derived form, *Dinomylostoma*); and a compacted derived orientation, 5, crushing ASG (fused and shifted posteriorly) and PSG (*Mylostoma*). Changes, such as, shortening of the out-force moment arm or expansion of the adductor mandibulae attachment site suggesting improved in-force, are not commonly seen in arthrodiran gnathal elements. Compaction is only seen in *Mylostoma*; however, the IG retains the same length proportion to the head as in other arthrodires (suggesting both increased in-force and shortened out-force moment arm). Fusion of the ASG occurs twice, once in *Mylostoma* where a derived crushing platform develops beneath a broad head (the plesiomorphic pattern for the head) and in *Bungartius* where fusion may be related to lateral compression of the head (a derived condition).

Systematic studies suggest a minimum of eight originations of durophagy in Late Devonian arthrodires (including European and Australian forms). This adaptive radiation parallels the "middle Paleozoic predatory radiation" where durophagy evolved numerous times among chondrichthyans, teleostomes, arthropods, cephalopods, and gastropods and suggests a greater role for Late Devonian arthrodires among the Paleozoic durophages.

Thursday 2:15

A REAPPRAISAL OF TYRANNOSAUROIDS FROM IREN DABASU, INNER MONGOLIA, PEOPLE'S REPUBLIC OF CHINA

CARR, Thomas, Carthage College, Kenosha, WI; WILLIAMSON, Thomas, New Mexico Museum of Natural History and Science, Albuquerque, NM

The hindlimb of the lectotype of *Alectrosaurus olseni* (AMNH 6554) is strikingly different from that of all other tyrannosaurids. However, an undescribed, but shattered, tyrannosauroid skull (AMNH 6556) from the same general area —Iren Dabasu—is not especially distinctive. A field crew from the American Museum of Natural History collected both specimens in late April 1923. They were found five days apart and in different locations; there is no evidence they are from the same individual.

The shattered skull is from a small animal and has never been described; it includes premaxillary and lateral teeth, an incomplete left lacrimal, the maxillary process of the left jugal, most of the right quadratojugal, the jugal process of the right ectopterygoid, and the quadrate ramus of the right pterygoid. The presence of a secondary fossa in the antorbital fossa of the jugal indicates the specimen is referable to Tyrannosauridae. The cornual process of the lacrimal is similar to some juvenile tyrannosaurids in that it is a low, laterally extending ridge. The lateral teeth are as finely denticulate as tyrannosauroid teeth of the same basal crown length from the Turonian of Uzbekistan.

AMNH 6554 includes a right hind limb, a partial left pes, and partial pubis. The hind limb and foot displays many diagnostic characters. Most notable of these is the hypertrophied condition of the joint surfaces of most of the metatarsals and phalanges, in contrast to other tyrannosauroids, a condition that readily would permit identification of isolated *Alectrosaurus* pedal bones in the field. A similar pediculate condition of the joint surfaces among extant birds is present in raptorial and large cursorial species, an occurrence consistent with the presumed fleet and predatory habits of tyrannosauroids. However, it is presently unclear if this enhanced condition in *Alectrosaurus* served one purpose more effectively than the other.

Friday 1:30

THE DINOSAUR FOSSIL RECORD

CARRANO, Matthew, Smithsonian Institution National Museum of Natural History, Washington, DC

Although macroevolutionary studies on dinosaurs have focused on such diverse topics as biogeography, coevolution, and faunal turnover, pervasive sampling weaknesses allow the fossil record to support conflicting hypotheses, or at least render them difficult to test. The incompleteness of the dinosaur record has been frequently noted but not quantified, and no consensus exists regarding the specific biases at work. Many studies simply ignore record quality altogether, treating missing data as simple unknowns whose absences can have no effect on hypotheses. Current summaries of this record are insufficiently resolved to permit determination or correction of biases, or to generate sampling-based estimates of lineage longevity, first and last appearances, and diversity.

An ongoing project is currently accumulating all published dinosaur occurrences in the fossil record. As a subset of the Paleobiology Database, it records detailed taxonomic, taphonomic, geologic, stratigraphic, and geographic information for each known dinosaur occurrence in a standardized, electronic format. When completed, the PBDB will allow any researcher to digitally access the entire published occurrence record of dinosaurs, download datasets, or generate temporally accurate distributional maps.

These data already demonstrate several important biases in the dinosaur record. Much of our current perspective on dinosaur evolution is driven by the North American record, which constitutes 47% of all collections though comprising only about 15% of land area. By contrast, all Gondwana (nearly 50% of land area) is represented by just 23% of collections. 43% of all collections are Campano-Maastrichtian, but only 4% derive from the entire Middle Jurassic. More generally, sampling is markedly but complexly correlated with country area, historical onset of study, and economic productivity. These are underlain by the same depositional and tectonic filters affecting many other fossil groups. Sampling density variations indicate that first appearances cannot be reliably determined simply by applying minimum divergence times to dinosaur phylogenies.

Poster Session A

MIOCENE-PLIOCENE PALEO LAKES WITHIN THE CENTRAL SECTOR OF THE MEXICAN VOLCANIC BELT

CARRANZA-CASTAÑEDA, Oscar, AGUIRRE-DIAZ, Gerardo, Centro de Geociencias, UNAM, Queretaro, Mexico; ALVARADO-ORTEGA, Jesus, Instituto de Geologia, UNAM, Mexico D. F., Mexico

At the central sector of the Mexican Volcanic Belt between 19° and 23° north latitude, there are widespread basins filled with thick volcanoclastic and fluviolacustrine deposits that contain volcanic rocks and index fossils that date back to the middle Miocene, and in few cases to the Eocene-Oligocene. The basins were originated by graben formation and/or by drainage obstruction by volcanic structures. The former process was related to both the Basin and Range and the Mexican Volcanic Belt (MVB) intra-arc normal extensional episodes. Examples of these basins are Zacualtipan, Tula-Tepeji del Rio and Santa Ma. Amajac (Hidalgo State); abundant material of *Ictiobus* and Goodeidos fishes are reported.

In the state of Tlaxcala, in the Panotla locality the fishes *Ictalurus* and *Ictiobus* are described, in addition, Blancan fossil horses and *Rhynchotherium* are known. In the Acambay Basin (State of Michoacan) has been reported a radiometric age of 1.9 Ma and abundant *Equus* and camel material. In the Cuitzeo basin, where the Rancho la Goleta lies, there are fish vertebrae and the cormorant *Phalacrocorax*, associated with horses, rodents and *Rhynchotherium*.

In the state of Jalisco, in the Chapala lake, the latest Blancan fishes *Ictalurus dugesi* and *Salmus australis* are associated with the aves *Pliolymbus, Phalacrocorax* and *Phoenicopterus*. The Tecolotlan basin sequence is interrupted by lake layers which contain evidences of fishes and *Crocodylus* material. In the San Miguel Allende Basin lake evidence is present in different localities, the most representative is the Arroyo Tepalcates, where a late Hemphillian assemblage is known.

At the Huanusco-Juchipila and Colotlan-Tlaltenango basins in the states of Jalisco-

Zacatecas, few vertebrate fossils have been discovered, however the lithology and evidences of microinvertebrates suggest the existence of large paleolakes in this region.
Systematic geological and paleontological studies by other colleagues and us in the last years have gathered substantial information that proves the existence of ancient lake environment at different times and places in the late Tertiary of Central Mexico.

Saturday 12:15

ANTARCTIC MAMMALIAN PALEOFAUNA: BODY SIZE DISTRIBUTION PATTERN INDICATES A RESPONSE TO CLIMATIC COOLING AND SEASONALITY

CASE, Judd, St Mary's College of California, Moraga, CA

The medial Eocene, Antarctic, mammalian paleofauna from Seymour Island, Antarctic Peninsula, exhibits a wide range of body sizes from small insectivorous, omnivorous and granivorous marsupials along with a sudamericid gondwanathere to moderate to large-sized ungulates (e.g. litopterns and astrapotheres), plus a large-sized sloth. The paleofauna lacks medium-sized, mammals in the size range represented by rabbit- to deer-sized animals. Thus, the paleofauna has a bimodal distribution of body sizes in that it contains small mammals and large mammals, but nothing in between. In contrast is an early Eocene (Vacan subage) mammalian paleofauna from southern Patagonia, which has a normal distribution of body sizes and is heavily represented by medium-sized ungulates. A comparison between the Antarctic paleofauna to the Patagonian paleofauna is appropriate, due to the taxonomic affinities between the two paleofaunas. Floral data for the early Eocene of Patagonia indicates subtropical conditions with mean annual temperatures (MAT) of 15.6°C with equable winter temperatures (above 10°C). Floral data from the medial Eocene of Antarctica indicates a cooler MAT of 11°C with a highly seasonal climate, where the mean winter temperature would range from –3° to 2°C. The bimodal body size distribution pattern is not an unusual pattern for higher latitude mammalian faunas as it can be seen in modern boreal mammalian faunas of North America. This bimodal pattern is in response to cold winter temperatures. The smaller sized mammals would adapt to the cold winter temperatures by physiological means (e.g. torpor). The larger animals have adapted to the winter conditions by conserving heat as a result of their greater bulk. The low frequency of medium-sized animals is due to the fact that neither of the thermal strategies is available to them and consequently these animals would be at a selective disadvantage in this climatic regime.

Wednesday, Preparator Poster

A LOOK AT THE UNIQUE AND PROBLEMATIC PRESERVATION FOUND WITH THE BIG PIG DIG QUARRY SITE, CONATA PICNIC AREA, BADLANDS NATIONAL PARK, SOUTH DAKOTA

CAVIN, Jennifer, Augustana College, East Moline, IL; SHELDON, Matthew, WEILER, Matthew, JOHNSON, Shawna, TATE, Allen, HERBEL, Carrie, South Dakota School of Mines and Technology, Rapid City, SD

The Big Pig Dig site has been quarried for eleven summers with several more ahead. As suggested in earlier presentations, this site represents a probable water hole environment similar to those found on modern African plains. As excavation throughout the quarry has moved from west to east, several different preservational types have been observed. The mudstone contains an abundance of smectite, a variety of swelling clay, covering much of the fragile fossils. Bone preservation varies within the quarry. The fossils recovered from an area that may be the edges of the watering hole are poorly preserved. This area consists of friable clay that is often very waterlogged by existing groundwater. Also bones recovered from these areas appear 'trampled' and powder very easily. Fortunately, the bones in this region are somewhat sparse, and occur primarily in the upper red layer which usually has extremely poor preservational quality. The next stratigraphic level contains bones found typically 1.5 meters below the surface. However, these bones are still found within friable clay that is much less waterlogged. Fossils become more abundant with slightly better preservation and are more likely to be complete elements. In the deeper parts of this level the deposit is such that the bones support each other with minimal matrix separating them. There is still a lack of orientation but a few articulated pieces can be found. In the area that appears to be the middle of the waterhole, the deepest layer, fossils are extremely well preserved. The compact clay contains ashy layers to produce a well-indurated mudstone. Bone preservation in these very hardened sediments is exceptional, plus this area contains small microvertebrate taxa typically not seen elsewhere within the quarry. These elements reflect more orientation than observed in other units of the quarry. There is even preservation of nearly vertically limbs with articulated feet. Therefore, this quarry demonstrates a wide variety of compositions, preservational types and taxa. These factors are a challenge to the crew, not only in the field, but also in the lab providing a wonderful and varied learning experience.

Wednesday 1:30

A FOSSIL PLANT! NOW WHAT DO I DO?

CHANEY, Dan, Smithsonian Institution National Museum of Natural History, Washington, DC

In the course of collecting fossil vertebrates eventually one will encounter fossil plant remains either associated with or in the overburden above the fossil layer. What to do? The tendency is to smash right through them to get them out of the way! As interest in the total paleoecologic picture of the landscape has become increasingly of interest-first impulse may not be the best approach.

Plant remains—just as fossil vertebrates—are not all the same. They vary greatly in preservational durability; thus there is no one correct answer to the "Now what do I do?" question. It is important to attempt to collect a representative sample.

Collect locality data as usual.

Petrified wood is perhaps the easiest to deal with. A fist-sized sample is sufficient if the cellular structure is preserved and too big if cells are not preserved. Collecting fossil leaves, on the other hand, varies greatly due to the extreme variation in the nature of preservation. Sunlight, water, and dry air are the most destructive elements to newly exposed fossil leaf.

The best method of recovering fossil plants from the field is to wrap them immediately; this prevents differential drying that causes cracking and thus disintegration. If the specimens are palm size or smaller wrapping them in a ball of tissue will, in most cases, suffice. If they are on larger slabs of rock then wrapping them in newspaper and placing them on edge, as a glazier handles panes of glass, is the best way to pack and transport them. In rare cases standard plastering techniques can be employed though it is important to cover the fossil with several layers of dry tissue, then a vapor barrier of thin plastic before applying the plaster bandages. Only in rare cases should a consolidant be applied.

E.C. Olson continually collected 'voucher' plant specimens and noted plant remains in his notes and publications. His efforts have subsequently aided greatly in the acquisition of an amazing collection of fossil plants from the Permian of north central Texas.

Wednesday 12:15

PROTOCOLS FOR THE THREE-DIMENSIONAL DIGITIZING OF SPECIMENS FOR RESEARCH, OUTREACH, AND SPECIMEN ARCHIVING

CHAPMAN, Ralph, DECK, Linda, Idaho Museum of Natural History, Pocatello, ID; ANDERSEN, Art, Virtual Surfaces, Inc, Mt. Prospect, IL; PETERSEN, Christian, SCHLADER, Robert, Virtual Idaho Museum of Natural History, Pocatello, ID

The availability of three-dimensional scanning devices—including both CT and non-contact surface scanners—opens up a multitude of new possibilities for research, outreach and specimen archiving. An ongoing project, the Virtual Idaho Museum of Natural History, has developed scanning process protocols. These maximize the virtualizing process productivity, allowing very high throughput. They also optimize the amount of information gathered for each specimen, anticipating applications for archiving the unique data represented by each specimen and for use in research, the various forms of outreach, and even for generating revenue. These protocols encompass the whole process: initial photographic imaging of the original specimen; 3-D scanning using either CT or non-contact surface scanners, or both; merging and archiving all the images and new data with existing collections information. Of particular importance at the outset is determining specimen ownership and having explicit written permission to scan the specimen. This includes the critical issue of file ownership, which should default to the owner of the specimen unless other, explicit arrangements are made. Having the proper language and permissions in place before the scanning process ever begins will obviate a multitude of potential problems. Specimen handling is a particularly important discussion point. The scanning processes used are considered non-destructive for most fossils but damage can occur while handling specimens before, during, and after scanning. Consequently, actions must be taken to properly stabilize the specimens before scanning, to move the specimens properly before and after scanning, and to ensure specimens remain motionless while scanning occurs. These methods will also yield better files. Files become important collections data; copies should reside associated with the original specimens, and backups should be kept at a secure remote location. Finally, other relevant protocols to access and manage files will be outlined.

Poster Session A

BIPLANE WING PLANFORM AND THE FLIGHT PERFORMANCE OF *MICRORAPTOR GUI*

CHATTERJEE, Sankar, Texas Tech Univ., Lubbock, TX; TEMPLIN, R., National Research Council, Ottawa, ON, Canada

Microraptor gui, a four-winged dromaeosaur from the Early Cretaceous of China, provides strong evidence for an arboreal-gliding origin of avian flight. The reconstructed hindwing of *Microraptor* with asymmetric flight feathers, supported by a laterally extended leg, however, conflicts with known dinosaur limb joints that entail a parasagittal posture of the hindlimb. Here, we offer an alternative planform of the hindwing of *Microraptor* that is concordant with its feather orientation and normal theropod hindlimb posture. Our analysis suggests that *Microraptor* held its hindwing under its body in a Z shape during gliding, where the forewing forms the dorsal wing and the metatarsal wing forms the ventral one. As a result, both wings of *Microraptor* resemble staggered biplane configuration during gliding. The ventral wing and horizontal tail surfaces offered inherent stability during gliding. The feathers on the tibia were positioned backward in a vertical plane for streamlining. Similar but shorter shin feathers are known in *Archaeopteryx* and modern raptors that would streamline the legs just before an aerial attack or during a flight with captive prey. The flight performance of *Microraptor* based on a computer simulation model (using mass = 0.95 kg; wing span = 0.94 m; aspect ratio = 6.7; total wing area = 0.13 m^2; wing loading = 70.6 N/m^2; and gliding speed = 12-15 m/sec) shows that its biplane wings were adapted for phugoid gliding between trees, but not for powered,

flapping flight. The metatarsal asymmetric feathers were lost in *Sinornithosaurus*, *Archaeopteryx*, and later birds to assume monoplane like wing configuration. It is intriguing to contemplate that perhaps avian flight, like the aircraft evolution, went through a biplane stage before the monoplane was introduced.

Wednesday, Preparator Poster

RESEARCH VS. SECURITY: COMMON SENSE APPROACHES TO PROTECTING YOUR COLLECTIONS

CHERRY, Megan, HERBEL, Carrie, GREENWALD, Michael, South Dakota Sch of Mines & Technology Museum of Geology, Rapid City, SD

Museum security is often a delicate balance between the needs of researchers and the needs of your collections. Many times security is overlooked in favor of research. This does not have to be the case. It is possible to accommodate researchers and still protect your collections and the information associated with them. The simplest and often most effective methods to protecting your collections can also be the cheapest. Key control, combined with a collections log, is a very simple and efficient method of protecting specimens. By restricting access to a few individuals, it is possible to keep track traffic within a storage space. By locking the cabinets within this space and placing the keys in a secure location, you can create yet another level of protection. Research by anyone, even students, should be monitored by collections staff. This monitoring can be done by only allowing access to specific specimens and maintaining a log on who is using what and why. If possible, a secure layout room is ideal. Those museums housing Federal collections must pay particular attention to their collections security and adhere to Federal policies. Failure to do so could result in a loss of funding and your collections. The information associated with museum collections must also be protected. Information stored in computer databases can be vulnerable to hacking and vandalism. By restricting access to your server and database, you can protect this information. Pass- word protection is a simple method of restricting access. Ideally, this database should only be accessible to a few specially trained individuals on your collections staff or trusted students. This staff can create and implement a spreadsheet template for use by students and researchers who may request this data. This same template can also be used by students who need to enter records for their research projects. These spreadsheets can be quickly and safely imported into your collections database, thus eliminating the possibility of your database being severely damaged by an inexperienced or disgruntled user.

Poster Session A

ANACHRONISTIC OCCURENCES OF PHENACODONTID SPECIES IN THE CLARKFORKIAN OF THE SOUTHERN BIGHORN BASIN: POSSIBLE EVIDENCE AGAINST TRANSIENT DWARFING IN *ECTOCION* AND *COPECION* DURING THE CIE-PETM INTERVAL

CHESTER, Stephen, BLOCH, Jonathan, Univ. of Florida, Gainesville, FL; BOYER, Doug, Stony Brook Univ., Stony Brook, NY; WING, Scott, National Museum of Natural History, Smithsonian, Washington, DC

The Paleocene-Eocene Thermal Maximum (PETM) is marked by a major carbon isotope excursion (CIE) and a nearly synchronous rapid increase in global temperature. The base of the PETM coincides with the beginning of the Wasatchian land-mammal age. Recent discovery of latest Clarkforkian mammals underlying Wasatchian (Wa-0) faunas and floras in the southern Bighorn Basin (Cabin Fork section), allows for a stratigraphically refined study of terrestrial biotic change through the PETM.

Paleocene mammals in the Cabin Fork section, including diagnostic Clarkforkian indicators, *Aletodon gunnelli*, *Apheliscus nitidus*, and *Haplomylus simpsoni*, were found 5 meters below the base of the CIE. Absence of *Plesiadapis cookei* and *Hyracotherium*, together with high relative abundance of *Phenacodus* and *Ectocion* specimens, indicates that this level corresponds with the latest Clarkforkian (Cf-3). Earliest Eocene mammals, including diagnostic Wa-0 taxa *Arfia junnei*, *Hyracotherium sandrae*, and *Diacodexis ilicis*, were found approximately 3 meters above the base of the CIE.

It has been suggested that certain Wa-0 mammalian lineages experienced a transient decrease in body size during the CIE-PETM interval related to the increase in temperature and elevated atmospheric CO2. Clarkforkian phenacodontids *Ectocion osbornianus* and *Copecion brachypternus* are thought to have dwarfed into *Ectocion parvus* and *Copecion davisi* respectively. We report the first well-documented Paleocene records of *E. parvus* and *C. davisi* in the same level as Clarkforkian *E. osbornianus* and *C. brachypternus*. While it is possible that these surface collected specimens (N=2) are contaminants, lack of other Wa-0 taxa at this level, as well as the distinctive black color of the specimens (Wa-0 fossils typically have amber-colored teeth), argues against this. As an alternative to the dwarfing hypothesis we suggest that both pairs of species in these lineages existed prior to the PETM, and that *E. parvus* and *C. davisi* increased in abundance during the PETM, possibly because they extended their ranges northward in response to warming.

Romer Prize Session, 8:45

MAMMALIAN FAUNAL TURNOVER IN THE EARLY EOCENE OF THE CENTRAL BIGHORN BASIN, WYOMING

CHEW, Amy, Baltimore, MD

Many analyses of faunal turnover in terrestrial ecosystems have relied on global paleoclimatic signals derived from deep-sea cores to test for significant correlation between paleoclimate and faunal turnover. Lack of correlation between important paleoclimatic change and faunal evolution is often attributed to an independence of the faunas to large-scale changes in mean annual temperature. However, it can also be argued that the marine paleoclimatic signal does not sufficiently reflect the terrestrial conditions under which the faunas existed. I test the relationship between local paleoclimatic and paleoenvironmental change and faunal evolution in a large sample of fossil mammals from the Bighorn Basin, WY. For this project, I collected data from approximately 47,000 specimens tied into a composite stratigraphic section of 630m from the central Bighorn Basin. This dense sample, spanning nearly 2.5 my of the early Eocene, is associated with local, highly resolved paleoclimatic and paleoenvironmental reconstructions based on paleosols, leaf-margin analysis and the oxygen isotope ratios of hematite nodules.

Using confidence interval analysis and a method developed to rarefy and resample specimens grouped by 20 m intervals, this project demonstrates that following the Paleocene-Eocene boundary there were two statistically significant episodes of species turnover (biohorizons), involving 40-50% of the standing species diversity. The first was related to an abrupt decrease in mean annual temperature that resulted in a faunal reorganization involving many phyletic species transitions and size increases. The second was a much more intense event, including both evolutionary change and immigration/emigration. This latter episode was probably the result of the crossing of a biotic threshold of conditions including climate warming, basin drying and habitat fragmentation related to tectonic activity. Further important changes in faunal composition following the onset of relatively unstable local environmental conditions conformed to the predictions of the variability selection hypothesis.

Friday 9:45

EVOLUTIONARY HISTORY OF THE CRETACEOUS ENANTIORNITHES

CHIAPPE, Luis, Natural History Museum of Los Angeles County, Los Angeles, CA; O'CONNOR, Jingmai, Natural History Museum of Los Angeles County/USC, Los Angeles, CA; ZHOU, Zhonghe, Insitute of Vertebrate Paleontology and Paleoanthr, Beijing, China

Like no other Mesozoic lineage of birds, the Enantiornithes embody the bulk of the remarkable burst of avian fossil discoveries of the last two decades. Recorded throughout the Cretaceous and from every continent except Antarctica, nearly half of all Mesozoic birds are members of this group. Yet, its existence was only recognized in 1981. With important derived features (alula, modern wing proportions, carinate sternum, etc.) and sizes similar to those of small passeriforms, the earliest members of this group already document a significant departure from larger and more primitive fliers. These superior flying abilities likely facilitated the occupation of a wide range of environments and the evolution of a diversity of feeding specializations. Indeed, already in the Early Cretaceous, the fossil record of enantiornithines shows a diversity of cranial specializations/morphologies surely related to different foraging preferences and lifestyles. The later evolutionary history of enantiornithines was characterized by a distinct increment in size and the evolution of an even greater diversity of ecomorphological types (e.g., lineages of aquatic, long-legged waders, and near-flightless birds). The interrelationships of enantiornithine birds have remained largely unexplored due to the incompleteness of several of the taxa and the great similarity of the postcranial anatomy of many of these birds. Here we present a phylogeny of enantiornithines, highlighting both well-supported nodes as well as areas of the tree that need further examination. Some of the well-supported phylogenetic relationships include the basal position of the Chinese Early Cretaceous *Protopteryx*; the sister-group relationship of the long-snouted *Longipteryx* and *Longirostravis*, also from the Early Cretaceous of China; and the clustering of a number of generalized Early and Late Cretaceous taxa (*Sinornis*, *Cathayornis*, *Concornis*, *Neuquenornis* and others).

Thursday 2:45

BONE MICROSTRUCTURE AND GROWTH PATTERNS OF EARLY MAMMALS

CHINSAMY-TURAN, Anusuya, Univ. of Cape Town, Cape Town, South Africa; HURUM, J., Universitetet i Oslo, Oslo, Norway

Here we present results of the first studies of the bone microstructure of early mammals to deduce aspects of their growth and biology. Based on the Early Jurassic *Morganucodon*, the Late Cretaceous multituberculates, *Kryptobaatar* and *Nemegtbaatar*, and the Late Cretaceous eutherians *Zalambdalestes* and *Barunlestes*, our histological analyses show that the two eutherian taxa grew relatively slowly with periodic pauses in growth indicated by the presence of rest lines, while the multituberculates and Morganucodon had a faster rate of bone formation that suggests an overall rapid growth rate that slowed down later in ontogeny. Comparisons of the early mammalian bone microstructure with that of non-mammalian cynodonts and traversodontids, extant monotremes, and placentals are also made, and significant differences in the rate of bone deposition in the various groups are documented. Our findings suggest differences in the growth rate between the multituberculates and the Mesozoic eutherians, and moreover, both groups appear to have slower growth rates as compared to modern monotremes and placentals. Our findings further suggest that the determinate growth strategy typical of extant mammals evolved early in the evolution of the non-mammalian therapsids.

Poster Session A

BODY MASS ESTIMATES FOR *SMILODON* SPECIES

CHRISTIANSEN, Per, Univ. of Copenhagen, Copenhagen, Denmark; HARRIS, John, George C. Page Museum, Los Angeles, CA

The somatic proportions of many saber-toothed cats *sensu lato* differ from those of their extant felid counterparts by appearing more stocky and powerful, with proportionally shorter and stouter limb limb bones, especially the distal ones. The demands on the appendicular skeleton in terms of support of mass and stresses of locomotion in extinct animals probably did not differ markedly from the constraints observed in extant animals. Limb bones have been found to show high correlation with body mass in terrestrial carnivorans. The body masses of the three *Smilodon* species, *S. gracilis, S. fatalis* and *Smilodon populator* were estimated on the basis of 36 osteological variables from the appendicular skeleton of extant felids. A new model is introduced that takes the reliability of the predictor equations into account, because mass estimates are more reliable when computed from multiple variables per bone. *Smilodon populator* was found to be substantially heavier and larger than any extant felid, with a body mass range of 220-360 kg. Particularly large specimens of *Smilodon populator* almost certainly exceeded 400 kilograms in body mass. *Smilodon fatalis* was somewhat lighter than previously assumed, with a body mass range of 160-280 kg, similar to that of the largest extant felid, the Siberian tiger. *Smilodon gracilis* was lion-sized at 150-170 kg. Differences from previous estimates are probably due to differences in the databases used for mass estimation.

Poster Session A

THE SYSTEMATICS AND BIOGEOGRAPHY OF THE BALAENOIDEA

CHURCHILL, Morgan, San Diego, CA; BERTA, Annalisa, San Diego State Univ., San Diego, CA; DEMERE, Thomas, San Diego Natural History Museum, San Diego, CA

The Balaenoidea is the superfamily of mysticetes (baleen whales) that includes the right whales (Balaenidae) and the pygmy right whales (Neobalaenidae). Previous morphological analyses found a monophyletic Balaenoidea, while molecular phylogenies consistently place the Neobalaenidae as closer to the rorquals and gray whales, in the Balaenopteroidea. However, previous work often failed to include all relevant outgroup taxa, rigorous phylogenetic methods, or important fossil forms.

A cladistic analysis was performed using 40 characters and 15 taxa. All modern genera of mysticetes are represented, as well as several fossil balaenids. Monophyly of Balaenoidea and Balaenopteroidea was well supported. The Neobalaenidae is recognized as the earliest diverging lineage of Balaenoidea, and a clade composed of the modern *Eubalaena* and fossil taxon *Balaenula astensis*. In addition, the taxon *Idiocetus guicciardinii*, formerly considered a balaenopterid, is recognized as a balaenid and possibly related to *Balaenula astensis*.

Using a phylogenetic framework, the biogeography of the balaenoids was examined. Among mysticetes, balaenoids have the oldest record, with *Morenocetus parvus* from the early Miocene of Argentina as the earliest described taxon, and an earlier undescribed taxon is reported from the Oligocene of New Zealand. Balaenids occupied the North Pacific by the Mio-Pliocene, and are well represented in the Pliocene cetacean faunas of the North Atlantic and Pacific. This suggests an origin for the balaenoids in the southern hemisphere, followed by subsequent invasion of northern oceans, and possible reinvasion of the southern hemisphere by the genus *Eubalaena* during the Pleistocene, leading to the present antitropical distribution of the genus.

Poster Session A

CROCODILIANS FROM THE MORRISON FORMATION (UPPER JURASSIC; KIMMERIDGIAN) OF DINOSAUR NATIONAL MONUMENT

CHURE, Daniel, Dinosaur National Monument, Jensen, UT

Although best known for its abundant dinosaur fauna, exposures of the Morrison Formation in Dinosaur National Monument have produced a number of significant crocodilian fossils. This crocodilian fauna is diverse, and includes small and large members from several families. The remains come from a variety of depositional environments, including lake and pond deposits as well as the channel sandstones of the Carnegie Quarry.

Eutretauranosuchids are rare, but represented by an incomplete, ~ 1.5 m long, skeleton including both skull and postcranial elements. The skull is disarticulated, but the palate shows the diagnostic eutretauranosuchid condition of the interpterygoid vacuity. The disarticulated braincase elements are highly pneumatic. The postcranium consists of numerous vertebrae, pectoral and pelvic elements, and limb bones.

Hoplosuchus kayi is known only from the type, a small (<20cm), but complete articulated skeleton including the skull and an extensive covering of dorsal armor. Originally described as an aetosaur, *Hoplosuchus* was later referred to the Atoposauridae, although it is not included in recent analyses of that family. Its affinities remain uncertain and it may be a juvenile.

Small isolated, shed tooth crowns recovered during screen washing resemble those of the small cursorial bunny croc *Fuitachampsa* . Finally, there is a small, incomplete, and disarticulated skull (length <7cm) of uncertain affinities. Unlike *Hoplosuchus*, the skull elements are highly ornamented. The dentition in this small specimen precludes it from being referable to *Fruitachampsa*. It may also be a juvenile.

Diagnostic goniopholid material has not been found, although this group may be represented by shed teeth. Similarly, no diagnostic material of *Macellognathus* has been found.

Anyone interested in studying this material should contact the author.

Poster Session A

FIRST NEOCOMIAN (EARLIEST CRETACEOUS) MAMMALS FROM NORTH AMERICA

CIFELLI, Richard, GORDON, Cynthia, Univ.of Oklahoma, Norman, OK

Much of the scant record of Early Cretaceous (144-99 Ma) terrestrial vertebrates from North America (eg. Trinity Group, Cloverly Formation, Arundel Clay) dates to the Aptian-Albian (ca 115-105 Ma). The Lakota Formation, exposed around the Black Hills, South Dakota and Wyoming, is widely regarded as being Neocomian (Berriasian-Barremian or 144-121 Ma) in age, therefore falling within the largely unrepresented earliest Cretaceous. To date, vertebrates reported from the unit are limited to Lepidotes (palaeoniscoid) and several dinosaurs, including Polacanthus, otherwise known from the Wealden (Berriasian-Aptian) of Britain. Herein we report the discovery of the first Neocomian mammals from North America, represented by fossils recently collected from the Lakota Formation. At least six taxa are known thus far, representing a broad spectrum of groups known from the Jurassic and/or Cretaceous of North America. These include two plagiaulacidans (multituberculates), one amphilestid and one triconodontid (eutriconodontidans), a spalacotheriid ("symmetrodont"), and a dryolestid (stem cladotherian). Most of these appear to be new at the generic level. In North America, amphilestids and dryolestids are otherwise unknown later than the Jurassic, spalacotheriids are limited in known distribution to the Cretaceous, and plagiaulacidans and triconodontids have been recorded from both the Jurassic and Cretaceous. Hence, the fauna of the Lakota Formation is intermediate in some respects, and helps fill an important void in the Early Cretaceous record of North America. Notable by their absence are tribosphenic mammals, which appear as early as Berriasian in Europe but remain unrecorded in North American earlier than Aptian-Albian.

Saturday 9:45

INSIDE THE SKULL OF A PRIMITIVE BONY FISH, *ERPETOICHTHYS CALABARICUS* (ACTINOPTERYGII: CLADISTIA: POLYPTERIDAE), THE ROPEFISH

CLAESON, Kerin, Univ.of Massachusetts, Amherst, MA

Polypterid fishes are considered the most basal group of extant actinopterygians and may be a direct link to understanding the systematics and evolution of the earliest bony fishes. The clade Polypteridae, today endemic to the fresh water rivers and lakes of tropical Africa, includes at least twelve named genera. Two of these are extant: *Polypterus*, containing ten species, and *Erpetoichthys*, represented by a single species *E. calabaricus*. Several investigations have been conducted on *Polypterus*, however, since Smith first described specimens of *E. calabaricus* in 1867, remarkably little work has been done on the species. I present a new description of the skull of *E. calabaricus* based on classical methods, computed micro-tomography scanning, and 3D-digital reconstruction.

In 1928, Holmgren stated that *E. calabaricus* was in all details of its cranial osteology the same as *Polypterus*. However, I found several differences between *Erpetoichthys* and at least three species of *Polypterus* (*P. bichir*, *P. senegalus*, and *P. endlicheri*). *Erpetoichthys* differs from *Polypterus* in having 1) an overall elongation of the skull roof observable in most elements; 2) a strong reduction of the lacrimal bone and 3) an absence of the accessory cheek plates; 4) a large ventral process of the preopercle; 5) a shorter intertemporal-supratemporal processes; and 6) a wider and shorter posterior process of the parasphenoid. Results of a quantitative morphometric comparison of *E. calabaricus* and *Polypterus* will allow for a better understanding of the osteological transitions associated with miniaturization.

Romer Prize Session, 9:00

THE SKELETAL RESPIRATORY PUMP AND ARCHOSAURIAN PULMONARY EVOLUTION

CLAESSENS, Leon P.A.M., Harvard Univ., Cambridge, MA

Birds and crocodylians are the only living representatives of the Archosauria, a once-diverse group that includes dinosaurs, pterosaurs, and other fossil forms exhibiting an enormous range of anatomical diversity. Because crown-group archosaurs offer examples of highly specialized respiratory systems serving both cold-blooded (ectothermic) and warm-blooded (endothermic) metabolic physiologies, the clade presents an unparalleled opportunity to examine evolutionary pathways in respiratory design and function.

In vivo visceral and skeletal kinematics were examined during lung ventilation in the crocodylian *Alligator mississippiensis* and Guinea fowl (*Numida meleagris*) and other basal avian taxa. High-speed cineradiographic (x-ray filming) studies reveal distinctly different patterns of thoracoabdominal expansion between crocodylians and birds.

The avian thorax exhibits fewer degrees of freedom than the crocodylian thorax. For example, birds lack the intermediate ribs and lumbar region characteristic of crocodylians. Moreover, crocodylian sternal ribs are cartilaginous, whereas avian sternal ribs are fully ossified. Lateral expansion of the crocodylian thorax is greatest caudally, due to an abrupt shift in the location of the parapophysis between thoracic vertebrae two and three. In contrast, the greatest expansion of the avian trunk is in the ventrocaudal region and parapophyses remain in virtually the same position along the vertebral series.

Basal neotheropods exhibit a gradual shift in the location of the parapophysis, versus the abrupt shift present in basal crurotarsans. The maniraptoran theropods *Oviraptor* and *Velociraptor* lack intermediate ribs and have fully ossified sternal ribs, similar to the condition in birds. Various accessory breathing mechanisms have evolved within the Archosauria, such

as pubic rotation and gastralial aspiration breathing. Based on skeletal pneumaticity and changes in the structure of the aspiration pump within Archosauria, it can be concluded that higher levels of pulmonary complexity are associated with increased levels of constraint on thoracic mobility.

Friday 9:30

NEW CRETACEOUS FOSSIL EVIDENCE FOR THE TIMING AND PATTERN OF AVIAN DIVERSIFICATION

CLARKE, Julia, North Carolina State Univ./NCMNS, Raleigh, NC; TAMBUSSI, Claudia, Museo de La Plata-CONICET, La Plata, Argentina; NORIEGA, Jorge, Centro de Investigaciones Cientificas TTP-CONICET, Diamante, Argentina; ERICKSON, Gregory, Florida State Univ., Tallahassee, FL; KETCHAM, Richard, Univ. of Texas at Austin, Austin, TX

Whether extant bird lineages emerged after the Cretaceous/Tertiary (K/T) boundary or whether these lineages coexisted with other dinosaurs for much of the Cretaceous and passed through this mass extinction event has remained controversial. A partial postcranial skeleton from the late Maastrichtian (66-68my) of Antarctica (Cape Lamb, Vega Island) is among the most complete Cretaceous specimens to be identified as part of the extant avian radiation and the first so identified through cladistic analyses. Although collected in 1992, new preparation and X-ray computed tomography (CT) data brings abundant new information to its evaluation. Inclusion of the specimen in three of the largest cladistic datasets considering Avialae, Aves and Anseriformes establishes hierarchically nested character support for the placement of recently recognized species, *Vegavis iaai*, as closely related to true ducks and geese (Anatidae) among waterfowl (Anseriformes). This placement, indicated by 20 unambiguously optimized synapomorphies, is further supported by independent histological data.

A minimum of five basal divergences within crown clade Aves prior to the K/T boundary is inferred from placement of *Vegavis*. This result is compatible with either limited deep avian divergences by this time and, thus, limited survivorship at the K/T boundary or the Cretaceous presence of most major lineages and previously hypothesized 'mass survival' at this boundary. It contradicts a proposed early Tertiary crown clade origin. Of the basal lineages inferred in the latest Cretaceous from placement of *Vegavis*, however, only the stem lineage leading to the most speciose extant clade of birds, Neoaves is supported, but not its crown clade. When other new data from fossil ornithurines are considered, we see, in fact, a pattern of the treatment of these remains which often assumes, and discovers, low diversity within Ornithurae in the Late Cretaceous. Further indicated by these data is continued weak support for hypotheses necessitating most major neoavian divergences deep in the Cretaceous (e.g., by 100 Ma or even 80 Ma).

Saturday 1:30

BASIC ASPECTS OF DIGESTION IN HERBIVORES OF EXTREME BODY SIZE

CLAUSS, Marcus, Univ. of Zurich, CH-8057 Zurich, Switzerland; HUMMEL, Juergen, Ludwig-Maximilians-Univ. of Munich, 85764 Oberschleissheim, Germany

Speculations on digestive processes in very large dinosaurs are based on extrapolations from extant animals. These include the concept that gut capacity scales linearily with body mass, that both energy requirements and ingesta retention (mean retention time, MRT) scale allometrically with body mass, and that larger animals therefore have an increased digestive efficiency, especially with regards to plant fiber material.

We will present data that adresses these concepts, in particular gut capacity and ingesta retention. While the linear increase of gut capacity with body mass can be confirmed even for the largest extant herbivore, the elephant, the allometric increase of MRT with body mass cannot be confirmed by a thorough data compilation (even within a group like large mammalian hindgut fermenters). Instead, within the mammalia (for which the most comprehensive database on MRT exists), there seems to be no overall interspecific increase in MRT between body masses of 1 kg and 5 tons. As the claimed allometric increase of MRT is fundamental for the prediction of digestive strategies in models developed so far, this result necessitates the development of other models where MRT is not determined automatically by body mass.

Specific disadvantages of large body mass with regards to digestion have, in contrast, rarely been adressed, such as a decrease in the ratio of gut surface: gut volume, the potential for increased energy losses due to methane production, and an increase in ingesta particle size. The latter appears to be of particular relevance for sauropod dinosaurs that lacked adaptations for mastication.

The most basic determinant of any digestion model for large dinosaurs, therefore, remains body mass, the derived energy requirement, and the available energy content of dinosaur forage.

We will explain how these factors need to be taken into account in a digestion model for large sauropod dinosaurs.

Friday 12:00

THE ENDOCRANIAL ANATOMY OF THE EARLY SARCOPTERYGIAN *POWICHTHYS* FROM SPITSBERGEN REVEALED BY HIGH-RESOLUTION CT SCANS

CLEMENT, Gael, AHLBERG, Per, Evolutionary Biology Center, Uppsala, Sweden

The phylogenetic position of the early Devonian genus *Powichthys* within the Sarcopterygii has proved difficult to resolve. In recent analyses it has been successively considered as the sister taxon of Porolepiformes, of all other Dipnoiformes, of *Youngolepis*, or of all other Sarcopterygii except *Youngolepis*, *Diabolepis* and the Dipnoi. A more complete account of cranial data is necessary to solve this phylogenetic problem as well as to improve our understanding of the early sarcopterygian radiation.

We have investigated an anterior part of the skull of the Lochkovian-Pragian *Powichthys spitsbergensis* using high resolution CT scans. Acid preparation of the specimen before the CT scanning operation has allowed an outstanding degree of resolution. Three-dimensional digital reconstructions of the specimen confirm some recent assumptions, such as an absence of junction between the supra- and infra-orbital sensory-line canals and the presence of a strong internal process of the lachrymal. But it also challenges some others, such as the shape of the anterior part of the palatoquadrate (which is more porolepiform-like than osteolepiform-like) and the polyplocodont-type histological structure of the teeth (which is in fact more complex than previously assumed). New anatomical characters have been revealed such as a complex premaxilla/skull roof overlap arrangement and a pair of processes located on both sides of the so-called mushroom-like structure of the ethmosphenoid. The cranial endocast is on the whole porolepiform-like with separate parapineal and pineal tracts and a hypophysial complex very similar to that of *Glyptolepis*.

Powichthys spitsbergensis presents a combination of characters uniquely shared with *Powichthys thorsteinssoni* from Canada: these two species are indubitably congeneric and distinguishable from *Porolepis*. However, they both share numerous features with porolepiforms, although many of these are plesiomorphic for sarcopterygians.

Saturday 3:00

MAJOR TRANSITIONS IN TERRESTRIAL ARTIODACTYL FORELIMBS

CLIFFORD, Andrew, Brown Univ., Providence, RI

The ancestral condition of artiodactyl forefeet is four digitigrade toes with a reduced digit I. Several extinct families (primitive merycoidodontids, agriochoerids, cainotheriids, anthracotheriids) retain this morphology, but no extant families do. Forefeet in canids are adequate extant analogs. From this ancestral condition, I have identified two major transitions. First, foot posture changed from ancestral digitigrade to simple unguligrade. This foot is best studied in suids. Skeletal indicators of this transition include loss of digit I, modification of the articular surfaces of the phalanges, and reduction of digits II & V. Soft-tissue changes include the loss of fibrofatty digital pads and elaboration of the ligamentous connections of the sesamoid plate. The second major transition in artiodactyl manual evolution is from a simple unguligrade foot to an elastic spring foot, best studied in bovids. Skeletal indicators of this foot type are loss of one or more synovial attachments of digits and/or metacarpals II & V and (usually) fusion of metacarpals III & IV into a cannon bone. Modification of the interosseous muscles into a suspensory ligament is the key soft-tissue change in this transition. The simple unguligrade foot evolved at least four times, and two of these lineages evolved an elastic spring foot. Entelodontids and camelids evolved secondarily digitigrade feet from an (unguligrade) elastic spring ancestor. The mechanical implications of the simple unguligrade foot are poorly understood, although the elastic spring foot presumably increases energy storage and recovery during a stride. Each of the three types (ancestral, simple unguligrade, elastic spring) occupies a distinct region of whole-limb proportion morphospace. They are separated primarily by the proportion of limb devoted to the foot segment, indicating that the key evolutionary changes in artiodactyl locomotion are in the foot. Changes in the proportions or morphology of the forearm segment (radius and ulna) do not describe discreet types of forelimbs. The important mechanical properties of ungulate feet during locomotion await testing.

Poster Session A

A NEW BASIN-WIDE MAGNETOSTRATIGRAPHIC FRAMEWORK FOR THE BIGHORN BASIN, WYOMING

CLYDE, William, HAMZI, Walid, Univ.of New Hampshire, Durham, NH; FINARELLI, John, Univ.of Chicago, Chicago, IL; SECORD, Ross, WING, Scott, Smithsonian, Washington, DC

The Bighorn Basin of Wyoming preserves one of the most continuous continental records of late Paleocene to early Eocene biotic and climatic change. Incomplete paleomagnetic data, highly asymmetric sediment accumulation rates, and differing biostratigraphic zonations have, however, complicated efforts to make precise chronostratigraphic correlations among distant parts of the basin. Geomagnetic polarity reversals are ideal for making chronostratigraphic correlations since they are independent of lithostratigraphic variations and are more precise than biostratigraphic correlations. New paleomagnetic data from the Bighorn Basin (9 sections, > 700 samples) are combined with previously published results to construct a basin-wide magnetostratigraphic framework. Polarity reversals between Chrons C26r, C26n, C25r, C25n, C24r, and C24n have been identified among multiple stratigraphic sections in different parts of the basin. Paleontological, paleobotanical, and isotopic information from these varied locations in the basin can now be correlated using the new magnetostratigraphic framework.

Biostratigraphic records in the basin serve as the basis of biozones used for regional correlation and the new magnetostratigraphic results have several important implications for correlating these biozones to the geomagnetic polarity timescale. (1) Two new magnetostratigraphic records show that the first appearance of *Bunophorus* falls below Chron C24n, resolving previous uncertainty. (2) Cedar Point Quarry (Ti-3), Divide Quarry (Ti-4), and Croc Tooth

Quarry (Ti-4) all occur in Chron C26r, contrary to previous biostratigraphic correlation of the Ti-4 quarries to C26n. (3) Location of Chron C26n on the west side of Polecat Bench helps constrain the first appearance of the immigrant *Probathyopsis* (base of Ti-5) to lower C25r. (4) The Fort Union Formation in the south-central part of the basin extends into Chron C26n which is significantly older than previously assumed.

Friday 10:30

SEARCHING FOR SIGNAL IN THE EARLY ACTINOPTERYGIAN RECORD

COATES, M., FRIEDMAN, Matt, Univ. of Chicago, Chicago, IL

The record of early actinopterygians has long been depicted as a slender spindle through the Devonian, broadening to a substantial column within the Carboniferous before further expansion in the early Mesozoic. This pattern of steady and continual increase in diversity has been unchallenged, and the only questions raised have been to contrast the actinopterygian 'slow-start' with that of the sarcopterygians: consistently more abundant and diverse in Devonian vertebrate faunas. In recent years the Devonian actinopterygian record has been enhanced, but the total number of genera remains remarkably low compared with those of subsequent stratigraphic intervals. However, closer examination of the Carboniferous record yields a much more uneven stratigraphic distribution of actinopterygians than generally reported; there is no steady increase in diversity. A review of genus-level entries in an augmented version of the Sepkoski compendium yields an extraordinary peak-and-trough diversity curve throughout the late Paleozoic. The significance of this pattern is currently unexplored, and questionable given the prevalence of singleton taxa in the database. Levels of supra-generic taxonomic precision and stability needed for such analysis are fairly low, but this is not the case for historical biogeography. Reliable inferences of spatial and temporal patterns of early actinopterygian evolution require more detailed and stable phylogenies than are currently available. Stratigraphic gaps are as likely to reflect poor sampling as they are real absences in the fossil record. Therefore, hypotheses of early actinopterygian biogeography are probably premature. Current efforts should be directed towards phylogeny reconstruction and estimates of record quality, both of which constrain levels of confidence that can be placed in biogeographic scenarios.

Saturday Evolution of Giants symposium poster

BIRD LUNGS: THE KEY TO GETTING REALLY BIG: THE ALLOMETRY OF RESPIRATORY PARAMETERS IN SAUROPODS

CODD, Jonathan, PERRY, Steven, Bonn Univ., Bonn, Germany

The avian lung-airsac system consists of a constant-volume lung, composed of a lung pipes (parabronchi) and an extremely dense meshwork of blood capillaries and air capillaries, and large, compliant air sacs. The lung contains on the average three times as much surface area (S) per unit volume as a mammalian lung and the air-blood diffusion distance (δ) is only half as great. Thus the anatomical diffusion factor (ADF = S/ δ), which is an indicator of the diffusive conductance (diffusing capacity = DO_2) of the lung for oxygen, can be 6 times as great as in a mammal of the same size. Physiologically, avian lungs are also more efficient than those of mammals: they show a lower air convection requirement (amount of air breathed per unit oxygen obtained) and are able to obtain a greater partial pressure of oxygen in the blood than in the expired air. Analyzing published data for the anatomy and physiology of respiration in birds and mammals of different size and extrapolating these values to sauropod proportions reveals that at body weights of 100 tonnes the physiologically measured DO_2 approaches or may even exceed the anatomically measured value in both birds and mammals. Since the diffusing capacity in birds increases at a greater rate than that of mammals as the body weight increases but the oxygen consumption rate in mammals increases more rapidly than in birds, it is clear that an avian lung would provide an advantage for very large animals. Comparing the values of birds and mammals with morphometric estimates of dinosaur lung anatomy (based on the best values for recent reptilian lungs) shows that the dinosaur lung has a lower diffusing capacity and increases less rapidly with an increase in body weight than in homeotherms. Thus the physiological advantages provided by the avian-style lung-airsac system could have been important in achieving very large body size.

Saturday 11:15

TAPHONOMY OF THE VERTEBRATE SKULL AS REVEALED BY HRXCT

COLBERT, Matthew, Univ.of Texas Austin, Austin, TX

The internal cavities of vertebrate skulls represent a remarkable setting for sediment deposition and diagenesis. The confined passageways and cavities of the skull present a unique hydrodynamic situation that constrains the movement and deposition of sediment, as well as the movement of mineral-rich groundwaters involved in cementation and mineralization. Although these sedimentary and diagenetic features are usually either inaccessible or destroyed using conventional preparation techniques, they can be dramatically illuminated using high-resolution X-ray computed tomography (HRXCT), a non-destructive and non-invasive technique for visualizing the interiors of opaque objects. Some examples of depositonal features observed in CT data sets of vertebrate skulls include sedimentary bedforms and graded or sorted sediment, all of which can be used as hydrodynamic indicators. Bioturbation of the enclosed sediments is also observed, demonstrating the suitability of vertebrate skulls as habitat for other organisms after death. Mudcracks and fractures are common, and CT scans can also reveal patterns of cementation and mineralization corresponding to fractures and anatomical features. These patterns often indicate different generations of cementation and mineralization. To illustrate the potential of HRXCT for taphonomic studies, several examples are presented here, including scans of marine and terrestrial reptiles and mammals from a wide range of geological settings.

Poster Session A

TRACE FOSSILS IN MARINE SEDIMENTS OF THE MOWRY SHALE (EARLY CRETACEOUS) OF WYOMING ARE POSSIBLY VERTEBRATE IN ORIGIN

CONNELY, Melissa, TALBOT, Brandy, Casper College, Casper, WY

A variety of ichnofossils was found in a Bureau of Land Management's (BLM) Off Highway Vehicles (OHV) Park northwest of Casper, WY. The outcrop is a well preserved upper surface of the Mowry Formation, believed to be marine in origin. The surface is covered with various trace fossils. One set of impressions have been identified as a squid-like creatures: *Asterichnites octoradiatus*. Other traces are unknown but are believed to be vertebrate in origin. These tracks and traces resemble claw marks, foot prints and tail drags. These unique and poorly known trace patterns may possibly be produced by Mesozoic crocodiles and/or other marine reptiles. The presence of these traces can be used to describe the paleoecology of the Mowry Seaway as well as give possible clues to the paleoenvironmental conditions. Because this site is located in a high traffic recreational vehicle park, and because most of the traces have yet to be described, the BLM has developed a partnership with Casper College to map and document the site.

Poster Session B

THE DIET OF CHALICOTHERES (MAMMALIA, PERISSODACTYLA) AS INDICATED BY LOW MAGNIFICATION STEREOSCOPIC MICROWEAR ANALYSIS

COOMBS, Margery, Univ.of Massachusetts Amherst, Amherst, MA; SEMPREBON, Gina, Bay Path College, Longmeadow, MA

Chalicotheres (Mammalia, Perissodactyla) bear clawed digits but have dental characters suggesting an herbivorous diet, an unexpected combination that has long fascinated paleontologists. To investigate chalicothere diet, we used low magnification stereomicroscopic microwear analysis to explore molar tooth surfaces of selected North American and Eurasian chalicotheres. None of the chalicotheres studied has microwear typical of extant leaf-dominated browsers. Eocene chalicotheres (North American *Eomoropus* and Asian *Litolophus*) have results consistent with standard fruit browsing such as that seen in extant duikers today (e.g. *Cephalophus natalensis*), while the more derived Miocene Chalicotheriidae possess a large percentage of coarse and hypercoarse scratches consistent with extant bark or twig consumers or hard seed and/or pitted fruit consumers. Cluster analysis places members of both chalicotheriid subfamilies—Chalicotheriinae and Schizotheriinae—with several unusual and coarse-wear extant browsers such as *Okapia johnstoni*—a high-level browser, *Cephalophus dorsalis*—a hard fruit/seed consumer, and *Loxodonta africana* and *Diceros bicornis*—which consume a fair amount of bark and twigs in their browse. Most of the Schizotheriinae studied (*Moropus*, *Tylocephalonyx*, *Ancylotherium*) lack the puncture pits and other microwear features typical of fruit consumption and may have relied more on bark or twigs in their browse. The European schizotheriine *Metaschizotherium* and the Chalicotherinae possess medium-sized and large-sized puncture pits and scratch textures typical of hard fruit and/or seed browsing. The chalicotheriines *Chalicotherium goldfussi* and *Anisodon grande* are unique in terms of possessing very coarse microwear, compatible with hard object processing and with the robust jaws of these animals. Such analyses suggest that chalicotheriids, which have postcranial adaptations indicative of high-level browsing, may have employed their claws to gather branches from trees (perhaps even to strip off bark) or to gain access to tough fruits and/or seeds.

Poster Session A

CLASH OF THE TITAN(OSAUR)S: INVESTIGATING SAUROPOD PHYLOGENY

CORFE, Ian, Univ. of Bristol, Bristol, United Kingdom; WILKINSON, Mark, Natural History Museum, London, United Kingdom

Ever larger sauropod phylogenies have been produced in recent years, bringing with them the promise of better resolution and support. However, despite increases in numbers of both taxa and characters, and data sets by numerous authors being merged to varying degrees, there is still much topological conflict between recent published analyses. There are a number of possible reasons for conflict in cases such as this, including; choice and interpretation of characters; choice of taxa; interpretation of homoplasy; amount of missing data; various forms of error. A comparison of the two most taxonomically complete published recent sauropod phylogenies revealed that all of these problems are present to varying degrees in both.

The way in which, and the degree to which each of the causes of conflict influences phylogeny topology is largely unknown. The goal of this study was therefore to use the debate over sauropod relationships as a case study in the comparison of differing morphological phylogenetic analyses. The principle aims were; quantification of the degree of congruence and conflict between the two phylogenies; assessment of the causes of topological conflict and discussion of how such problems may be resolved; and evaluation of the various strategies available to the morphological phylogeneticist for data analysis and conflict investigation.

Results show that each of the phylogenetic hypotheses examined has topological areas that are well supported, and different areas that are poorly supported. Conflict between the two phylogenies was identified and examined in detail, and either the conflict resolved, or the char-

acter/taxa removed, as necessary. A composite data matrix was produced in order to investigate the behaviour of new character and taxa interactions. Finally, a set of methodological recommendations is presented to enable the comparison of conflicting phylogenetic hypotheses, and guide the use of techniques for investigating them. Although the taxonomic focus is on the phylogeny of the sauropoda, many of the issues detailed are of wider concern in morphological phylogenetics.

Saturday 8:30

INFERRING HABITAT FOR THE LATE EARLY MIOCENE SANTA CRUZ FAUNA (SANTA CRUZ PROVINCE, ARGENTINA) USING ECOLOGICAL DIVERSITY ANALYSIS

CROFT, Darin, TOWNSEND, Kathryn, Case Western Reserve Univ. School of Medicine, Cleveland, OH

The upper lower Miocene Santa Cruz Formation of southern Argentina has produced the largest and best-preserved sample of Tertiary mammals in South America. Charles Darwin was among the first to note the presence of Santa Cruz mammals (based on fossils found by Captain B.J. Sulivan) and important collections were later made by well-known collectors such as Carlos Ameghino, John Bell Hatcher, and Elmer Riggs. The degree to which Santa Cruz taxa have influenced understanding of pre-Pleistocene South American mammals cannot be overestimated; most genera from the fauna are represented by skulls and/or skeletons and many of these are the most completely known members of their families. Despite these incredibly rich Santa Cruz collections, few studies have explicitly attempted to reconstruct the environment in which these animals were living.

The present study used Ecological Diversity Analysis (EDA) to infer the habitat of the Santa Cruz Fauna. Three ecomorphological variables were used (body mass, locomotor style, and dietary preference), each subdivided into a varying number of categories (twelve, six, and five, respectively). A comparative dataset of 34 modern Neotropical mammal faunas was compiled and a discriminant model was constructed to distinguish among different modern habitats based on the percentage of taxa in seven ecomorphological categories (or combinations thereof). After reconstructing the ecomorphology of each Santa Cruz taxon, the discriminant model was used to infer the habitat of the lower biozone, the upper biozone, and the entire fauna. In all three cases, the faunas were interpreted with high probability as open habitats (similar to that of the Altiplano), though centroid distances far exceeded those of the modern faunas. This analysis suggests that the Santa Cruz fauna was highly dissimilar to any modern Neotropical fauna and that more appropriate models—if they exist at all—might be found in the Old World Tropics. It also highlights the need for detailed paleobiological reconstructions of South American taxa to increase the precision of this type of paleoecological analysis.

Poster Session B

THE PLEISTOCENE CAMELID RECORD FROM CENTRAL MEXICO

CUEVAS-RUIZ, Gloria, Universidad Autonoma del Estado de Hidalgo, Pachuca, Mexico

The published information about Mexican pleistocene camels indicates the presence of specimens referable to *Titanotylopus*, *Palaeolama*, *Camelops* and *Hemiauchenia*. In particular, the fossil material of the latest two taxa is abundant and the available sample proceeds from localites in Central Mexico, specifically in the Mexican Basin and the states of Jalisco, Aguascalientes, Guanajuato, Hidalgo, Tlaxcala and Puebla.

In recent years, paleontological work performed in Pleistocene fluviolacustrine deposits located in south-central region of Hidalgo, southern Puebla and Tlaxcala, allowed to recover diverse dental and osteological camelid remains. The taxonomic analysis of this sample leads to consider the presence of material belonging to *Camelops* and *Hemiauchenia*.

The *Camelops* sample includes numerous isolated lower molariforms, a mandibular fragment, sixth cervical vertebra, scapular, radius and metapodial fragments, two phalanges, one astragalus and a scaphoid. The taxonomic assesment of this assemblage was based on the following character conditions: very hypsodont molariforms, poorly developed llama buttresses, wedge-shaped p4, well developed posteroventral costellar process on cervical vertebra, W-shaped suspensory ligament scar on the proximal phalanx, as well as long and stocky metapodials.

Hemiauchenia remains includes a partial skull, two mandibular fragments, several upper and lower molariforms, scapular and tibial fragments, two phalanges, and two metapodial fragments, whose identity is defined by the skull morphology, moderately developed llama buttresses, long and slender metapodials.

This record gives additional information on the presence of *Camelops* and *Hemiauchenia* in Central Mexico, and constitutes the southernmost evidence of both genera in North America, likewise, corroborates its wide distribution during the Pleistocene.

Saturday 3:00

THE POSTCRANIAL ANATOMY OF *RAPETOSAURUS KRAUSEI* (SAUROPODA: TITANOSAURIA), WITH COMMENTS ON LIFE HISTORY STRATEGY

CURRY ROGERS, Kristina, Science Museum of Minnesota, St Paul, MN

Titanosauria, the last surviving group of sauropod dinosaurs, attained a near-global distribution by the close of the Cretaceous. Titanosaurs are known from many isolated elements but few partial skeletons, and their overall anatomy has remained ambiguous. Fortunately, an exceptional sample of titanosaur fossils from the Upper Cretaceous Maevarano Formation of Madagascar provides a head-to-tail look at *Rapetosaurus krausei* that clarifies titanosaur anatomy. Hundreds of bones have been recovered including an associated juvenile skeleton (FMNH PR 2209) from locality MAD93-18, as well as numerous other associated and articulated juvenile and adult specimens. The axial skeleton of *Rapetosaurus* consists of at least 15 cervical, 10 dorsal, and six sacral vertebrae. Eighteen mid-posterior caudals were preserved with FMNH PR 2209, as were sternal plates, scapulae, coracoids, humeri, radii, ulna, and metacarpals I-V. The hindlimb of FMNH PR 2209 includes ilium, ischia, pubes, femur, tibia, fibula, and metatarsals I-V. The association of large osteoderms with adult specimens confirms the lithostrotian status of *Rapetosaurus*, and these new skeletal data have proven significant for phylogenetic revision of Titanosauria.

Data garnered from *Rapetosaurus* postcrania have implications for the paleobiology of Titanosauria, which includes both the smallest and largest sauropods. However, lack of phylogenetic resolution and few ontogenetic series have hindered a detailed understanding of these evolutionary innovations. *Rapetosaurus*, with its well known skeleton and ontogenetic sample ranging from juvenile to adult stages (femur length 19 cm-1.6 m) provides the first opportunity for the application of developmental mass extrapolation to a member of Titanosauria. Preliminary data indicate that, like other sauropods, *Rapetosaurus* exhibited an elevated growth rate, particularly in early ontogeny. Resolution of *Rapetosaurus'* somatic growth rates pave the way for the analysis of dwarfism and gigantism within Titanosauria.

Student Poster Session

NEW INFORMATION ON THE HOLOTYPE OF *BRACHYLOPHOSAURUS CANADENSIS* (ORNITHISCHIA: HADROSAURIDAE): ANATOMICAL RECONSTRUCTION AND ANALYSIS

CUTHBERTSON, Robin, Carleton Univ., Ottawa, ON, Canada

The holotype of *Brachylophosaurus canadensis* was collected by C.M. Sternberg in 1936 from the Oldman (Judith River) Formation of Alberta, Canada. Recovered was a partial skeleton consisting of the skull, cervical and anterior dorsal vertebrae, ribs, scapulae, coracoids, humeri, left ulna and radius, and partial left and right manus.

A brief description by Sternberg was not published until 1953. The paper was predominantly a cranial description and other than providing basic dimensions, the postcranial skeleton remains virtually undescribed. Consequently, a redescription of the holotype skeleton of *B. canadensis* was undertaken to allow proper comparison and evaluation of the genus.

New information provided on the holotype of *B. canadensis* includes a corrected and reoriented rostrum, repositioned anterior nasals that laterally cradle the posterodorsal premaxillary process, properly repositioned anterior maxillary processes (with resulting inferences on maxillary kinetics), and a revised maxillary tooth row count of approximately 43 from 49. Additionally, reconstructive drawings made for this study display elements or views not previously published.

Morphological comparison is also made with recently published work on *B. canadensis* from eastern Montana. The holotype differs from these Montana specimens in having 6 additional dentary tooth row positions for a total of 39, no nasal foramina medial to the prefrontals, the presence of a single premaxillary foramen, and an intermediate crest morphology.

Poster Session B

RELATIONSHIP OF BODY WEIGHT AND MOLAR SIZE IN BATS AND THE PREDICTION OF BODY MASS IN SOME EXTINCT SPECIES

CZAPLEWSKI, Nicholas, GORDON, Cynthia, Univ.of Oklahoma, Norman, OK

The relationship between tooth size and body size has been well documented for a variety of mammalian species. To date, no studies have been done examining this relationship in bats. In this study, least squares regression analysis was used to examine the relationship between body mass and length and width of first and second molars in living species of Chiroptera, mainly New World taxa. About 180 species were measured, selected from among all families in the order, except Pteropodidae and Craseonycteridae. Regression analysis was performed for all bats (a pooled sample), as well as for 15 families and four superfamilies (Emballonuroidea, Noctilionoidea, Rhinolophoidea and Vespertilionoidea). The predictive equations were then used to estimate the body mass of extinct species of bats known mainly by fossil teeth.

Among the four molar loci (upper and lower first and second molars), the lower first molar usually was the most highly correlated with body mass, as is often true in other orders of mammals. Correlation coefficients for analyses of all bats were highest for lower first molars. When analyses were performed on superfamilies, the highest correlation between lower first molars and body size occurred in Emballonuroidea and the lowest in Rhinolophoidea (probably due to a small sample) and Vespertilionoidea. Of the regression analyses performed on 15 families, lower first molars were most highly correlated with body mass in Emballonuridae, Molossidae, Noctilionidae and insectivorous Phyllostomidae. Lower second molars and body mass were also highly correlated in these families. The relationship between tooth size and body size was much stronger in insectivorous Phyllostomidae than in frugivorous species of this family. The predicted body mass of several extinct bat species indicates that body mass of fossil bats is well within the range of modern bat species.

Friday 10:15

BIOGEOGRAPHY OF THE MIDDLE AND LATE DEVONIAN (LATE GIVETIAN-FRASNIAN) ICHTHYOFAUNA FROM THE OKSE BAY GROUP, NUNAVUT TERRITORY, CANADA

DAESCHLER, Edward, Academy of Natural Sciences, Philadelphia, PA; ELLIOTT, David, Northern Arizona Univ., Flagstaff, AZ; SHUBIN, Neil, Univ. of Chicago, Chicago, IL; MARK-KURIK, Elga, Tallinn Univ. of Technology, Tallinn, Estonia; JENKINS, Farish, Harvard Univ., Boston, MA

A diverse Middle and Late Devonian (late Givetian-Frasnian) ichthyofauna has recently been recovered from the Fram and Nordstrand Point Formations on southern Ellesmere Island and their distal equivalent (Beverley Inlet Formation) to the west. The fauna includes agnathan, placoderm, and sarcopterygian taxa that suggest close biogeographic affinity with the Baltic Region and Scotland.

Psammosteid agnathans from the Okse Bay Group include *Psammolepis*, *Ganosteus*, *Rohonosteus*, and *Psammosteus*. These taxa occur in the same stratigraphic order in the Okse Bay Group and in the Main Devonian Field in the Baltic Region. The obrucheviid, *Perscheia*, from the Okse Bay Group is the only record of these distinctive agnathans outside of northwestern Russia where *Obruchevia* occurs in the same time interval. Preliminary work on asterolepid and bothriolepid placoderms from the Okse Bay Group indicate a diversity of species, some of which appear to be new. Sarcopterygians found in association in the middle part of the Fram Formation include *Laccognathus*, *Eusthenopteron*, and an elpistostegid-grade taxon. These taxa are also found in association in the early Frasnian of the Main Devonian Field. The diversity of other holoptychiid porolepiforms from the Okse Bay Group is in need of further investigation.

The close similarity between the ichthyofaunas of the Okse Bay Group in Nunavut and the Main Devonian Field in the Baltic Region supports the existence of a northern Euramerican biogeographic province during the Middle and Late Devonian. Similar faunas are seen at Scottish localities and to a lesser degree at North American localities such as Miguasha and Red Hill, Nevada.

Poster Session A

A SMALL ORNITHISCHIAN DINOSAUR FOOTPRINT ASSEMLAGE FROM THE EARLY JURASSIC, HOLYOKE, MA

DALMAN, Sebastian, Univ.of Massachusetts Amherst, Amherst, MA

Numerous trackways of small ornithischian dinosaurs referable to the ichnogenus *Anomoepus* were discovered in spring 2004 in an outcrop of mudstone layer belonging to the East Berlin Formation at the Gary Gaulin footprint site in Holyoke, MA. Much of the rock bearing these small footprints was excavated in 1996, and as a consequence some of the footprints occur on several disarticulated slabs. However, the recently discovered tracks of various sizes still remain *in situ*. Additionally, the site also yields multiple tracks belonging to the ichnogenera *Eubrontes*, *Anchisauripus* and *Grallator*. However, the small footprints of *Anomoepus* are the subject of the present study.

I have documented the footprints using a variety of techniques, including photography, mylar tracing and mapping. Measurements recorded from the fossils include length and width of the pes and manus, pace length and stride length. The tracks are randomly distributed *in situ* without preferred orientation. However, proximity of these trackways to one another might provide evidence for possible herding behavior of ornithischian dinosaurs inhabiting the same locality. Additionally some of the trackways indicate that some of the animals walked in a plantigrade quadrupedal manner, a mode of locomotion common for this ichnogenus from the Connecticut Valley.

Wednesday 11:30

FEEDING IN THE KOMODO DRAGON, *VARANUS KOMODOENSIS*: TAPHONOMIC AND FUNCTIONAL IMPLICATIONS OF ZIPHODONT DENTITION

D'AMORE, Domenic, Rutgers: The State Univ. of New Jersey, Edison, NJ

The majority of carnivorous Mesozoic archosaurs possessed ziphodont dentition, yet the functional and taphonomic implications of this dentary morphotype for paleoecological studies remain largely unexplored. First, there is disagreement in the paleontological literature concerning the frequency and validity of tooth marks presumably produced by extinct taxa with ziphodont dentition, especially the theropod dinosaurs. Secondly, there are few experimental studies that primarily address the functional morphology of ziphodont dentition. The Komodo dragon, *Varanus komodoensis*, is the only extant tetrapod with this dental morphotype, making it an appropriate analogue for feeding behavior in carnivorous Mesozoic archosaurs. Therefore, neo-taphonomic observations were conducted to gain a better understanding of these principles. Carcass portions, consisting of partially defleshed limbs of domesticated artiodactyls, were fed to a captive bred *V. komodoensis*. The animal's behaviors exhibited during the feeding bouts were observed and recorded using a handheld, one mega-pixel, digital camera. The bones were later processed and examined for tooth marks.

These experimental results showed that a tetrapod with ziphodont dentition (*V. komodoensis*) does produce tooth marks, even though the animal tended to avoid unnecessary contact with bone surfaces and did not process the bones for within-bone nutrients. These tooth markings occur at a low frequency and consist of mostly scores. In the future, these marks will be compared to alleged tooth marks found on Mesozoic fossil bones in order to better determine if the assemblage was accumulated by carnivory. In addition, analysis of the movement of the *V. komodoensis* head suggests a functional correlation with the positioning of serrations along the tooth carinas. If this correlation holds true for extinct ziphodont taxa, one may be able to deduce the direction of head and tooth movement while feeding based on the relative positioning of these serrations in extinct taxa.

Wednesday 3:00

PALEOECOLOGICAL INFERENCES USING TOOTH WEAR RATES, HYPSODONTY AND LIFE HISTORY IN UNGULATES

DAMUTH, John, Univ.of California Santa Barbara, Santa Barbara, CA; JANIS, Christine, Brown Univ., Providence, RI

Ungulate teeth wear at different rates, depending on both the diet and habitat preferences of each species. Increased crown height (hypsodonty) lengthens the lifetime of a tooth in the face of high rates of tooth wear. The time required for the permanent dentition to be worn to the point where function is lost places a definitive limit on individual lifespan. Thus ungulates are constrained by their degree of hypsodonty to particular combinations of habitat types and plant foods. Knowing these joint constraints would allow well-informed paleoecological inferences, but disentangling the various factors is difficult. A major problem is the fact that the fitness consequences of differences in longevity are understandable only in the context of a population demographic analysis. Many life history variables (e.g., litter size, age at first reproduction) are predictable from body size, so we can estimate realistic values for fossil species. This allows us to model the demography of fossil species using standard matrix projection models. With projection matrices we can take a fossil species of known unworn m3 crown height and estimated body mass, and generate a series of demographic models, varying longevity (which represents limits imposed by different rates of tooth wear) and life-history parameters. This way we can identify those combinations of demographic variables that allow the possibility of a positive population growth rate (λ), and thus estimate the maximum rate of molar wear that the species could experience without rapid population extinction. Comparing this rate with a new dataset on rates of tooth wear in extant ungulates reveals the combinations of habitat and diet that are viable for those species. Application to mid-Miocene low-crowned (brachydont) fossil ungulates shows that these species could not have endured wear rates characteristic of species that today feed on substantial amounts of grass in any habitat, nor could they have fed on any diet in a grassland steppe. Because they are the species most severely limited by crown height, brachydont species are particularly powerful in constraining interpretations of paleohabitats.

Poster Session A

HEADS AND SKULLS AS SEDIMENT SORTERS: AN ACTUALISTIC, CT-BASED STUDY IN TAPHONOMY

DANIEL, Joseph, WITMER, Lawrence, Ohio Univ., Athens, OH

Whereas fossilization is an uncertain process at best, soft-tissue preservation is particularly rare, typically found as impressions, casts, or stains. Soft-tissue preservation can be difficult to recognize, and interpretations are often hotly debated. Interpretations may be clarified by actualistic taphonomic studies. CT scans of fossil skulls frequently show density variations within rock matrix within the skull cavities (e.g., the matrix filling the pneumatic cavities of *Nanotyrannus* is clearly of lower density). These variations may be due to factors inherent in sediment infilling, biological activity or remains, or some combination. Due to their complicated construction, fleshy heads and dried skulls may sort sediment, and this sediment sorting may be influenced by soft tissue. If this hypothesis is valid, considerable anatomical information may remain in the matrix, even after the soft tissues themselves were degraded. For example, one might predict that finer sediments might infill the paranasal sinuses than the main nasal cavity, and that relatively coarser sediments might be found in the oral cavity. In exceptional cases, it may even be possible to distinguish remnants of nasal conchae and other major soft tissue structures. We are addressing this question in laboratory experiments in which we will bury a variety of heads (e.g., pig, alligator, ostrich), spanning the spectrum of decomposition from fresh heads to clean skulls and allowing control of both the aqueous depositional environment and the grain size of the sediment. After burial, the heads and surrounding 'matrix' will be frozen and CT scanned. Variations in the CT density will be correlated with grain size by direct sampling of infilled sediment. These data will be compared with variations found in CT scans of fossil skulls. The experimental 'modern fossils' will provide a baseline for interpretation of CT scans of matrix-filled fossils, potentially allowing us to extract more anatomical information than previously thought possible. Moreover, it may be possible to identify optimal soft-tissue preservational environments, such that fieldwork can target promising rock units.

Poster Session A

CHRONISTER DINOSAUR SITE INVESTIGATIONS: NEW INFORMATION ON THE CRETACEOUS OF MISSOURI

DARROUGH, Guy, Marble Hill, MO; FIX, Michael, Univ. of Missouri, Saint Louis, MO; PARRIS, David, New Jersey State Museum, Trenton, NJ; GRANDSTAFF, Barbara, Univ. of Pennsylvania, Philadelphia, PA

Improved excavation technologies have yielded better specimen recovery and detailed records than were previously possible at the Chronister Site, an admittedly challenging deposit.

Well-preserved specimens have been collected, as jacketed removal has become possible. Among these are substantial skull fragments of hadrosaurs, with major portions of dentitions. Partially articulated limb material is currently being prepared in relief. Recovery of tiny specimens can now be more systematically sustained, and additional fish taxa have been identified. The associated fauna of hybodontids, batoids, lepisosteids, amiids, aquatic turtles, and crocodylians along with dinosaurs indicates a substantial body of water not far from the epicontinental shoreline. Virtually all taxonomic groups thus far identified are also known from the Ellisdale Site, Campanian of New Jersey.

Poster Session B

FIRST VERTEBRATE FOSSILS FROM THE EAGLE FORMATION (UPPER SANTONIAN), NORTH CENTRAL MONTANA

DAVIS, Brian, Univ.of Oklahoma, Norman, OK; DAVIES, Kyle, OMNH, Norman, OK

The Aquilan Land Mammal Age (?latest Santonian-early Campanian) was an important period in the evolution of early higher mammals. It marks the first major marsupial diversification event in North America, as well as the first uncontroversial occurrence of Eutheria since the Aptian/Albian. Appearing in the fossil record during the Aquilan are basal members of "Pediomyidae" as well as morphologically important didelphids and stagodontids, and the Asian nyctitheriid *Paranyctoides*. Until now, the only well-represented Aquilan fauna comes from the Milk River Formation, southern Alberta; smaller, presumably time-equivalent assemblages have been reported from the Wahweap Formation and other units in southern Utah. Hence, this important time interval remains poorly represented by the fossil record.

The OMNH has conducted brief reconnaissance trips to the Eagle Formation in north central Montana. Previous studies have suggested a stratigraphic correlation between this unit and the Milk River Formation, which outcrops in nearby southern Alberta. Small rock samples were collected from two microsites in the Eagle Formation, yielding an abundant and diverse microvertebrate assemblage. Teeth and other skeletal elements were recovered, representing a variety of fish, sharks, turtles, lizards, crocodiles and dinosaurs. Isolated mammal teeth were also recovered, likely representing at least six taxa, including several multituberculates, a marsupial, a eutherian, and the stem boreosphenidan *Picopsis*. Given the small samples collected, preliminary results to date suggest the potential for recovery of a large microvertebrate fauna from the Eagle Formation, significantly augmenting knowledge of mammalian evolution during the Late Cretaceous of North America.

Wednesday Mammal Evolution Symposium poster

TESTING THE TURNOVER PULSE HYPOTHESIS WITH FAMILIES OF MAMMALIAN UNGULATES IN THE MIOCENE OF THE WESTERN USA

DAVIS, Edward, Univ. of California Berkeley, Berkeley, CA

Previous work has indicated no consistent relationship between North American mammalian evolution and global climate change, and, similarly, turnover pulses have not been recognized in the Neogene of the USA. I have used faunal records from the MIOMAP database (Miocene mammals of western USA) to test whether dynamic, turnover-pulse-style responses to changing global climate might be clade specific. That is, turnover pulses might be characteristic in some lineages, but the typical mammalian response to climate change is individualistic, swamping the signal of those lineages tied to climate. In order to test this hypothesis, I examined origination and extinction dynamics for six clades of ungulate mammals (Equidae, Rhinocerotidae, Camelidae, Moschidae, Antilocapridae, and Palaeomerycidae) that had relatively high diversity in western North America during the changing climates of the middle to late Miocene. Herbivores, like these ungulates, should be more closely tied to environmental change than carnivores.

Results indicate no significant correlation of turnover pulses with climate change for any of these groups at the million-year scale. Camelids and moschids experienced significantly high speciation during intervals marked by long-term climate stability. Neither pulse was matched by a significant pulse of extinction.

Origination and extinction rates are significantly correlated only for camelids and moschids, indicating the other families are not experiencing turnover pulses at a smaller temporal scale. Removing singletons reduces the significance, but the correlation between rates remains. This could indicate turnover pulses structuring their diversity, but could also be a spurious correlation because of the number of clades examined.

Pulsed turnover is not a mammalian response to climate change at the million-year, subcontinental scale in the western USA, but this macroevolutionary process may be operating at a smaller temporal scale within a minority of clades. Future work at higher temporal resolutions, using local climate proxies, is necessary to understand individual clade responses at local and regional scales.

Romer Prize Session, 9:15

FEEDING DINOSAURIAN HERBIVORES: THE NUTRITIVE VALUE AND DIGESTIBILITY OF MESOZOIC FOLIAGE

DECHERD, Sara, Raleigh, NC

A paradox of the Mesozoic Era is that many herbivorous dinosaurs were large-bodied and numerous and are hypothesized to have been energetic with high metabolic rates, while plants were predominantly gymnosperms of low nutritional quality and poor digestibility. This study tests the hypothesis that Mesozoic terrestrial ecosystems were more productive and plants were more digestible and nutritious on a per unit basis than in modern environments due to an atmosphere highly enriched in both carbon dioxide and oxygen.

In order to test this hypothesis, month-long growth chamber experiments were performed at the Duke Univ. Medical Center (Durham, NC) on *Ginkgo biloba* seedlings. Gas exchange, nutritive value, and digestibility parameters of the leaves produced during experimentation were measured. *Ginkgo* is a living fossil with an abundant Mesozoic fossil record. Experimental treatments employed the following atmospheric compositions:

1. Control: modern/ambient atmospheric gas mix, 1 atm pressure
2. CO_2: carbon dioxide elevated to 2000 ppm (5.5 times ambient) and pressure increased to 1.25 atm
3. CO_2&O_2: carbon dioxide elevated to 2000 ppm, oxygen elevated to 30% (50% increase over ambient) and pressure increased to 1.25 atm.

Results indicate that primary production is increased up to 200% over ambient levels when plants are exposed to elevated carbon dioxide and oxygen. Similarly, the digestibility of *Ginkgo* leaves increases with an increase in carbon dioxide. Nutritive value, however, decreases with additional carbon dioxide, but this decrease is not observed when oxygen is also increased, indicating that overall nutritive value is not significantly decreased even with the hypothesized doubling of productivity. Therefore, in an atmosphere with elevated carbon dioxide and oxygen, such as that thought to have occurred during the Mesozoic, plants were likely more productive, more digestible, and as nutritious as modern plants. This physiological response to an enriched atmospheric composition could have allowed the flora to support the herbivorous megafauna, thus providing a possible solution to the Mesozoic paradox.

Romer Prize Session, 9:30

PHYLOGENETIC RELATIONSHIPS BETWEEN PALEOGENE PROBOSCIDEANS: NEW DATA AND IMPACT ON TETHYTHERIAN SYSTEMATICS

DELMER, Cyrille, Museum National D'Histoire Naturelle, Paris, France

During the last two decades, successive discoveries of new early proboscideans drastically increased the knowledge of the emergence and differentiation of this emblematic taxon. The description of *Numidotherium koholense*, *Phosphatherium escuillie*i and *Daouitherium rebouli* from the early and middle Eocene of North Africa led to reconsider the ancestral morphotype of the order, as their strictly lophodont dentition associated with very primitive cranial and post-cranial features contradict the commonly agreed theory on the emergence of the proboscidean dentition from a bunolophodont dental pattern very close to that of the genus *Moeritherium*.

The recent availability of the collections of the enigmatic *Barytherium grave* from Dor El Talha, Libya, led to the revision of all available data on Paleogene proboscideans and their comparison with early tethytheres and related taxa. This study resulted in a cladistic analysis of 226 cranial, dental and post-cranial characters applied to 17 taxa. Its results confirm the growing hypothesis of a lophodont dental ancestral morphotype for the proboscideans, *Moeritherium* appearing to be closer to deinotheres and elephantiformes than the other strictly lophodont taxa such as *P. escuillei*, *N. koholense* or *B. grave*. More over, this analysis led to reconsider the status of the Libyan species *Numidotherium savagei*. Deinotheres also seem to share more similarities with early elephantiformes than with other early proboscideans. Their dentition, superficially similar to that of *B. grave*, appears to be convergent, and the recently proposed taxon Plesielephantiformes is shown to be paraphyletic. Finally, this study, using partial analyses and partitioned Bremer support, emphasizes that the close relationship between proboscideans and *Arsinoitherium* often found in recent parsimony analyses focusing on cranial morphology, appear here to rely essentially on a convergence of its post-cranial anatomy, especially on its limb extremities.

Poster Session B

FAUNAL ANALYSIS AND PALEOECOLOGY OF THE LOWER VERTEBRATE MICROFOSSIL ASSEMBLAGES OF THE MESAVERDE FORMATION (UPPER CRETACEOUS, CAMPANIAN) OF THE WIND RIVER AND BIGHORN BASINS, WYOMING

DEMAR, JR., David, BREITHAUPT, Brent, Geological Museum, Univ. of Wyoming, Laramie, WY

The Mesaverde Formation (Campanian, 74-76 Ma) of the Wind River and Bighorn basins of Wyoming has produced abundant vertebrate microfossil material throughout 44 localities. The most taxonomically diverse and productive of these sites is the Barwin Quarry/Fales Rocks locality (UW V-81006) situated stratigraphically within the lower part of the unnamed middle member in the southeastern Wind River Basin. Fossil material collected from UW V-81006 was found within yellow channel sandstones. Paleoecological interpretations of the non-mammalian vertebrates of UW V-81006 have been derived and are based on descendant taxa, faunal associations, and sedimentological analyses. Comparisons of these vertebrate taxa with those of other geographically contemporaneous formations allows paleontological comparisons to be made across a north-south transect of the Western Interior during the Late Cretaceous. Based on the paleontology and sedimentology of this region, the interpreted paleoecology is that of a meanderbelt depositional system, with floodbasin and point-bar deposits.

Previous work done on these microsites has yielded thousands of fossil remains consisting of cartilaginous and bony fishes, amphibians, reptiles (including pterosaurs and dinosaurs), and birds via underwater screen-washing, dry screening, surface collecting, and quarrying. Several

new taxa have been identified within the sampled material from UW V-81006 and include the remains of juvenile hadrosaurs, theropods, and crocodilians. Additional material recovered northeast of Worland in the Bighorn Basin includes teeth from the primitive tarpon, *Xiphactinus*, and the angel shark, *Squatina*. Unearthing of these fossil specimens may represent the first appearances of species previously unrecognized in Wyoming. Investigations of the Campanian faunas of Wyoming are still in their infancy, but continued research will no doubt unveil needed evidence to enhance our understanding of life during the Late Cretaceous.

Wednesday 4:45

MINIMIZING THE RISK-A REVIEW OF THE RELATIVE TOXICITY AND SAFE HANDLING OF POLYMERIC ADHESIVE AND CASTING MATERIALS USED IN PALEONTOLOGICAL PREPARATION

DENTON, Robert, Specialized Engineering, Ranson, WV

Polymeric adhesive and casting materials have been used for decades in the preparation and reproduction of vertebrate fossils, however few workers are aware of the potential risks to human health posed by these compounds. Often the only health and safety information for a particular product is contained in the Material Safety Data Sheet (MSDS), the arcane language of which can be confusing at best, and indecipherable at worst.

Most workers are aware that uncured liquid polymers and prepolymers can present significant chemical hazards, especially via inhalation and dermal contact routes of exposure. However little is known regarding the post-cure health hazards posed by polymeric materials. Considered by many to be essentially inert, safe and non-toxic, cured polymers can present significant health hazards when they are subjected to grinding, cutting or other techniques that produce heat. Among the most suspect are the polyurethanes, which canbe thermally degraded into hazardous byproducts including the highly toxic isocyanates. Other polymers that can produce toxic byproducts upon heating include polytetrafluoroethylene (PTFE), polyvinyl chloride (PVC) and polyethylene.

The relative risks associated with various adhesive and casting materials, signs and symptoms of acute poisoning, and techniques for reducing chemical risks in the prep lab will be discussed, including the use of positive pressure ventilation, fume hoods and respirators.

Wednesday Mammal Evolution Symposium poster

ANOMALOUS PALEOECOLOGY OF A NEOGENE FOSSIL SITE, GRAY, TN: UTILIZING STABLE ISOTOPE ANALYSES OF FOSSIL TOOTH ENAMEL TO RECONSTRUCT PAST ENVIRONMENTS

DESANTIS, Larisa, Univ. of Florida/FLMNH, Gainesville, FL; WALLACE, Steven, East Tennessee State Univ., Johnson City, TN

Determining relative canopy density in C_3 ecosystems is viable because of predictable differences in $\delta^{13}C$ values attributed to irradiance and/or CO_2 levels. $\delta^{13}C$ values decline with increasing canopy density; therefore, relative canopy density can be determined. Extant tapirs are highly conservative in dietary and migratory behavior, and typically inhabit the densest canopy environments available; consequently, tapirs are model organisms for comparing relative canopy density between sites.

Eastern Tennessee's Gray Fossil Site, biostratigraphically dated between 4.5 and 7 million years ago, is highly fossiliferous containing a unique combination of taxa, including the highest known concentration of Neogene tapirs and several taxa with Eurasian ancestry. Due to the rarity of late Cenozoic fossil sites in eastern North America and the ideal nature of fossil tapirs for such analyses, the Gray site has the potential to clarify currently unknown paleoecological phenomenon during the Neogene. In addition, the Gray site's faunal and floral macrofossils suggest the presence of North American forest refugia; therefore, stable isotope sampling of herbivorous taxa may support this hypothesis and clarify paleoecological dynamics.

Constraining our hypothesis with knowledge of temperate fossil pollen, the Gray site represents a relatively closed canopy environment. *Tapiravus polkensis* is a hyperbrowser that inhabited dense, closed canopy environments. *Teleoceras* sp., morphologically presumed grazers, yields stable carbon isotope data suggesting their presence as forest dwelling browsers. Since palynological data demonstrates negligible amounts of grass pollen, and grass pollen is typically overrepresented when found, *Teleoceras* sp. are presumed to be browsers as opposed to mixed feeders/C_3 grazers. Additionally, oxygen isotopes suggest average cooler temperatures at Gray than Florida fossil sites of similar age. These data further support the presence of North American refugia in the southern Appalachians that may have contributed towards delaying the C_4 grassland transition that was occurring in western North American at that time.

Saturday 11:15

WHAT'S AN OMNIVORE? GENERATING MORE ECOLOGICALLY MEANINGFUL DIETARY CATEGORIES USING DENTAL MICROWEAR

DEWAR, Eric, Univ. of Massachusetts Amherst, Amherst, MA

In most studies of community paleoecology, the structure of fossil mammalian communities is described using a few ecologically meaningful variables. Most commonly, the paleoecology of a resident species is described by its estimated body mass, locomotory mode, and diet. Of these variables, only diet is usually categorized in relatively qualitative terms, particularly in the case of "omnivorous" fossil mammals. For Recent mammals, we can observe feeding behavior or analyze gut contents to determine the frequencies of particular food items in the diet. The percentages of foods eaten can then be sorted into separate variables which are incorporated into a multivariate analysis with the rest of the species in a community. Since direct observation is impossible, I propose an indirect but more quantitative approach to describe the dietary ecology of fossil mammals using information from dental morphology and microwear.

Low-magnification dental stereomicroscopy has been shown to be useful in differentiating the diets of herbivorous and carnivorous mammals. Because abrasion by particular food items causes characteristic enamel wear scars, we can use the frequencies of this use wear as characters to reconstruct the diets of fossil mammals. The resulting dietary variables are more amenable for use in multivariate analysis of the structure of fossil communities. For this work, I examined species of living and extinct "omnivorous" ungulates, primates, and carnivorans whose diets have an herbivorous or carnivorous emphasis with varying degrees of other foods. I described the microwear fabric of each species in terms of the counts of pits, scratches, and puncture pits, and the presence of cross-scratches and gouges. I also included measures of hypsodonty, carnassialization, and other morphological characters to add more resolution to the analysis. I will outline examples of this approach to analyzing the structure of fossil communities with subfossil localities from Madagascar and paleocommunities from the Paleogene White River Group.

Poster Session A

RECONSTRUCTION OF THE PELVIC AND HIND LIMB MUSCULATURE IN THE ANKYLOSAUR *GASTONIA*

DICROCE, Tony, CARPENTER, Kenneth, KINNEER, Billy, Denver Museum of Natural History, Denver, CO

Previous attempts have been made to describe the ankylosaur pelvic musculature as a way to explain and understand the origin, evolution and development of its unusual ilium. These attempts have been incomplete because either important muscles were not considered or the skeletal elements were incomplete. None of these studies offered a convincing argument to explain the peculiarities of the ilium. A pelvis and hind limb cast of the ankylosaur *Gastonia* was used to reconstruct the musculature in clay. Muscle scars on the original elements were interpreted for correct origin and insertion points. Unlike most other attempts at reconstruction, this restoration shows the superficial and deep muscles in full-size three-dimensional arrangement. The muscles were identified based on the dissection of birds (*Gallus*), (*Megeagris*), and crocodile (*Caiman*). The broad flat ilium blade is the origin for the large tricep extensors, M. ilio-tibialis, along the lateral margin. The ischium has developed proximally and with the synsacrum forms the anteromedial wall of the acetabulum. The pubis has a thin, blade-shaped, postpubic process and retains muscle scars suggesting the origin for M. ambiens and M. puboischio femoralis. The location of M. ambiens in this reconstruction is placed anterolaterally to an extreme preacetabular position, unlike any other ornithischian. Ankylosaurs share with other large quadrupedal dinosaurian and mammalian herbivores a large, splayed, massive pelvic girdle. In mammals, this is clearly an adaptation for a large fermenting gut. We therefore suggest that the horizontal ilium in ankylosaurs is also to accommodate a large gut needed to process food. Ankylosaurs retained primitive, non-chewing teeth requiring a longer digestion and fermentation process. As the gut widened laterally it also expanded posteriorly as the attachment for abdominal muscles were transferred from the pubis to the ischium, thus resulting in a much wider pelvic girdle required for stabilization.

Wednesday 10:15

FIGHT THE GOOD FIGHT — WHAT PALEONTOLOGISTS NEED TO KNOW ABOUT RELIGION

DODSON, Peter, Univ. of Pennsylvania School of Veterinary Medicine, Philadelphia, PA

Religion is not, and rarely has been anti-science. Science cannot in principle either affirm or disprove the existence of God. Science is taught in schools because citizenship requires that everyone understand science at some level, whether they practice it or not. Similarly, paleontologists need some understanding of religion, whether they practice it or not. Hostility or condescension towards people of faith is counterproductive. Willful ignorance of religion, or worse yet, caricaturing or demonizing it after the manner of Dawkins preaches only to the converted, and fails to win hearts and minds of the population, or to convince wavering school boards to abandon anti-evolutionary stances. The so-called warfare of religion with science is largely a fabrication of two 19th century writers, John William Draper and Andrew Dickson White. The Galileo affair is best seen as an aberration in a historical pattern in which the Church has generally promoted scientific research. Until the middle of the 19th century, the primary motivation for the advancement of science was to understand and glorify the Creator God. While Creationists and Fundamentalists read certain passages in the Bible in such a way as to preclude acceptance of evolution, mainstream Christian denominations embrace evolutionary thought with little difficulty. The most problematic aspect of evolution is social Darwinism (with us today under the name evolutionary psychology), which has been used during the past century to justify such societal pathologies as colonialism, warfare and class strife. In making the case for evolution, Gould flatly rejected social Darwinism as a basis for organizing human societies, and distanced himself from the misuse of evolution. We can say no to our genes!

Poster Session B

A REVISED FAUNAL LIST FOR THE CARMEL CHURCH QUARRY, CAROLINE COUNTY, VIRGINIA

DOOLEY, JR., Alton, FRASER, Nicholas, Virginia Museum of Natural History, Martinsville, VA

The Carmel Church Quarry in Caroline County, Virginia, contains a rich middle Miocene bonebed. The marine vertebrate fauna is well documented and includes *Eobalaenoptera harrisoni*, the oldest described member of the Balaenopteridae + Eschrichtiidae clade. Continuing excavation and preparation of fossil remains from Carmel Church have significantly expanded the known vertebrate fauna, and allowed a revision of the stratigraphy at the site and correlation with the North American Land Mammal Ages.

The Tertiary section at Carmel Church is approximately 10 m thick, and sits unconformably on Proterozoic metasediments. There are eight distinct, disconformity-bounded Tertiary strata at Carmel Church, ranging from Paleocene to Plio-Pleistocene in age. Four of these strata are fossiliferous, and three contain vertebrate fossils.

The most fossiliferous unit at Carmel Church is Bed 14 of the middle Miocene Calvert Formation. This deposit includes at least seven cetacean taxa, a sirenian, a pinniped, a crocodile, two turtles, and numerous chondrichthyans and osteichthyans. Carmel Church is the single most productive site for Miocene land mammals on the middle Atlantic Coastal Plain. These land mammals, which include the equid *Merychippus* sp. and the tayassuid "*Prosthennops*" *xiphidonticus*, indicate that this bed correlates with the Barstovian Land Mammal Age. The presence of marine diatoms in the same unit as terrestrial mammals allows the correlation of Miocene terrestrial and marine biostratigraphic units.

Wednesday 5:45

DEGRADATION OF CYANOACRYLATE ADHESIVES IN THE PRESENCE AND ABSENCE OF FOSSIL MATERIAL

DOWN, Jane, Canadian Conservation Institute, Ottawa, ON, Canada; KAMINSKA, Elzbieta, Contract Chemist, Ottawa, ON, Canada

Although cyanoacrylate (CA) adhesives are widely used for fossil preparation, a controversy exists as to whether they should be used for this purpose. Currently, little conservation research on CAs has been done. In 2003, Jane Down from the Canadian Conservation Institute (CCI) received the Preparator's Grant from the Society of Vertebrate Paleontology (SVP) to do preliminary research on the suitability of CA adhesives for fossil material.

Most CA adhesives sold in North America, including those used for fossil preparation, are ethyl CAs. However, the medical profession uses butyl CAs for tissue closure and bone fracture repair. This is because medical research, which is currently the largest body of research on CAs, indicates that butyl CA degrades more slowly than ethyl CA. Thus, toxic degradation products (eg., formaldehyde) from the butyl CA can be absorbed by the body better than from ethyl CA causing less dermatitis and carcinomas. Medical research also indicates that CAs tend to degrade more in alkaline and moist conditions, and under UV light.

The CCI research investigated the degradation (ie., formation of formaldehyde) of various CAs (eg., ethyl, butyl, etc) in the presence and absence of fossil material. The fossil material was obtained from several different sites in North America (ie., Dinosaur National Monument, Royal Tyrrell Museum, Mammoth Site and Badlands National Park) and varied in pH, moisture content, ash content, porosity, and mineral/elemental composition.

This narrated Powerpoint presentation will outline some CA properties, advantages/disadvantages of CAs, and the results of the CCI research. The research confirmed that butyl CA degrades more slowly than ethyl CA, whether fossil is present or not. The results also suggest that acidic fossil material retards the degradation of CAs, while neutral and alkaline fossil materials increase it. How this degradation relates to actual bond failure and fossil composition has yet to be determined and will be the focus of future work.

Saturday 3:30

NORTH AMERICAN MUSK DEER (SUBFAMILY BLASTOMERYCINAE) REVISITED

DRAUS, Elizabeth, Univ. of Nebraska-Lincoln, Lincoln, NE; PROTHERO, Donald, Occidental College, Los Angeles, CA

The North American musk deer (subfamily Blastomerycinae) were an important element of many faunas during the Miocene. A complete skeleton of *Longirostromeryx wellsi* from the Clarendonian Poison Ivy Quarry at Ashfall Fossil Beds State Park in Nebraska prompted a review of blastomerycine systematics, which have not been revised since 1937. We used bivariate and multivariate statistics of large quarry samples (and accounting for sexual dimorphism) to greatly reduce the number of named valid taxa. The commonest taxon is *Blastomeryx gemmifer* (Barstovian-Clarendonian), which is the senior synonym of six other species of *Blastomeryx*. The primitive late Arikareean forms with unreduced premolars are simplified to *Problastomeryx primus* (for larger specimens) and *Pseudoblastomeryx advena* (for smaller specimens). *P. primus* is the senior synonym of *P. olcotti*, and *P. advena* has four junior synonyms. The large primitive taxon *Parablastomeryx* (from the Hemingfordian to Clarendonian) has two valid species, *P. gregorii* and *P. floridanus*. The tiny and rare genus *Machaeromeryx* includes two species, *M. tragulus*, and *M. gilchristensis*. Finally, the distinctive *Longirostromeryx* (with its derived elongated rostrum and diastema) includes the long-lived *L. wellsi* (Barstovian-Hemphillian) and *L. clarendonensis*, with extreme reduction of the anterior premolars, loss of p2, and expanded diastema (restricted to the early Clarendonian, mostly from Texas). The new specimen from Ashfall Fossil Bed sheds important new light on the anatomy of the blastomerycine skeleton, since few of the taxa above are known from more than jaws or teeth.

Friday 2:45

NEW RECORDS OF EXCEPTIONALLY WELL-PRESERVED FOSSIL BIRDS FROM THE DANISH LOWER EOCENE

DYKE, Gareth, Univ. College Dublin, Dublin, Ireland; BERTELLI, Sara, American Museum of Natural History, New York, NY; CHIAPPE, Luis, Natural History Museum of Los Angeles County, Los Angeles, CA; LINDOW, Bent, Univ. College Dublin, Dublin, Ireland

Well-preserved fossils that document early phases of modern bird evolution (Neornithes) are exceptionally rare. By far the bulk of described fossil specimens from the Cretaceous-Eocene are too incomplete, crushed or fragmentary to be usefully included within morphology-based phylogenetic hypotheses for the intra and inter-relationships of major clades. Our work aims to re-dress this balance: we present new, and remarkably three-dimensionally preserved, fossil neornithine birds from the marine Fur Formation of Denmark. Exposed in the Limfjord area of Jutland, the Fur Formation documents local upwellings of warm water and preserves a rich fauna, including birds and other vertebrates. Exceptional preservation of vertebrate carcasses in the muddy Fur sediments is as a result of anoxic burial conditions—fossils are often preserved in 3D, encapsulated within calcareous cementstone nodules. Acid preparation of these nodules has revealed exquisite details in many birds—fine details of cranial anatomy, stomach contents, tendons, and feathering.

Although the bulk of the Fur avian diversity remains undescribed in detail, we have identified representatives of at least 13 neornithine clades (including palaeognaths, Galliformes, Charadriiformes, Psittaciiformes, Coraciiformes, and Apodiformes) within the fauna by use of morphological character analyses. Complete descriptions of the remainder of this diversity are ongoing. Because of the age and articulation of the Danish birds, their importance lies in their inclusion within phylogenetic hypotheses for the modern avian radiation; fossil specimens add character combinations not seen in their extant counterparts. Although the bulk of these Danish fossil birds currently remain undescribed in detail, our ongoing systematic studies will allow us to add these new taxa and their novel character combinations to a number of regions of the modern avian tree.

Saturday 3:45

EARLY EOCENE BRONTOTHERIIDAE (PERISSODACTYLA) FROM THE EUREKA SOUND GROUP, ELLESMERE ISLAND, CANADIAN HIGH ARCTIC—IMPLICATIONS FOR BRONTOTHERE ORIGINS AND HIGH-LATITUDE DISPERSAL

EBERLE, Jaelyn, Univ.of Colorado Boulder, Boulder, CO

The northernmost (and among the oldest) records of early Eocene brontotheres, fossils of cf. *Eotitanops* and Brontotheriidae gen. et. sp. indet. are reported from early Eocene (late Wasatchian) strata of upper parts of the Eureka Sound Group, on central Ellesmere Island (~79°N). Although the fossils were initially tentatively identified on faunal lists as *Lambdotherium*, their larger size and dental morphology ally them more closely to mid-latitude *Eotitanops* and *Palaeosyops*. The Ellesmere Island specimens are dentally most similar to mid-latitude *Eotitanops*, but can be differentiated from the latter by derived characters on their premolars that are shared with the younger (i.e., Bridgerian) *Palaeosyops*.

Presence of brontotheres at early Eocene-aged localities on central Ellesmere Island implies that the group's evolution was well underway early on at northern high-latitudes, and seems consistent with an Asian origin for the group and subsequent high-latitude dispersal across Beringia into North America. While cf. *Eotitanops* from Ellesmere Island appears dentally too advanced to be ancestral to mid-latitude *Eotitanops*, it may be a suitable ancestor to *Palaeosyops*. Presence of cf. *Eotitanops* on Ellesmere Island may reflect an early 'wave' of Asian immigrant brontotheres that resided at northern high latitudes during the early Eocene, and subsequently dispersed to mid-latitudes during middle Eocene time.

Wednesday Evolution Symposium Poster

BRINGING TO LIFE THE LIFE OF THE PAST: TACTILE, MODELING, AND ON-SITE EXTENSIONS FOR STUDENT APPREHENSION OF ABSTRACT CONCEPTS OF CHANGE THROUGH TIME, DEEP TIME, AND EVOLUTION OF LIFE ON EARTH

EDMUNDS, Barbara, RUEDAS, Luis, CUMMINGS, Michael, LINDSAY, Thomas, Portland State Univ., Portland, OR

Evolution, the unifying framework of modern biology, is strongly supported by evidence from the fossil record. Today, this foundation of biological education is being weakened by proponents of alternative, nonscientific pseudoexplanations contrary to fundamental definitions of the concept of science. The scope of science is to understand nature by elucidating natural mechanisms. Alternative explanations state that these are manifestations of supernatural mechanisms at work. Theories are interpreted by the lay public as guesses.

Science embraces Popperian falsification by using testable questions and encouraging falsification. "Intelligent Design", in contrast, emphatically rejects falsification of a "Designer", in and of itself untestable. Science, however, is in constant refinement. Doubt and uncertainty are part and parcel of the scientific process as we engage in trying to understand our universe

and all contained herein. Intelligent Design ineluctably rejects doubt and uncertainty, using that very strength of scientific questioning as science's Achilles heel when addressing the uninformed laypeople that this *IS* how science works.

In this beleaguered effort to teach evolution, strong evidence needs to be presented to students still undecided about the validity of the theory of evolution. The lecture portion of this course is presented from current diversity back to the origins of life in an effort to start with what is known and then extrapolate to theory supported by fossil evidence. To support this method, tangible evidence of evolution, including fossils and field trips to find them, and models to represent and elucidate abstract concepts are used to construct a framework putatively providing strong evidence for evolution.

Upper division college students taking a "Life of the Past" laboratory were given pre- and post-tests to assess if: 1) comparison of fossil and extant species allow for student comprehension of speciation; 2) if their understanding of geological time, superposition, and speciation has changed through the use of paper modeling, 3) if on-site visits to fossil sites increases an awareness of deep-time and change through time.

Poster Session A

CREODONTS FROM THE MIDDLE EOCENE PONDAUNG FORMATION (MYANMAR) AND ITS PALEOBIOGEOGRAPHICAL SIGNIFICANCE

EGI, Naoko, Kyoto Univ. Graduate School of Science, Kyoto, Japan; TSUBAMOTO, Takehisa, TAKAI, Masanaru, Kyoto Univ., Inuyama, Aichi, Japan; HOLROYD, Patricia, Univ. of California, Berkeley, CA

The upper middle Eocene Pondaung Formation in central Myanmar has yielded a rich mammal fauna, consisting of approximately 35 genera from seven orders. As mammalian predators, five genera five species of creodonts (four proviverrines and one hyaenaelurine) and two genera two species of carnivorans are known.

All the Pondaung proviverrine creodonts are endemic to the fauna. The dental features of these genera indicate that they are taxonomically close to one another, and they relate more closely to the proviverrines from Africa and South Asia, which are called the advanced Old World proviverrines, than to ones from China, Mongolia, and North America. The hyaenaelurine, *"Pterodon" dahkoensis*, has been also known from the middle Eocene of southern and central China. This species gives the most eastern fossil record for the geological distribution of the subfamily. Because both the advanced Old World proviverrines and hyaenaelurines mainly known from the Paleogene and Miocene South Asia, Africa, and southern Asia, the Pondaung creodonts are evidences for immigrations between Southeast Asia and the Para-Tethys area. The dominance of creodonts among mammalian predators can be also considered as a similarity between the Pondaung fauna and the Paleogene African and South Asian faunas.

The creodonts and many mammals from the Pondaung fauna are endemic to the fauna, presumably reflecting the fact that only a few mammalian fauna are known from the Paleogene Southeast Asia. Some relatives of the Pondaung ungulates can be found from the contemporaneous fauna in East Asia, indicating that the large herbivores had different dispersal route from that of creodonts. On the other hand, anomalurid rodents, anthracotheriid artiodactyls, and possibly primates are similar to creodonts in having fossil records both from the Pondaung Formation and from the Eocene of North Africa. The presence of the multiple number of anomalurid rodents and proviverrine creodonts endemic to the Pondaung fauna suggests that both of the taxa entered the area when geological barrier was not great and had a history of isolation before the late middle Eocene.

Student Poster Session

THE ROOF IS ON FIRE: FIRE-SCARRING IN PLEISTOCENE BOX TURTLES (*TERRAPENE*) FROM THE SOUTHEASTERN U.S.

EHRET, Dana, Univ.of Florida, Gainesville, FL

Forest fires are a natural phenomenon that have occurred for thousands of years across the United States. Only within the past 100 years have wildfires been suppressed, as human populations increase significantly. Within a habitat with a natural fire regime, animals have adapted to survive occassional periods of intense fire activity. In the case of box turtles (genus: *Terrapene*) they tend to dig into shallow pits under large tufts of grass. The result is a turtle that survives but also suffers, in some cases, extensive damage to its carapace.

Today, we see fire-scarred box turtles in areas that have reinstated a fire regime. Some turtles have been documented to regrow large portions of their carapace due to the severity of their burns. In the fossil record, several sites across the Irvingtonian and Rancholabrean (Pleistocene) of the southeastern United States show evidence of fire-scarring. This scarring is typified by loss of scute sulci and moderate to heavy shell remodeling. Information gathered from fire-scarred individuals is valuable for reconstructing possible fire regimes, extent, and severity throughout the southeast.

Saturday 9:30

INTERNAL GILL RAKER MORPHOLOGY OF FOSSIL SALMONIDAE USING HIGH-RESOLUTION X-RAY COMPUTED TOMOGRAPHY

EITING, Thomas, SMITH, Gerald, Univ. of Michigan, Ann Arbor, MI

The internal anatomy of fossil teleosts is rarely well preserved. Investigations dependent upon internal anatomy in extant taxa (e.g. morphological systematics) cannot be performed on the majority of fossil fish. Evolutionary hypotheses are thus restricted to limited morphological data.

Using high resolution X-ray CT (HRXCT) scans, we are able to explore details of the internal gill raker morphology of two Late Miocene specimens of *Oncorhynchus*, one tentatively assigned to *Oncorhynchus keta* and the other to the *Oncorhynchus nerka* species group (*Oncorhynchus salax*). Gill rakers on the first arch are commonly used to differentiate closely related species. The gill arches and associated rakers are an especially complex and sometimes confounding region of Oncorhynchus anatomy. Many morphological details cannot be studied in hand specimen alone. HRXCT of articulated skulls avoids this problem. We examined approximately 150, 0.1 mm-thick sagittal slices through the gill arch regions of each specimen. To assure accuracy in identification, rakers on each arch were traced and subsequently compared with recent specimens. Rakers from the *O. salax* specimen are well preserved on the first arch, though most of the internal anatomy has been lost. The ?*O. keta*? specimen lost the anatomy of its first arch post-mortem, but the rakers on its second arch are especially well preserved and identify it as a new species, not *O. keta*.

We also report possible evidence for predation. The *O. keta* specimen has no brain case elements preserved. It resembles fish that have been preyed upon by bears. Such predation could explain distortion and absence of part of the branchial basket.

Wednesday 10:15

ONTOGENY OF THE INNER EAR OF MAMMALS: IMPLICATIONS FOR THE PHYLOGENETIC ASSESSMENT OF FOSSILS

EKDALE, Eric, Univ.of Texas Austin, Austin, TX

The middle ear of mammals as preserved on the external surface of the petrosal is widely used to infer phylogenetic relationships between mammals; however, mammalian systematists often overlook the complex anatomy of the inner ear in phylogenetic studies. As with all morphological systems, the structure of the bony labyrinth of the inner ear varies between mammalian taxa. Ontogeny is generally considered to be a major source of variation, and it poses a problem for paleontologists where only a single specimen of a taxon is known. The otic capsule ossifies early in the prenatal development of humans, which has led to the assumption that the bony labyrinth of the inner ear of all mammals does not change after ossification. Therefore, observed variation in postnatal mammals is thought to be independent of ontogenetic age, and these differences may be phylogenetic.

This study explores whether variation within the bony labyrinth of an extant marsupial mammal, *Monodelphis domestica*, can be explained by ontogeny. Specimens representing six ontogenetic ages were CT scanned at the Univ. of Texas at Austin, and I constructed digital endocasts of the bony labyrinth from the CT data. I measured various aspects of the labyrinth, including angles between the semicircular canals, number of cochlear turns, volumes of inner ear components, as well as heights and widths of the arcs of the semicircular canals. There is a strong correlation between total skull length and age, but only weak to moderate correlation between age and bony labyrinth dimensions, including total volume and length of the inner ear cavity. Because many dimensions of the inner ear are apparently age independent in *Monodelphis*, variation in the bony labyrinth may serve as an important source of phylogenetic information for fossil and extant mammals, as well as other vertebrates.

Friday 9:00

BIOGEOGRAPHIC IMPLICATIONS OF EARLY DEVONIAN HETEROSTRACANS FROM THE WESTERN UNITED STATES

ELLIOTT, David, Northern Arizona Univ., Flagstaff, AZ

The western United States is potentially an important area in understanding the biogeographic relationships of the Old Red Sandstone Continent in the Early Devonian. The sedimentary sequence includes a rich heterostracan fauna but one that has been only partly documented. Some heterostracan faunas are present in the Lochkovian of Nevada and Idaho but the richest are present in the Emsian of California, Nevada, Utah, and Wyoming where an endemic *Allocryptaspis*-*Cardipeltis*-protaspid fauna has been recognized. Although the protaspids (a dorso-ventrally compressed group of pteraspids) have been well described the same is not true of the cyathaspids, as at present only four species of the genus *Allocryptaspis* have been reported. Collecting in Emsian localities in Death Valley California, east-central Nevada, and northern Utah has now shown that there are at least twelve new cyathaspid taxa present. Although many of these appear to be endemic at least three show connections to taxa previously described from the Canadian Arctic, Spitsbergen, the Welsh Borders, and Severnaya Zemlya.

Anglaspis is present in the Water Canyon Formation of northern Utah and is otherwise known from the Canadian Arctic across to Severnaya Zemlya in strata of Lochkovian age. *Ctenaspis*, which is present in east-central Nevada is also known over the same temporal and geographic range. Additionally the western U.S. fauna includes several species of large, flattened, leaf-shaped cyathaspids that appear to be related to the boothiaspids of the Canadian Arctic Peel Sound Formation, also of Lochkovian age. All the previous records for these taxa are Lochkovian indicating that they were part of the widespread heterostracan diversification event at this time, possibly related to a high-stand of the world's oceans. In contrast the western U.S. taxa are Emsian and are not present in the known Lochkovian faunas in this area suggesting a later dispersal event of these forms from centres in the arctic.

Friday 10:45

COMPARATIVE BITE-FORCE PERFORMANCE OF EXTANT AND FOSSIL CROCODYLIANS: A WINDOW INTO EVOLUIONARY FEEDING BIOMECHANICS

ERICKSON, Gregory, Florida State Univ.Dept Biological Science, Tallahassee, FL; LAPPIN, A, Kristopher, Northern Arizona Univ., Flagstaff, AZ; VLIET, Kent, Univ. of Florida, Gainesville, FL; BRUEGGEN, John, KLEDZIK, David, St. Augustine Alligator Farm Zoological Park, St. Augustine, FL; WEBB, Grahame JW, Wildlife Management International, Sanderson, NT, Australia

Which bites more forcefully, an alligator or a crocodile? Can piscivorous crocodylians with their delicate, slender snouts bite as hard as other species? Can bite forces for extinct crocodylians ever be known? To address such questions we measured the adult bite-force performance for all 23 living species of crocodylians and bite forces throughout development in three species with differing rostral types. Our results show that with respect to body size, alligators and crocodiles, including most slender-snouted forms, surprisingly all bite with the same vigor. Such similarities hold true throughout development. We attribute these invariant patterns to evolutionary conservativism of the post-orbital, jaw-closing anatomy. Because relative bite-force capacities went unmodified for most of crocodylian evolution, potential adaptations to procure different prey were limited to modifications of the teeth and rostra and/or through whole-organism size changes. The remarkable repeated evolution of the same rostral and dental types in crocodylians are attributable to these limited avenues for anatomical change. Bite forces for extinct crocodylians can now be reliably estimated, even throughout development, and the evolutionary feeding biomechanics of these animals explored throughout their 85 million-year tenure.

Poster Session B

PHYLOGENETIC UTILITY OF CERVICAL VERTEBRAL MORPHOLOGY IN CERCOPITHECOID PRIMATES

ERICSON, Kristin, PATEL, Biren, GILBERT, Christopher, Stony Brook Univ., Stony Brook, NY

Primate vertebrae are unique among mammals in their morphology. While the functional morphology of the primate vertebral column has been well studied, the phylogenetic utility of vertebral morphology has not been investigated in detail. Because isolated vertebrae are occasionally found among fossil faunal assemblages, proper identification of the taxon to which the vertebrae belong is required to infer proper faunal dating, paleoenvironmental reconstructions, and faunal dispersal patterns. Although primate vertebrae can be distinguished from those of most other mammals, specific phylogenetic and taxonomic designations of vertebrae within the order Primates, especially below the family level, may be more problematic.

In this study, we address the issue of whether shape and size variables can be used to make phylogenetic distinctions in extant and fossil primate vertebrae at the genus level. Eight linear measurements capturing the size and shape of cervical vertebrae (C3-C7) were taken on seven extant cercopithecoid primate genera (*Papio*, *Mandrillus*, *Theropithecus*, *Macaca*, *Semnopithecus*, *Colobus*, *Nasalis*). These data were then analyzed using discriminant functions and principal components analyses. Results suggest that although some broad phylogenetic separations are possible, there is significant overlap between most extant genera. Furthermore, separation between taxa is based on absolute vertebral size and not shape.

Recently, three large cervical vertebrae (C3, C5, and C6), unassociated with any craniodental material, have been described from Early Pleistocene deposits in Italy and attributed to the cercopithecoid genus *Theropithecus*. Because these vertebrae have implications for cercopithecoid and possibly hominin dispersals out of Africa, we re-examine the phylogenetic designation and paleontological implications of these cervical vertebrae, based on the results of this study.

Friday 12:15

HOW DIFFERENT ARE CATS AND MICE? NEW 3D METHODS FOR CORRELATING DIETS AND DENTITION FROM DISPARATE DENTAL SYSTEMS

EVANS, Alistair, WILSON, Gregory, FORTELIUS, Mikael, JERNVALL, Jukka, Univ. of Helsinki, Finland

Dietary reconstruction from dental morphology has a very long and distinguished history. However, most often very simple aspects of morphology, such as lengths and widths of teeth or crests, have been used to draw a parallel with ecological and dietary information. The explosion of methods for capturing 3-D surface data on morphology has opened the door to a new range of possibilities in analysis. These are not limited to using two-dimensional representations of teeth and can exploit the full 3-D tooth shape, including true surface areas, volumes and curvatures. In addition, we are now capable of tooth shape analyses that do not require identification of homologous landmarks. Here, we present two main types of techniques: one that uses very specific functional correlates between shape and function; another that uses more general characteristics of shape to give summary information on aspects that can be related to some functional measures. We demonstrate the application of these techniques to two very different dental systems: 1) muroid rodents, which are very diverse in ecology and diet, ranging from strict herbivores, granivores or faunivores, to broad diets; 2) carnivores, with a more homogenous diet but including sufficient diversity for some specialization. Certain general measures of shape, such as "complexity" (measured as number of distinct faces), and specific measures of shape, including rake angle of crests, correlate well with diet. The power of these new techniques is displayed in the ability to pick up morphological correlates in both of these very different systems with very different ranges of diets and tooth morphologies.

Saturday 4:00

THE FIRST INSIGHTS INTO THE EARLY CREST ONTOGENY OF *PARASAUROLOPHUS* (ORNITHISCHIA: HADROSAURIDAE)

EVANS, David, REISZ, Robert, Univ. of Toronto, Mississauga, ON, Canada

The iconic lambeosaurine hadrosaurid *Parasaurolophus*, distinguished by its elongate tubular cranial crest, is known from rare occurrences in Campanian deposits of Alberta, Canada, and the southwestern United States. Whereas most North American lambeosaurines are known from fairly complete cranial growth series, juveniles of *Parasaurolophus* have remained elusive. An unusually well preserved but incomplete juvenile braincase originally referred to *Lambeosaurus* is recognized here as *Parasaurolophus* on the basis of several derived characters associated with the frontal-nasal articulation at the base of the crest. The skull roof of *Parasaurolophus* differs markedly from that of 'corythosaurs', including *Lambeosaurus*, in the absence of a frontal tongue anterior to the presphenoid, the massive thickness and steep, posterodorsal inclination of the frontal platform, and the greatly shortened ectocranial surface of the frontal. The frontal is approximately half the width of that in the *P. walkeri* holotype, and is comparable in size to *Procheneosaurus praeceps*. This specimen represents the second and smallest cranial specimen of *Parasaurolophus* from the Judith River Group, Alberta.

The cranial vaults of juvenile 'corythosaurs' are virtually indistinguishable from each other, as is the early development of their cranial crests. Although the specimen discussed here lacks a crest, the distinctive morphology of the frontal platform suggests that the crest and facial profile were very different from other juvenile lambeosaurines in the same size class. *Parasaurolophus* therefore appears to deviate from the lambeosaurine ontogenetic bauplan early in development.

Poster Session B

MORPHOBROWSER—A NEW DATABASE FOR SURFING THE DENTAL MORPHOSPACE

EVANS, Gudrun, EVANS, Alistair, PLJUSNIN, Ilja, FORTELIUS, Mikael, JERNVALL, Jukka, Institute of Biotechnology, Univ. of Helsinki, Finland

Morphologists have long faced challenges in extracting and disseminating information about morphology. Traditional and more modern techniques including line drawings, photographs and SEM images do not allow the measurement of many aspects of the original three-dimensional form. We present a new interface for examining and analyzing morphology. The "MorphoBrowser" is a new database for storing and viewing 3-D morphology. It allows the user to interactively "browse" through a diverse range of fossil and recent morphological forms. The system is accessible through the Internet on a Java database interface that runs on all major operating systems (Windows, Mac and Linux). The MorphoBrowser stores full taxonomic information and ecological characteristics on each species represented, as well as detailed data on individual specimens. The interface consists of a 3-D viewing window that displays shapes from 3-D data collection devices such as laser scanners, confocal microscopes and needle scanners. The user can rotate the object in any direction and zoom in to view additional detail. The applications to which this new research tool has been put are diverse: the user can track changes in morphology in a single individual as tooth wear progresses, examine variation within species, and compare similar and disparate tooth forms from a wide taxonomic range. In addition, it provides the ability to address aspects of morphology that were previously impossible—make wide-ranging 3-D comparisons between shapes, explore techniques of shape categorization and utilize new 3-D shape recognition methods. The MorphoBrowser provides the infrastructure for collecting and analyzing the immense amount of 3D morphological data now being assembled.

Poster Session A

THE MIDDLE JURASSIC VERTEBRATE ASSEMBLAGE OF SKYE, SCOTLAND

EVANS, Susan, Univ. College London, London, United Kingdom; BARRETT, Paul, The Natural History Museum, London, United Kingdom; HILTON, Jason, Univ. of Birmingham, Birmingham, United Kingdom; JONES, Marc, Univ. College London, London, United Kingdom; PARRISH, Jolyon, Univ. of Oxford, Oxford, United Kingdom; RAYFIELD, Emily, The Natural History Museum, London, United Kingdom

In the Middle Jurassic (Bathonian), Britain consisted of a series of small island landmasses at the western edge of the European archipelago. The vertebrate faunas of these islands are preserved in a series of microvertebrate deposits that have produced some of the earliest frogs, salamanders, albanerpetontids, turtles, lizards, choristoderes, and maniraptoran dinosaurs, as well as a diversity of mammals. However, most of the remains from these localities consist of dissociated bones. The Kilmaluag Formation on the Scottish island of Skye differs in producing not only dissociated material but also rare articulated specimens (salamanders, lepidosauromorphs, crocodiles, mammals). Recent fieldwork has extended the known assemblage and added further associations, most notably a nearly complete turtle and partial salamanders. In all, the Skye assemblage contains representatives of at least 12 major vertebrate clades and more than 20 distinct taxa including hybodont sharks; semionotiform fish; primitive caudates; a turtle; lepidosauromorphs (*Marmoretta* and lizards); choristoderans (*Cteniogenys*), croco-

diles (goniopholids, atoposaurs); pterosaurs; sauropod dinosaurs; tritylodont synapsids (*Stereognathus*), and mammals (*Borealestes*, a second docodont). In general the Skye assemblage is very similar to those from more southern localities (Kirtlington, Watton, Hornsleasow), but appears to differ in the rarity of crocodiles, and the absence of frogs and albanerpetontids. Salamander and turtle remains are the most abundant at the site, whereas terrestrial animals (pterosaurs, dinosaurs, mammals) are relatively rare. This could imply an environmental bias in the record (probably the most likely option) and/or the operation of a taphonomic filter related to body size (the latter in the case of dinosaurs and crocodiles).

Saturday 4:15

A SIMPLE, CHEAP, NON-INVASIVE, AND FAST QUARRY MAPPING SYSTEM; WITH COMPARISONS TO COMMON QUARRY MAPPING TECHNIQUES

EVANS, Thomas, POOLE, Karen, SMITH, Joshua, NOVAK, Stephanie, Washington Univ. in St Louis, St Louis, MO

Once a fossil locality has been identified, the next step in the assemblage analysis is the removal of fossils, taking with them as much data as possible. Many quarry mapping techniques, with relatively unknown error, have been used to locate bones in three dimensions relative to each other and to lithologic units.

We mapped a small quarry (4x4 meters) with three common methods to determine what the approximate error is of each method. The results indicate an error of ~8 to 10 cms in the location of any one point using each method.

In some cases an error of 10 cms is too large, and would compromise the validity of a quarry reconstruction when bones are on the order of 10 cms. We therefore attempted to devise more accurate and precise means of mapping quarries. Three different methods were devised and tested by setting up a simulated quarry and mapping it repeatedly with the experimental techniques. The experimental methods worked well, each possessing different advantages and disadvantages.

Mapping a quarry using polar coordinates (vertical and horizontal angles from a datum, and a distance) works well when the angles are measured using a theodolite or total station. Obtaining a distance from the datum point to a location on a bone was problematic. This method works well, however theodolites and total stations are prohibitively expensive.

Two-dimensional triangulation (using two datum points and triangulating to a point in a quarry using two measured distances) worked well, however its use is limited to a flat quarry; a condition which is often violated.

Three-dimensional triangulation (using three datum points and measuring the distances from each datum to a point in the quarry) worked well and is flexible. The method only requires three points that can be placed anywhere, and a measuring tape. The materials are fast to set up, can be made completely non-invasive, are cheap, and the math is simple. Its other advantages include a way to quantify your error in each measurement, and it is possible to remove bones in a quarry at any time during the excavation process. Its disadvantage is the expanding error the further away a measurement is taken from datum points. Ways to reduce this error will also be discussed.

Poster Session A

NEW STRATIGRAPHIC RECORDS (ALBIAN-CONIACIAN) OF THE GUITARFISH, *RHINOBATOS INCERTUS* (CHONDRICHTHYES; RAJIFORMES), FROM THE CRETACEOUS OF CENTRAL AND WESTERN KANSAS

EVERHART, Mike, Sternberg Museum of Natural History, Hays, KS

Guitarfish (Rhinobatidae) are a conservative group of extant rays with worldwide distribution and a fossil record that extends back to the Late Jurassic of Europe. Modern representatives of the order inhabit shallow tropical and sub-tropical waters, at depths less than 200 m, and are also found in fresh water environments. The most common fossil remains are isolated teeth (less than 2 mm) although complete specimens are known. In North America, the earliest documented *Rhinobatos* sp. teeth were recovered from the Early Cretaceous (Lower Albian) of Texas. *Rhinobatos* sp. has been reported in the western interior from the Albian-Campanian of Texas, the Turonian and Santonian of Kansas, the Cenomanian of Nebraska, the Cenomanian-Turonian of New Mexico and South Dakota, and the Coniacian of Saskatchewan, Canada. Recent discoveries of *Rhinobatos incertus* teeth in the Cretaceous of Kansas indicate a reasonably continuous presence of the species in a variety of marine environments within the Western Interior Sea from the Upper Albian to the Lower Campanian. New Kansas records of *R. incertus* teeth are: 1) Kiowa Shale (Upper Albian), McPherson County; 2) Dakota Sandstone-Graneros Shale contact (Middle Cenomanian), Russell County; 3) Basal Lincoln Limestone Member, Greenhorn Limestone (Upper Cenomanian), Russell County, and; 4) Smoky Hill Chalk (Upper Coniacian), Trego County. The only previous reports from Kansas include the Blue Hill Shale Member, Carlile Shale (Middle Turonian), Jewell County, and the Smoky Hill Chalk (Middle Santonian and Lower Campanian), Gove and Logan counties. Depositional settings varied from marginal marine sandstone to near-shore shales and deeper water (< 200 m) limestone and chalk during the Kiowa-Skull Creek, Greenhorn and Niobrara cyclothems. The earliest (Upper Albian) and smallest (< 0.5 mm) *R. incertus* teeth were found in a shelly lag deposit composed predominately of *Turritella belviderei*. Hundreds of *R. incertus* teeth were collected near the top of Dakota Sandstone, and the species represented nearly one-third of about 1600 selachian teeth picked from a fish tooth conglomerate in the upper Blue Hill Shale.

Poster Session A

A CHASMOSAURINE CERATOPSID PARIETAL FROM THE NAASHOIBITO MEMBER, OJO ALAMO FORMATION OF NEW MEXICO, WITH IMPLICATIONS FOR CERATOPSID SYSTEMATICS AND BIOGEOGRAPHY

FARKE, Andrew, Stony Brook Univ., Stony Brook, NY; WILLIAMSON, Thomas, New Mexico Museum of Natural History and Science, Albuquerque, NM

Most ceratopsid fossils from the Maastrichtian Naashoibito Member, Ojo Alamo Formation, New Mexico, are fragmentary and non-diagnostic. A recently discovered incomplete parietal, NMMNH (New Mexico Museum of Natural History) P-44477, is similar to other parietals described from the Naashoibito Member in mediolateral breadth and dorsoventral thinness. However, P-44477 is the first specimen known from the Naashoibito to preserve an epoccipital in articulation with the parietal. In this specimen, a single midline epoccipital occurs on the caudal margin of the parietal. A similar condition is known only in *Triceratops*; however, the thinness of the parietal fragment (<20 mm) precludes assignment to this taxon. Additionally, the midline placement of the epoccipital eliminates an identification as *Torosaurus latus*. The character state in *Torosaurus utahensis*, definitively known only from the North Horn Formation of Utah, is unknown. Computed tomography (CT) of P-44477 was used to study the parietal morphology in relation to the epoccipital. Scans show a clear delineation between the parietal and the epoccipital. However, digital reconstruction of the parietal fragment without the epoccipital reveals no distinctive midline bump on the caudal border of the parietal. Thus, presence or absence of the midline epoccipital cannot be inferred in specimens which lack this bump and lost their epoccipitals prior to burial. P-44477 demonstrates that 1) presence of a midline epoccipital should no longer be considered an autapomorphy for *Triceratops*; 2) morphology of the caudal border of the parietal cannot be used to reliably indicate the presence or absence of epoccipitals; 3) thin-frilled ceratopsids from New Mexico are not *Torosaurus latus*, further supporting the distinctness of southwestern North American fauna from those of the north.

Saturday 3:30

LINEAR AND GEOMETRIC SHAPE CHANGES BETWEEN SEXES IN *ALLIGATOR MISSISSIPPIENSIS* FEMORA: STATISTICAL IMPLICATIONS FOR INFERRING FOSSIL ARCHOSAUR SEX

FARLOW, James, Indiana Purdue Univ.Fort Wayne, Fort Wayne, IN; BONNAN, Matthew, MASTERS, Simon, Western Illinois Univ., Macomb, IL

Determining the sex of dinosaurs and other fossil archosaurs has been challenging because no unambiguous sex-linked osteological correlates are known. Femora are ideal bones from which size and sex inferences might be inferred in fossil archosaurs because they are often preserved intact. We tested the hypothesis that differences between male and female archosaurs would be reflected in the linear dimensions and geometry of the femur.

We measured femora of more than 200 *Alligator mississippiensis* from Rockefeller Wildlife Refuge (Louisiana) and surrounding areas; most of these alligators were of known size and sex. A subset (n = 84) of these femora were photographed and analyzed using thin-plate splines software.

We used analysis of covariance (with femur length as the covariate) to look for differences between the sexes of wild alligators in transverse dimensions of the proximal and distal articular ends of the femur, and minimum midshaft circumference. Of these parameters, only midshaft circumference showed a statistically significant difference between the sexes; for femora of a given length, male alligators have a midshaft circumference 4-5 % greater than that of females.

Thin-plate splines analysis revealed a statistically significant difference between the sexes on partial warp scores. Relative warps indicated that most shape variation occurred in the direction of femoral shaft curvature and in the location of the fourth trochanter and "lesser" trochanter landmarks. In both linear and thin-plate splines analyses, statistically signficant sex differences were detected only on bones from wild individuals.

We speculate that our results reflect reproductive differences in calcium utilization. Because females mobilize calcium to shell their eggs, femora of gravid individuals might be predicted to differ from males in growth and shape as a result of differential calcium uptake. Assuming that a similar reproductive physiology occurred in fossil archosaurs, sex might be determined from differences in femoral dimensions and shape for taxa with appropriate sample sizes.

Poster Session A

NEW VERTEBRATE REMAINS FROM THE UPPER JURASSIC/LOWER CRETACEOUS OF PORTUGAL

FECHNER, Regina, Bayerische Staatssammlung für Paläontlogie und Geologie, München, Germany

In the 1960s, paleontologists of the Free University of Berlin, Germany, started a prospecting campaign for new vertebrate fossil sites in Portugal, during which, amongst ohters, the well-known mammal fossil site Guimarota was discovered. In the years 1967/68, the screen-washing activities concentrated on the dinosaur-bearing sediments of the Upper Lourinh Formation (Upper Tithonian/Lower Berriasian) of Porto Dinheiro near Lourinh. The fluvial deposits consit of shales, marls, sandstones, and conglomerates. The ostracod fauna also indicates brackish water influence.

So far, only the mammalian fauna of Porto Dinheiro has been described. It comprises about

800 teeth, consisting of Multituberculata, Triconodonta, Symmetrodonta, Dyrolestidae, and stem-lineage representatives of Zatheria. The new material described here consists of about 17 000 microvertebrate remains representing Chondrichthyes (2 taxa), Osteichthyes (3 taxa), Testudines (1 taxon), Crocodyliformes (5 taxa), Pterosauria (3 taxa), Theropoda (4 taxa), Sauropoda (1 taxon), and Ornithischia (3 taxa).

The microvertebrate assemblage of Porto Dinheiro provides new insights into the vertebrate fauna of the Upper Jurassic/Lower Cretaceous of Portugal, since almost all these taxa are only known from microvertebrate remains so far. The size range of the material indicates sorting by fluvial transport. With that information and the use of data from palynology and invertebrates, it is attempted to reconstruct the paleo-ecosystem of Porto Dinheiro.

Saturday 10:30

TWO HEADS ARE BETTER THAN ONE: CONSIDERING *ANCHISAURUS* AS A SMALL SAUROPOD

FEDAK, Tim, Dalhousie Univ., Halifax, NS, Canada

Only two sauropomorph skulls are known from the Lower Jurassic Portland Formation, YPM1883 (*Anchisaurus polyzelus*) and YPM209 (previously *Ammosaurus major* now synonymized with *Anchisaurus polyzelus*). The YPM1883 skull has been completely prepared for many years and figures prominently in most previous studies of *Anchisaurus*, whereas the smaller skull (YPM209) has remained only partially exposed. New preparation of the YPM209 skull permits a revised description that includes many previously unseen elements. This information provides the first opportunity to reconsider the synonymy of *Ammosaurus* and *Anchisaurus* based on cranial characters. The YPM209 skull represents a very immature individual based on size, the degree of ossification, and the simple tooth morphology. The skull is approximately 80% the size of the smallest post-embryonic skull of *Massospondylus* (BPI 4376) and, assuming a growth rate similar to that of *Massospondylus,* YPM209 may be less than two years old.

During the past 140 years, the interpretation of the braincase of YPM1883 has been hampered by pre-burial deformation and previously unrecognized damage that occurred during collection. A redescription of the YPM1883 braincase is briefly presented, specifically in relation to skeletal (im)maturity and in reference to several of the characters used to identify *Anchisaurus* as a basal, and the smallest, sauropod.

Considering the implication of skeletal immaturity of the current specimens and the association of *Anchisaurus*with a clade expected to have increased growth rates, future histological analysis of the post-cranial skeleton of *Anchisaurus* will be of considerable interest. The cranial characteristics suggest the current specimens are immature and that considerable growth may have been possible, therefore small specimen size may be attributable to young ontogenetic age.

Wednesday 5:30

MAMMALIAN RESOURCE USE STABILITY ACROSS GLACIAL-INTERGLACIAL CYCLES DURING THE PLEISTOCENE IN COLORADO

FERANEC, Robert, HADLY, Elizabeth, PAYTAN, Adina, Stanford Univ., Stanford, CA

Climate change is known to affect mammals having influences on species abundance, density, morphology, and phenology for example. The strata and fossils from the Pit Locality in Porcupine Cave, Colorado, have been dated to the middle Pleistocene, cross at least two glacial-interglacial cycles, and therefore provide a unique opportunity to study how Pleistocene-scale climate change affects ecology in mammals. This particular study aims at understanding the influence of climate change on resource use in the herbivores and carnivores of the Pit Locality. To evaluate ecology in mammals, isotope values obtained from tooth enamel permit preferences in landscape use and forage to be determined. Particularly, strontium isotope values generally reveal the predominant landscape use patterns of both carnivores and herbivores, while carbon and oxygen isotope values provide information about herbivore diet. Results from 29 samples analyzed for $^{87/86}Sr$ values show no significant changes among any of the levels within the Pit. All of the $^{87/86}Sr$ values are above 0.7095. This value and lack of significant differences among Pit levels indicates that either the predominant landscape use of mammals was solely on the granite-derived soils from the basin in front the cave, or alternatively that the Sr isotope signal surrounding Porcupine Cave is homogeneous and dominated by atmospheric inputs. Both alternatives are explored further. Intra-taxon comparisons of carbon and oxygen isotope values from 64 rabbit and 20 marmot individuals showed no significant differences among any of the Pit levels. Further, similar $\delta^{13}C$ values between rabbits (mean = -10.9‰) and marmots (mean = -10.7‰) implies the lack of dietary partitioning, while differences in $\delta^{18}O$ values between rabbits (mean = -5.3‰) and marmots (mean = 2.1‰) suggest dissimilarity in water intake, or water use such as through metabolic processes. The isotope data from the Pit Locality suggest that climate change had limited affect on the ecology of the taxa present around Porcupine Cave during the middle Pleistocene.

Friday 2:45

THE ORIGIN OF THE ORNITHISCHIAN PREDENTARY BONE

FERIGOLO, Jorge, Fundacao Zoobotanica do Rio Grande do Sul, Porto Alegre, Brazil; LANGER, Max, FFCLRP-USP, Ribeirao Preto, Brazil

The predentary is usually considered neomorphic for ornithischian dinosaurs, i.e.: a structure with no evident equivalence to ordinary organismal traits from which it could have arisen. In addition, because the bone was never homologized with skeletal parts of the outgroups to Ornithischia, its presence has been considered synapomorphic for the group. The most peculiar attribute of the predentary is its unpaired condition. Yet, if related to the development of the mandibular arch, it most probably derives from the fusion of formerly paired ossification centers. The discovery of a new basal ornithischian in the Late Triassic Caturrita Formation of South Brazil corroborates that hypothesis. Some of its specimens have the rostral tip of the mandible formed by a pair of edentulous small bones independent from the dentary. This suggests that, during an initial stage of their evolution, those dinosaurs had a pair of predentary bones, which latter became fused into a single median structure. Considered as an originally paired bone, the predentary is comparable to bones and ossification centers that more often form the rostral mandibular segment of vertebrates. A common rostral bone is the mentomeckelian, a paired element well known in lissamphibians and fishes. More rarely, similar bones have been reported for lizards and birds. In mammals, small bilateral ossifications referred to as *ossicula mentalia* become fused to the dentary, contributing to the formation of the mental region. Accordingly, although synapomorphic for ornithischians, the predentary does not seem to represent a neomorphic structure, since it appears to be homologous to bones or ossification centers found in the mandibles of most, if not all vertebrates.

Saturday 8:15

THE MARFIL LOCAL FAUNA, BRIDGERIAN OF GUANAJUATO, CENTRAL MEXICO: REVIEW AND SIGNIFICANCE. A PROGRESS REPORT ON THE SOUTHERNMOST PALEOGENE TETRAPOD ASSEMBLAGE OF NORTH AMERICA

FERRUSQUIA, Ismael, Institute Geology Univ. Mexico, Mexico City, DF., Mexico

The southern extent, makeup and evolution of the North American Paleogene tetrapod fauna, as well as its relationships with the South American one are poorly known, because its record in Middle America is quite meager; it includes three faunas in northern and central Mexico, and a single mammalian occurrence in Southeastern Mexico. A major task of current research is to improve this record. Here the Marfil local fauna is reviewed and discussed.

The locality lies close to Guanajuato City, in badlands developed in the Eocene Guanajuato Red Conglomerate, and has been only intermittently collected in the last fifty years. The basic lithostratigraphy of the area is known; recently an andesitic lava flow emplaced ~400 below the Marfil l.f. bearing strata was dated, yielding a K-Ar age of 49 Ma, thus establishing an Early Bridgerian maximum age for such fauna.

The study in progress discloses that the fauna includes: The iguanid *Paradipsosaurus mexicanus*, a small bird of prey, *Marfilomys aewoodi*, a rodent seemingly related to the South American Caviomorpha, the sciuravids *Floresomys* species complex and *Guanajuatomys hibbardi*, the "condylarth"*Hyopsodus* sp., the viverravid *Viverravus* sp., the helaletid tapiroid cf. *Helaletes* sp., two new genera of ?palaeanodonts, and a mammal of uncertain affinities. This makeup is congruent with a Bridgerian age.

The Guanajuato site lies ~950 km [~ 8° latitude] south of the Texas Bridgerian localities, thus extending that much the corresponding tetrapod record in North America. The Marfil l.f. is a mixture of well known, widely distributed taxa [e.g., *Hyopsodus*, *Viverravus* and *Helaletes*] and of endemic taxa [e.g., rodents and ?palaeanodonts], which suggests that local speciation was taking place; the *Floresomys* species complex, which displays at least five cheek teeth morphic variants, also supports this contention. Size-wise, the fauna is biased toward microvertebrates, which indicates that sampling has not included yet the full body size and fossil preservation spectra; hence the Marfil l.f. affords only an incomplete, albeit tantalizing view of Bridgerian tetrapods in southernmost North America.

Poster Session B

LATE CRETACEOUS AULOPIFORMS (TELEOSTEI: AULOPIFORMES) FROM THE STATE OF HIDALGO, CENTRAL MEXICO

FIELITZ, Christopher, Emory & Henry College, Emory, VA; GONZALEZ-RODRIGUEZ, Katia, BRAVO-CUEVAS, Victor, Universidad Autonoma del Estado de Hidalgo, Pachuca, Mexico

The central-eastern region of Mexico contains Cretaceous rocks that belong to the Plataforma Valles San Luis Potosi geological province, which includes the states of Tamaulipas, San Luis Potosi, Queretaro and Hidalgo. In the northeastern portion of Hidalgo, the Zimapan Quarry has produced numerous fossil invertebrates and fishes. Specimens are from strata referable to the El Doctor Formation, consisting of light gray micritic limestones and black flint lenses deposited in an open marine neritic environment.

Over 400 specimens of sharks and teleosts are preserved. Teleosts include elopids, ichthyodectids, bericoids and gonorhynchids; however, the dominant taxa are aulopiform fishes. Aulopiforms are represented by an enchodontid, ichthyotringid, a dercetid, and a halecid. The enchodontid is the most common, represented by 51 specimens. This elongate fish exhibits numerous characters that place it within the family Enchodontidae, but several autapomorphies suggest a new genus. The ichthyotringid fish is represented by one complete and several fragmentary specimens. Its characteristic skull is equal to length of the body, and lacks ornamentation on the dermal bones. Poorly-preserved dercetid specimens display characteristics typical of the family. The halecid fish is represented by two complete, but poorly-preserved specimens. It has a deep skull and ornamentation on the dermal bones. We place it within the halecids due to its overall shape and tooth pattern which resemble that of other halecid species.

Fossil aulopiforms are found worldwide and constitute a large portion of the teleosts of many Late Cretaceous marine ichthyofaunas. Until now, the Late Cretaceous aulopiform taxa in the Western Hemisphere consisted of enchodontoids, represented entirely by *Enchodus,* and cimolichthyoids, represented primarily by *Cimolichthys*. The aulopiform diversity at Zimapyon resembles that of the Middle Cenomanian assemblages of Lebanon. Ichthyotringoids have not been observed in other Western Hemisphere assemblages. The relatively high abundance of this new enchodontid species at Zimapyon suggests that it occupies the niche normally filled by *Enchodus.*

Wednesday 10:45

ESTIMATING BRAIN SIZE IN FOSSIL CARNIVORANS USING EXTERNAL SKULL MEASURES

FINARELLI, John, Univ. of Chicago, Chicago, IL; FLYNN, John, American Museum of Natural History, New York, NY

Recent investigations of body size evolution in the mammalian order Carnivora have demonstrated the importance of incorporating fossil taxa into analyses of character evolution. Brain size is another character that is of broad biological interest, having been linked to intelligence, energetics, maternal investment, and many life history variables among mammal taxa. However, a rigorous study of the evolution of brain size has been hindered by a paucity of data. Endocasts minimally require special preservation of the interior of the braincase, and while CT scanning has the potential to recover brain anatomy for a wider range of fossil skulls, it can be both time-consuming and expensive. A method for accurately estimating endocranial volumes from external skull measures, which has not yet been developed for Carnivora, has the potential to rapidly increase the understanding of brain size evolution in fossil taxa.

Endocranial volumes were estimated for 130 extant carnivoran species, spanning all major monophyletic carnivoran clades, using three external skull measures: 1) maximum length from the occipital to the nasal-frontal suture, 2) maximum breadth across the squamosal/parietal, and 3) maximum inter-bullar to apex height. Measurements were taken on 859 museum specimens and regressed against published endocranial volumes for the same species. A multiple-linear regression and information-theoretic approach to model averaging produced a tight relationship between endocranial volumes and linear measures (R^2=0.983). This regression defines a scaling relationship between external features of the carnivoran braincase and its volume. Importantly, this relationship remains highly correlated (r=0.922) even after body size is removed. Verification of the regression equation against fossil taxa, for whom endocranial volumes have been directly measured from endocasts, demonstrates that the scaling relationship observed in the Recent also pertains to extinct carnivoran taxa, documenting the broad applicability of this method for making accurate predictions of endocranial volume in fossil carnivorans.

Poster Session A

FIRST EVIDENCE OF CENOMANIAN DINOSAURS IN ALASKA: FURTHER INSIGHT INTO THE CRETACEOUS ORIGIN OF BERINGIA

FIORILLO, Anthony, Dallas Museum of Natural History, Dallas, TX; TRIPLEHORN, Don, LAYER, Paul, Univ. of Alaska, Fairbanks, AK; FERGUSON, Kurt, Southern Methodist Univ., Dallas, TX

Recent work along the Kaolak River in northwestern Alaska has produced two new dinosaur sites, one containing fossil ornithopod bones and the other a dinosaur tracksite, herein referred to as the Natchisit Tracksite. A total of three vertebrate ichnotaxa are preserved at this new tracksite, attributable to a large theropod, a small theropod, and an ornithopod. These sites combined are first occurrences of dinosaurs both spatially and temporally for this region and provide further insight into the Cretaceous origin of Beringia.

The localities are contained within the upper Nanushuk Formation, a rock unit that crops out over much of the North Slope of Alaska and varies in thickness from approximately 1500 m in the western exposures to 250 m in the northeastern exposures. The Nanushuk is dominantly marine in the lower part of the section and becomes a mix of nonmarine and marine facies in the upper part. The dinosaur bone locality is within a fluvial facies that includes a fire horizon, while the Natchisit Tracksite is within a muddy tidal flat facies. The Nanushuk Formation is Albian to Cenomanian in age.

Both localities are associated with volcanic ashes. The ash at the fossil bone locality has yielded a 40Ar/39Ar age of 95 Ma, placing the locality within the Cenomanian. Preliminary hydrogen isotope data from organic matter within the entombing rocks in these sections along the Kaolak, when compared to data from coeval rocks in Texas, are consistent with a lesser mean annual temperature gradient between the lower latitudes and higher latitudes for the Cenomanian than that observed today.

Saturday 2:15

CALVING HISTORIES OF FEMALE MASTODONS (*MAMMUT AMERICANUM*)

FISHER, Daniel, Univ.of Michigan, Ann Arbor, MI; FOX, David, Univ.of Minnesota, Minneapolis, MN

Tusks of mastodons (*Mammut americanum*) are dimorphic, especially when comparisons are standardized by stage of molar eruption and wear or by number of years in the tusk. By analogy to a similar dimorphism in African elephants (*Loxodonta africana*), the shorter, more slender morphotype, with thinner annual increments and a pulp cavity apex located proximal to the alveolar margin, is recognized as female. Tusks of young males can be distinguished from those of adult females by their greater annual increment dimensions (with correspondingly fewer years in the tusk), greater pulp cavity length (relative to the alveolar margin), and less advanced stage of molar eruption and wear (if associated cheek teeth are available). Recently reported sites in Ohio, New York, and Michigan have yielded new specimens of adult female mastodon tusks, which have been analyzed to determine their pattern of variation in annual increment length. As had been observed previously, we often see intervals of 3-4 years between local maxima in rate of tusk growth, starting after about the tenth year in the tusk. These intervals in life history, from one local maximum to the next, are tentatively interpreted as calving cycles, reflecting increasing investment of calcium and phosphate in fetal development (and correspondingly slower tusk growth) through the time of birth and possibly early lactation, followed by declining investment (and recovering tusk growth rate) during later lactation. Runs tests provide a measure of departure of cycles of tusk growth rate from a random pattern of fluctuation, but we seek a stronger test of the interpretation of calving cycles. We previously observed positive excursions in $\delta^{13}C$ of lattice-bound carbonate in tusk dentin of female mastodons from the Hiscock site in western New York, interpreted as a response to fractionation due to lipid production during the first year of lactation. We now use longer time series to examine the relationship between patterns of tusk growth and stable isotope composition.

Poster Session B

RE-REVEALED: VERTEBRATE PALEONTOLOGY ARCHIVES IN THE AMERICAN MUSEUM OF NATURAL HISTORY

FLEMMING, Clare, The Explorers Club, New York, NY; NORRIS, Christopher, BELL, Susan, American Museum of Natural History, New York, NY

The AMNH Division of Paleontology maintains an extensive archive of vertebrate paleontology manuscripts, catalogues, illustrations, and photographs from the 1890 founding of the Department of Vertebrate Paleontology (VP) to the present day. While much of the VP Archives is accessible to staff and researchers, certain parts have been inaccessible since the 1970s when they were bundled and placed in deep storage. These inaccessible collections include work created by notable researchers Henry Fairfield Osborn, Roy Chapman Andrews, Walter Granger, and artists Charles Knight, Margaret Flinsch, and Albert Operti. New initiatives and resources will enable us to "re-reveal" these records of enduring value, which include correspondence, manuscript notes, vintage prints, retouched photographs (many unpublished), paintings, figures and illustrations depicting maps, specimens, mounts, phylogenies, charts, artifacts, reconstructions (both specimen and animal), as well as lithographs, engravings, and other unique materials. We have three long-term objectives with regard to this currently inaccessible part of the VP Archives:

Identification. We have begun this phase, which requires that we identify the scope and content of the whole collection, as well as the nature and condition of materials therein.

Preservation. Over the next few years, we aim to decompress overstuffed conditions and preserve materials in proper conservation-grade storage at both the collection- and the item levels. This phase takes place, where possible, in conjunction with Identification to minimize handling of materials.

Access. The intent of this phase is to make available original materials for study and use by researchers (after the assessment of copyright issues). Toward this end, we will create the first definitive guides (i.e., finding aids) to this material in order to connect researchers to the contents.

Researchers investigating personalities in, and the history of the AMNH, international vertebrate paleontology, early 20th century photography, scientific illustration, and other topics will find this collection worthy of their attention.

Saturday 8:00

THE TAPADO FAUNA (?CASAMAYORAN SALMA), ABANICO FORMATION, TINGUIRIRICA VALLEY, CENTRAL CHILE

FLYNN, John, American Museum of Natural History, New York, NY; CROFT, Darin, Case Western Reserve Univ. School of Medicine, Cleveland, OH; HITZ, Ralph, Tacoma Community College, Tacoma, WA; WYSS, Andre, Univ. of California at Santa Barbara, Santa Barbara, CA

Our previous studies in the Tinguiririca River Valley documented an early Oligocene assemblage, the main reference fauna for the Tinguirirican SALMA. The same valley has yielded a second assemblage, the Tapado Fauna, ~14 km NW of the main Tinguirirican localities. Several dozen fossils have been recovered from the Tapado Fauna in steeply-dipping exposures on both the N and S sides of the Tinguiririca River (over a N-S distance >3 km and nearly 1,000 meters elevation). Casual observation, and even previous mapping (e.g., Klohn's 1957 map), of the nearly continuous Abanico Fm. exposures in this valley give the misleading impression that the western horizons producing the Tapado Fauna lie substantially higher stratigraphically (≥ hundreds of meters) than the eastern deposits bearing the Tinguiririca Fauna. Six taxa have been identified from the Tapado Fauna to date: a "didolodontid condylarth" cf. *Ernestokokenia* (Itaboraian-Casamayoran), cf. *Notonychops* (a questionable notoungulate, ?Riochican), the notostylopid *Notostylops* sp. (Casamayoran), a new basal interatheriid ("notopithecine"; a basal member of the clade containing all the Tinguirirican and younger interatheriids), the archaeohyracid *Eohyrax* sp. (Riochican-Casamayoran), and the isotemnid

Pleurostylodon sp. (Casamayoran). Therefore, the Tapado Fauna is inarguably older than the Tinguiririca Fauna, likely assignable to some part of the Casamayoran, demonstrating that low-angle faulting has thrust (albeit cryptically) older strata over younger within the Tinguiririca Valley.

A few fossils of similar age have been recovered farther NW, in the Azufre River Valley. One small rostrum pertains to a basal interatheriid, preliminarily assigned to *Antepithecus brachystephanus*, suggesting a Casamayoran age for at least part of these deposits and representing the first known occurrence of this taxon outside of Patagonia. A diverse assemblage of Eocene age also has been discovered in the Teno River drainage (the next major drainage S of the Tinguiririca), documenting the excellent potential for recovery of early Paleogene faunas from this region of the Chilean Andes.

Friday 1:45

THE MID-CENOZOIC MICROFOSSIL RECORD OF THE INDIAN SUBCONTINENT

FLYNN, Lawrence, Harvard Univ., Cambridge, MA

The Siwalik Group of the Indian Subcontinent presents an unparalleled sequence of superposed microfaunas that reveal the style and timing of faunal change for small mammals throughout the middle and late Miocene. Other than important assemblages at Banda Daud Shah and near Bugti, Baluchistan, little was known until recently of the pre-18 Ma and post-Eocene microfaunas of India or Pakistan. Significant improvement came with successive field seasons near Dalana in the Zinda Pir Dome of the Sulaiman Range, western Pakistan. The Dalana sequence includes 10 superposed micromammal assemblages in paleomagnetic sections. Faunal comparison shows that the youngest assemblages antedate the oldest Siwalik sites (18 Ma). The paleomagnetic data agree, placing the young localities of the Vihowa Fm. in the early Miocene. Magnetic data accompanying localities in the subjacent Chitarwata Fm. can be interpreted in two ways, but both show the sequence to span considerable time, and both show the lowest sites to be Oligocene in age. The oldest locality, Z108, produces a rodent assemblage like that from the classic Bugti sites, including Paali (C2). Rodent composition for these sites, dominated by ctenodactyloids, stands in sharp contrast at the family and higher levels to that of the much younger Siwaliks. Z108 is early or late Oligocene in age, 29 or 25 Ma, depending on magnetic interpretation. A series of higher localities (Z113, Z139, Z150) introduces modern elements: squirrels, muroids of modern grade, and gundis. These are late Oligocene in age or near the Oligo/Miocene boundary. Z135 and Z126 in the upper part of the Chitarwata Fm., early Miocene in age, produce more derived species, including early members of genera found in the lower Siwaliks. The youngest localities (Vihowa Fm.) date to 19 Ma and record a Siwalik style rodent fauna. The Dalana assemblages document change in the microfauna of one basin and offer a temporal scale previously unavailable. They help to put in perspective microfaunas from elsewhere in the Indian Subcontinent, perspective both relative to major faunal trends and an estimate of age of local deposits, which increases the significance of fossils from the far-flung locales of Kargil, India, and Sind, Pakistan.

Saturday 10:15

NEW *THEROPITHECUS* FOSSILS FROM COOPER'S CAVE AND PRELIMINARY PHYLOGENETIC ANALYSIS OF BABOONS

FOLINSBEE, Kaila, Univ. of Toronto at Mississauga, Mississauga, ON, Canada

Baboon fossils are common in the Plio-Pleistocene karst cave deposits northwest of Johannesburg. At least five genera are recognized from southern Africa at this time, the most commonly occurring earlier forms being *Papio* and the smaller genus *Parapapio* with isolated occurrences of *Gorgopithecus* and *Dinopithecus*. *Theropithecus*, a genus more frequently found in eastern Africa, is also present in small numbers. By the end of the Pleistocene, all taxa except *Papio* become extinct in southern Africa. Presently, *Theropithecus* (the living gelada baboon) only occurs in Ethiopia, while members of the genus *Papio* are found across the continent.

One of these karst deposits, Cooper's Cave, has yielded an important primate fauna since its discovery in 1938. This report describes new material referred to *Theropithecus oswaldi* from the Cooper's D locality. This identification is based on the presence of distinctive molars (thickly enameled cheek teeth with high cusps and deep foveae), an upright mandibular ramus and anterior fusion of temporal lines. Other salient features of the new fossils include an extremely thick cranial vault and robust post-crania.

Recent phylogenetic work has revealed some interesting complexities within the baboon clade. Traditional morphological data suggest that the mangabeys and *Papio*+mandrills form two monophyletic clades, whereas molecular analyses have found these groups to be paraphyletic. Preliminary phylogenetic analysis based on morphological characters of both living and extinct taxa suggest that some morphological data corroborates the molecular results in finding paraphyly of traditionally accepted clades. This analysis will further clarify phylogenetic relationships within the group, and shed light on the significant biogeographic changes within the baboon clade over the last five million years.

Friday 8:30

NEW SPECIMEN OF ARCHAIC BALEEN WHALE *MAUICETUS PARKI* (LATE OLIGOCENE, NEW ZEALAND) ELUCIDATES EARLY CROWN-MYSTICETI

FORDYCE, Ewan, Univ.of Otago, Dunedin, New Zealand

Mauicetus is cited widely as one of the earliest and most basal baleen whale genera (Mysticeti). The 4 named species are of late Oligocene-earliest Miocene age from New Zealand; a few other *Mauicetus*-like fossils have been identified elsewhere. Typological problems have long obscured the genus. The type species, *Mauicetus parki*, has hitherto been known only from the holotype, an incomplete large braincase and periotic (OU 11573; Milburn Limestone, South Otago, New Zealand). Until now, it has been difficult to compare the fragmentary *M. parki* with the 30+ other Oligocene-earliest Miocene mysticete specimens from New Zealand or the increasing record of basal crown-Mysticeti from other ocean basins.

A newly prepared juvenile whale (OU 22545; skull, mandibles, tympanoperiotics) represents an informative second specimen of *M. parki*. OU 22545 is from mid-shelf Otekaike Limestone of Hakataramea Valley (Waitakian Stage, later to latest Oligocene, ?24 Ma). Skull cbl is about 1210 mm, while the broad-based triangular toothless rostrum is about 820 mm long, with nares forward of subhorizontal antorbital notches. Medially, the frontals descend gently laterally. Parietals (and interparietal?) form a short intertemporal region between short wide temporal fossae. Much ventral structure is lost, but one squamosal retains the zygomatic process and details around the ear. The periotic has a prominent deep wedge-shaped anterior process, a markedly porous dorsal surface, and a small rounded pars cochlearis, while the bulla is rounded rather than bilobed posteriorly.

The new skull is fairly disparate from the ontogenetically older holotype, but the periotics are more similar to one another than to 25+ other local fossils of comparable age, strongly supporting conspecificity. Comparisons allow other hitherto problematic New Zealand fossils to be placed confidently near *Mauicetus*, while Marples' species *M. lophocephalus* and *M. waitakiensis* are confirmed as not congeneric; they probably lie close to Eomysticetidae. More work is needed to determine whether, as previously suggested, *Mauicetus* is a stem-balaenopterid.

Wednesday 4:30

PALEOENVIRONMENTS AND MAMMAL COMMUNITIES OF THE LATE NEOGENE RED CLAY AT BAODE, SHANXI, NORTH CHINA

FORTELIUS, Mikael, Univ. of Helsinki, Helsinki, Finland; PASSEY, Benjamin, Univ. of Utah, UT; KAAKINEN, Anu, Univ. of Helsinki, Helnsinki, Finland; ZHU, Yanming, Peking Univ., Beijing, China; ZHANG, Zhaoqun, IVPP, China; ZHOU, Liping, Peking Univ., China

The land mammal fossils ('dragon bone') from the Red Clay of North China played a crucial role in the early development of Chinese paleontology. A century ago, Max Schlosser announced his discovery in this material of distinct 'forest' and 'steppe' faunas, based on the distribution of brachydont versus hypsodont gazelles. As Schlosser was unaware of the precise provenance of the material, the discovery posed an enigma that a century later is still not entirely resolved, although both geographic and temporal explanations have been proposed. Recently both fieldwork and analysis of continental-scale hypsodonty patterns has suggested that the climatic trend within the late Miocene of China was towards more humid conditions, opposite to the global trend of increasing aridity. This has turned our interest towards Schlosser's enigmatic discovery.

The Red Clay deposits in Baode County by the Yellow River in Northern Shanxi Province have long been known for containing faunas of a 'mixed' character, intermediate between the 'forest' and 'steppe' assemblages. Paleoenvironmental information inferred from the lithology, susceptibility and grain size characteristics of the Red Clay sequence indicates that the Late Miocene of the Baode area was relatively humid with cold-warm alterations while the Pliocene was relatively arid. The carbon isotope record indicates that the animals have had mainly C3-dominated diets, but several localities have values indicating significantly more C4 vegetation (up to about 50%). These results suggest that the Baode faunas represent an environmental transition between a 'C3-world' and a 'C4-world'. Mesowear analysis of molar teeth shows that the 'mixed' faunas comprised a wide range of diets, from browsing to graze-dominated mixed feeding. Isotopes and dental wear agree that the stratigraphically late Baode Locality 30 was the most variable in terms of diet, including browsers, mixed feeders and true grazers. The Baode Red Clay may thus record the history of an increasingly seasonal or climatically variable environment in the transition zone between two biomes.

Poster Session B

DECIDUOUS DENTITIONS AND TOOTH ERUPTION SEQUENCES IN FOSSIL AND RECENT ARTIODACTYLA

FOSS, Scott, John Day Fossil Beds National Monument, Kimberly, OR; THEODOR, Jessica, Illinois State Museum, Springfield, IL

The deciduous dentition of mammals is thought to be only rarely preserved in the fossil record. However, careful recording of the available dentitions has allowed us to characterize the deciduous tooth arrangement and morphology of nearly one-hundred artiodactyl taxa. The observed morphology of artiodactyl deciduous dentitions is quite variable and deserves consideration when making both ecological and phylogenetic inferences with regard to these taxa. The variability in deciduous artiodactyl premolars includes deep crenulations in some anthracothere taxa, accessory cuspules in cebochoeres, serrations in entelodonts, and the more typi-

cal cusp arrangement of diacodexids. However, all taxa observed share the derived 6-cusped dp4 morphology that appears to be consistent in all artiodactyls.

The timing and order of replacement of the deciduous dentition by the permanent dentition can also be inferred in many species. By looking at multiple dentitions of a similar species, a general dental eruption and replacement sequence may be reconstructed for individual taxa. Inferring the eruption sequence of multiple artiodactyl taxa allows us to better understand the life history of these groups. In addition, it allows us to recognize developmental characters that may be used in phylogenetic analysis and which may help shed light on the evolutionary transformations within Artiodactyla.

Poster Session B

EVIDENCE OF SIZE-CLASSES AND SCAVENGING IN THE THEROPOD *ALLOSAURUS FRAGILIS* AT THE MYGATT-MOORE QUARRY (LATE JURASSIC), RABBIT VALLEY, COLORADO

FOSTER, John, Museum of Western Colorado, Grand Junction, CO

The Mygatt-Moore Quarry in the Brushy Basin Member of the Morrison Formation contains a dinosaur fauna dominated by disarticulated elements of the sauropod *Apatosaurus excelsus*, but also common at the site are elements of the theropod dinosaur *Allosaurus fragilis*. Herbivorous dinosaur carcasses at the quarry appear to have been frequently scavenged by *Allosaurus*, as suggested by the fact that numerous bones of herbivorous dinosaurs exhibit tooth marks from bites of carnivorous dinosaurs. These bones include pelvic, pectoral, and limb elements of adult and juvenile sauropods and the type ilium of *Mymoorapelta*. The tooth marks include short, narrow scratches up to long, deep gouges made by adults. There are also 225 shed theropod teeth collected so far from the quarry, and 98-99% of these belong to *Allosaurus* (three belong to *Ceratosaurus* and two may belong to *Torvosaurus*). Measurements of basal crown length of these shed *Allosaurus* teeth demonstrate a distinctly bimodal distribution, with peaks in abundance at tooth lengths of 15mm and 20mm. The measured teeth range in basal crown length from 5mm to 23mm, but 64% of the teeth are 15mm or less in length and another 25% are between 18mm and 21mm. A gap in abundance occurs at tooth lengths of approximately 16-17mm. The reasons for this bimodal distribution are not clear, but the distribution may imply a population of *Allosaurus* in which specific size or age groups were particularly abundant. In this case, most of the individuals appear to have been small to approximately half grown or to have been close to 90% maximum size, with few moderately large (~70-74% maximum size) individuals. Alternatively, the pattern may arise from a preference of moderately large *Allosaurus* for food from other environments or an annual switch by the population to food sources in other areas. Generally similar basal crown length distributions were first reported for *Allosaurus* from similar terrestrial paleoenvironments at Como Bluff, Wyoming.

Saturday 11:45

THE IMPACT OF VARIABLE PRESERVATION PROBABILITY ON THE ACCURACY OF STRATOCLADISTIC HYPOTHESES

FOX, David, MARCOT, Jonathan, Univ.of Minnesota, Minneapolis, MN; FISHER, Daniel, Univ.of Michigan, Ann Arbor, MI

Stratocladistics uses both the distribution of character states among taxa and the stratigraphic order of taxa to identify most parsimonious phylogenetic hypotheses. Based on theory, we expect the accuracy of stratocladistics to be relatively insensitive to variations in preservation probability, whether among taxa or through time, that are partly responsible for gaps in the fossil record. We test this idea with simulated evolutionary histories that allow us to compare the ability of cladistics and stratocladistics to recover simulated trees given the same character data. A previous simulation study found that stratocladistics yields fewer and more accurate hypotheses than cladistic analysis independent of the completeness of the fossil record. We use the same evolutionary simulation, a time-homogeneous birth-death model that evolves 50 binary characters based on forward (F) and back (B) state transition probabilities. The previous study used uniform preservation probabilities. In this study, we assign preservation probabilities randomly to lineages, lineage segments, or stratigraphic intervals based on 10 models of preservation probability that degrade complete simulated evolutionary histories in different ways. Each model is applied to a history 10 times independently, so one simulation yields 100 taxon x character matrices. For each matrix, results from both methods are compared to the simulated phylogeny using the consensus fork index (CFI). For a simulated history with F=0.1 and B=0.01, stratocladistics is not sensitive to variable preservation probability: the stratocladistic result was the same as or closer to the simulated phylogeny for 38 matrices, the cladistic result was the same or closer for only 23 matrices, and the methods tied for 39 matrices. This result suggests that under various models of preservation, on average, stratocladistics provides a more accurate hypothesis of evolutionary relationships than conventional cladistics. A newly completed computer program that performs full stratocladistic and cladistic searches will allow us to analyze many more simulated evolutionary histories efficiently and determine the generality of this result.

Wednesday 3:00

THE FIRST INTERNATIONAL WORKSHOP FOR MICROPREPARATION OF VERTEBRATE FOSSILS

FOX, Marilyn, Yale Peabody Museum of Natural History Div of Vertebrate Paleontology, New Haven, CT; DAVIDSON, Amy, American Museum of Natural History, New York, NY; KELLNER, Alexander, Museu Nacional de Ciencas Naturais, Rio de Janeiro, Brazil; POL, Diego, American Museum of Natural History, New York, NY; PUERTA, Pablo, Museo Paleontologico Egidio Feruglio, Trelew, Argentina; SILVA, Helder de Paula, Museu Nacional de Ciencas Naturais, Rio de Janeiro, Brazil

This workshop was funded through the SVP Preparator's Grant, through the generosity of Dr. Joseph Chance. Held at the Museo Paleontologico Egidio Feruglio, Trelew, Argentina, it was attended by preparators from the major paleontological institutions of Argentina and Brazil (10 institutions, 19 preparators). These preparators are routinely in charge of the preparation of fossil vertebrates of outstanding scientific importance. Hitherto, the majority of the vertebrate fossils from South America have been medium sized or larger. Recently, more finds have been made of the types of specimens that would benefit from skilled micropreparation, and this workshop was intended to address that need.

Enabling the participants to conduct high quality preparation work in the future for their respective institutions, this workshop represented a unique opportunity for the attendees to learn novel techniques and improve their skills in the preparation of small vertebrate fossils. This improvement in preparation quality will directly benefit the research conducted at these institutions, and the Argentine and Brazilian scientific communities. As the staff preparators of their institutions, the attendees will be in a critical position to communicate this knowledge to other professional preparators in the years ahead.

This 10-day workshop included lectures and practical classes taught by Amy Davidson (mechanical micropreparation), Marilyn Fox (molding and casting), and Dr. Alexander W. A. Kellner (acid preparation) with the assistance of Helder da Paula Silva. As the experience in preparation among the participants ranged from very little to 25 years, there was additionally great opportunity for the participants to learn, not only from the instructors, but from each other, and to discuss varying techniques and materials.

This talk will be a report on the activities conducted during the workshop, as well as its continuing importance for all participants.

Poster Session A

THE AERODYNAMIC PROPERTIES OF RHAMPHORHYNCHID TAIL FINS

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A prominent feature of Rhamphorhynchids is the fin on the distal base of the tail. It is widely accepted that the tails were oriented dorso-ventrally and acted like rudders, stabilizing or directing the animal while in flight (Wellnhofer, 1975). However, neither the exact aerodynamic properties of the tail fins nor differences between the four different tail shapes of Rhamphorhynchus muensteri have been examined. A year-long study has investigated whether or not the four different shapes of tail fins confer a particular aeronautical advantage purely as a result of different geometry. Our expectation was that the shapes would generate different forces, with the differences remaining constant, relative to each other. To control for the size differences between the species, each model tail was scaled to the surface area of the largest species' tail fin ("*R. longiceps*"). The models were made of an aluminum frame with neoprene stretched over to replicate the membrane that formed the fin. In addition to modeling the four tails, models of simple geometric shapes (circle, square, diamond, and triangle) were created as controls. The models were tested in a wind tunnel at four different angles into the flow (0, 10, 20, and 30 degrees), and at two different wind speeds (6 and 9 meters per second). The models were attached to force meters that measured their wind resistance, the force of which would, on the living animal, be the force of the "rudder" action the fin was supposedly evolved to perform. The testing showed that while different shapes did have different aerodynamic properties, they did not differ in any manner which could have been predicted by the fossils. Moreover, the geometrically shaped control fins and the models grouped differently at different angles and speeds. The data suggests that consistency over a wide range of speeds and angles is related to the rate at which the ratio of frontal area to total area of a shape changes as the angle of attack changes.

Wednesday 11:00

DETERMINING ISOTOPIC FRACTIONATIONS FOR CARNIVORES: A CASE STUDY AT ISLE ROYALE

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The application of stable isotope biogeochemistry to paleoecologic questions, such as the reconstruction of past predator-prey interactions, requires assumptions about how isotopes are sorted by trophic level. For example, previous isotopic reconstructions of late Pleistocene megafauna from La Brea found that dire wolves and sabertooth cats fed primarily on grazers (bison and camel). A larger than generally assumed $\delta^{15}N$ trophic enrichment factor would change the dietary interpretation for both carnivores to include browsing herbivores (sloth, horse, and mastodon). Unfortunately, the isotopic enrichments of ^{13}C and ^{15}N that occur between mammalian carnivores (predators) and their prey have not been well defined in mod-

ern populations. We use bone collagen from the Isle Royale wolf and moose populations to determine enrichment factors for $\delta^{13}C$ and $\delta^{15}N$ for a wild population of predators and their prey. Isle Royale is a closed system with low food web complexity, where wolves are the top predator and moose are the only ungulate and dominant prey species. This system allows us to measure a fractionation under natural conditions, while minimizing other inputs (i.e. prey selection) that often complicate this calculation for wild carnivore populations. We also examine how the isotopic record of wolves and moose reflect known climatic and ecologic events that have occurred since the 1960s.

Poster Session A

SPECTACULAR NEW QUATERNARY FOSSILS OF THE CUBAN CROCODILE AND AN EXTINCT TORTOISE FROM A FLOODED CAVE ON ABACO, BAHAMAS

FRANZ, Richard, Florida Museum of Natural History, Gainesville, FL; MORGAN, Gary, New Mexico Museum of Natural History, Albuquerque, NM; FRANZ, Shelley, Putnam Hall, FL; ALBURY, Nancy, Abaco, Bahamas; KAKUK, Brian, Bradenton, FL

At least 14 well-preserved skeletons of crocodiles and three complete shells (including one skull, several scute fragments, and most of an associated skeleton) of an extinct species of large tortoise were found by Brian Kakuk and cave diving associates in a large water-filled cavern at Sawmill Sink, Abaco, Bahamas, in early 2005. The skulls of the more accessible crocodile specimens possess the diagnostic features associated with the Cuban crocodile (*Crocodylus rhombifer*), including: short, broad rostrum; concave cranial roof and interorbital region; rounded protuberance on the posterolateral corner of the squamosal; and 13 maxillary teeth. These specimens supplement a previous discovery of this species in another bluehole cave system on Abaco in 1993. Whether all of the skeletal material can be referred to the Cuban species has not yet been determined because the American crocodile (*Crocodylus acutus*) is also known to occur in Bahamian waters. The tortoise material is exquisitely preserved. The lack of a nuchal scale on the nuchal plate and other diagnostic features suggest that the tortoise belongs to an undescribed species in the South American genus *Chelonoidis*. The Cuban crocodile and land tortoise no longer occur on Abaco nor elsewhere in the Bahamas. *C. rhombifer* still survives on Cuba, the tortoise is an extinct species.

The three tortoises were collected from the sides of a talus cone at water depths between 14.6 and 17.4 m, while most of the crocodiles were found on the lower part of the cone at depths between 17.4 and 29.1 m. The top of the talus cone coincides with a hydrogen sulfide layer at 9.1 m, and the cone extends downward for 30.5 m. A fluctuating halocline is developed at 21.3 to 24.4 m. At least two of the tortoise skeletons were embedded in layers of peat with an abundance of seeds, leaves, and woody twigs, which, along with pollen, will be evaluated by FLMNH paleobotanists to determine the environments associated with these fossils. The pristine preservation and unmineralized condition of the bone suggests a Quaternary age for the Abaco fossils. Forthcoming radiocarbon dates should provide a more precise chronology.

Poster Session A

FAUNAL COMPARISON OF MICROVERTEBRATE ACCUMULATIONS IN THE JUDITH RIVER FORMATION (CAMPANIAN) AND HELL CREEK FORMATION (MAASTRICHTIAN) OF MONTANA WITH CONSIDERATION OF COLLECTION METHOD BIASES

FREEDMAN, Elizabeth, Franklin & Marshall College, Lakeland, FL; WILSON, Laura, Museum of the Rockies, Montana State Univ., Bozeman, MT

Microvertebrate accumulations from mudstone and sandstone deposits were sampled from the Judith River Formation (Campanian) of northcentral Montana by two collection methods. At each site, specimens were collected from both surface collection and sieving of *in situ* matrix. R-mode correspondence analysis reveals that surface and matrix assemblages are distinctly different ($p<0.05$). Due to extensive weathering and size-related collection bias, the surface samples lack many fish and amphibian taxa found in sieved matrix, while more robust specimens occur in higher abundance. Because comparatively larger fossils such as turtle shells and dinosaur teeth occur at low densities in the matrix, the matrix samples may lack many reptilian taxa found in surface samples. Combining population data from both collection methods is beneficial for compiling a conclusive faunal list, but relative abundance data was calculated using only sieved matrix due to the disparity between methods.

The vertebrate paleocommunity resulting from this study in the Judith River Formation is compared to the community amassed from a similar study in the Hell Creek Formation (Maastrichtian) of eastern Montana. While there is a large faunal carryover from the Campanian to the Maastrichtian, there are distinct differences in percent abundances of taxa (most notably in the Dinosauria) as well as taxa shifts in lower vertebrates. Lancian specimens were collected through quarrying of *in situ* mudstone and sandstone deposits combined with the sieving of tailings to account for collection biases. Preliminary surface collection was undertaken before quarrying commenced, but that data is not used in calculating population abundances. Although collection methods differ between Judith River Formation and Hell Creek Formation microsites, taxa lists compiling data from multiple collection methods and depositional environments minimize collection and taphonomic biases, thus providing a more comprehensive view of the paleocommunities.

Saturday 5:00

IT'S ABOUT TIME: POPULATING A NEW PALEONTOLOGY CENTER WITH ACCURATE MODELS AND PALEOBIOMES

FREMD, Theodore, SMITH, Matt, DUNN, Regan, FOSS, Scott, RICKABAUGH, Skylar, National Park Service John Day Fossil Beds, Kimberly, OR

Reconstruction of ecosystems for exhibit purposes can be likened to the formulation and expression of testable hypotheses, but using artistic media. We wished to portray eight of the many temporal intervals preserved within the Tertiary John Day Basin of Oregon via a combination of large murals, accurate rockwork, and 3-D dioramas to help the public visualize changing biotas and processes. Previous attempts to depict taxa endemic to the area, however, are of uneven accuracy or non-existent, and complete fossil materials are not as abundant as one might prefer. Constructing accurate macquettes of ceratogaulids and unique nimravids, for example, has required multiple iterations by a team composed of scientists, modelers, paleontological illustrators, and contractors. This was then subjected to a critical peer review process which exposed a remarkable diversity of interpretations.

Initially, the NPS scientific staff viewed much of the process as a somewhat onerous burden distracting skills away from publishable investigations and fieldwork. It turns out, however, that the entire procedure has clarified many incorrect assumptions, and provided a whole new array of research questions demanding attention by paleontologists and laboratory scientists for years to come.

Saturday 9:15

BRAINCASES, BODIES AND BIOGEOGRAPHY: NEW CHARACTERS AND THEIR BEARING ON THE INTERRELATIONSHIPS OF EARLY LUNGFISHES

FRIEDMAN, Matt, Univ. of Chicago, Chicago, IL

Lungfishes are the most diverse clade of Devonian sarcopterygians, but their interrelationships remain poorly resolved. Methodological quarrels have contributed to the lack of consensus, but further problems lie with the characters themselves. Most studies have relied almost exclusively upon the dermal skull roof and the dentition, but both of these systems are highly derived in lungfishes relative to generalized sarcopterygians, making reliable inferences of character polarity within Dipnoi difficult. Compounding matters, intraspecific variability in dermal bone patterns in lungfishes is so pervasive that standard arrangements cannot be defined for some taxa. Meanwhile, character-rich neurocrania and postcrania have largely been neglected. Apart from providing new data, braincases and bodies offer an additional advantage over dentition and dermal bones: more informative comparison with non-dipnoan outgroups. Novel characters, coupled with recently discovered material and CT scans of old specimens, provide new insights on the interrelationships of early dipnoans. *Dipnorhynchus*, *Speonesydrion* and *Uranolophus* occupy basal positions, while 'chirodipterids' are problematic, and there is no evidence that they constitute a clade. Two major radiations are resolved among Late Devonian cosmine-free taxa, the interrelationships of which have been contentious in the past. The first places 'holodopterids' and 'rhynchodipterids' as successive grade groups along the lineage leading to fleurantiids, while a second clade comprises a series of toothplate-bearing forms including Carboniferous taxa such as *Sagenodus* and probably contains crown-group Dipnoi. This solution implies that the development of a long-based second dorsal fin is homoplastic, contrary to the gradual evolution of this feature within a single lineage as is often portrayed. Although large-scale interpretations of lungfish biogeography are premature, mapping depositional environments on to the cladogram reveals intriguing patterns, particularly the apparent radiation of some clades in continental settings.

Poster Session B

ICE AGE: MAMMOTHS AND PALEOLITHIC ART, A HISTORICAL PERSPECTIVE

FRIEDMAN, Virginia, Univ. of California at Davis, Suisun City, CA; FRIEDMAN, Joanna, Princeton Univ., Princeton, NJ

The word "mammoth" comes originally from the Tartars who called them *mamantu* from the huge bones these nomadic people encountered in their wanderings. Much later, Cuvier gallicized it into "mammouth" and from there, "mammoth." During the Ice Age, mammoths roamed the Northern Hemisphere coexisting with early man. Their imposing size and strength caused a deep impression in the minds of prehistoric people during the Upper Paleolithic in northern Eurasia where mammoth images were reproduced in magnificent cave paintings, drawings and engravings. The mammoth lineage dates to early Pliocene in Africa around 4 million years ago. From there they spread into Europe about 3 million years ago. Later, *Mammuthus* ranged over Eurasia and North America in the Pleistocene. The woolly mammoth, *Mammuthus primigenius*, is depicted in prehistoric art made approximately 30,000 years ago mainly in France and Spain including Font-de-Gaume, Rouffignac, Cougnac, Pech-Merle among others. In Spain: Cavern del Castillo and El Pindal. German sites include Goennersdorf and Obere Klause. In the Urals, the Kapova Cave. Prehistoric images of mammoths were usually highly stylized artistic renditions making it often difficult to be certain of the taxonomic position of the mammoth depicted. The attribution of some paintings and drawings of mammoths to *Mammuthus primigenius* appears sustainable. Large dwellings in Upper Paleolithic sites from Poland and Russia contained stacked tusks and bones from dozens of mammoths. The extensive hunting in northern Eurasia of these magnificent beasts does not seem to have been a contributing factor in their ultimate demise. On the other hand, the interactions between

mammoths and Paleoindians in North America may have been a leading cause of their eventual extinction, in addition to the disappearance of the continental ice sheet in North America around 14,000 years ago. It also appears that mammoths did not make the same strong impression on prehistoric American artists as they made on Eurasians. The significance of the images of mammoths in prehistoric art is still debatable. Even though the formidable mammoth is long gone, the images of them are timeless.

Saturday 2:45

A DOUBLE-TUSKED DICYNODONT THERAPSID—PATHOLOGY, VARIABILITY, OR A NEW SPECIES?

FROEBISCH, Joerg, Univ. of Toronto, Mississauga, ON, Canada

As their scientific name already implies, the presence of a pair of large teeth is one of many synapomorphies that diagnoses dicynodont anomodonts. In basal taxa, additional dentition consists of a varying number of cheek teeth. In addition, substantial parts of the lower jaw, palate, and snout region were covered by a keratinous beak during life, as indicated by pitted and roughened surfaces in these areas. The enlarged teeth are not homologous with the caniniforms of more basal synapsids and thus represent neomorphic structures, more properly called tusks. They usually erupt from more or less prominent, ventrally projecting caniniform processes in the maxillary bones on each side of the skull. In some derived taxa the tusks are reduced or completely absent. In other forms the absence or presence of tusks in various specimens of the same taxon has been interpreted as sexual dimorphism.

Here I report on an unusual specimen that shows close affinities to the Middle to Upper Permian genus *Emydops* to which it has previously been ascribed. The specimen was discovered within the known stratigraphic range of *Emydops* in the *Cistecephalus* Assemblage Zone of the South African Karoo Basin in 1917. It shares a number of derived characters with *Emydops* such as its small size, a wide temporal region, prominent lateral dentary shelfs, and an embayment on the medial surface of the palatal rim. However, instead of one tusk it bears two tusks on each side of the skull. This double-tusked condition, as yet unknown in dicynodonts, raises the question whether this feature is pathological, falls within the range of intraspecific variation, or represents a diagnostic character that sets this specimen apart from other taxa.

Saturday 4:30

FORELIMB ANATOMY OF *TRICERATOPS* (CERATOPSIA: CERATOPSIDAE) WITH IMPLICATIONS TO SECONDARY QUADRUPEDAL POSTURE

FUJIWARA, Shin-ichi, The Univ. of Tokyo, Tokyo, Japan

A new specimen of *Triceratops* (NSM PV 20379) excavated from Bowman County, North Dakota, preserved in nearly complete articulation the right side of the body. Detailed study of the forelimb anatomy resulted in a new restoration of the manus. Based on morphological and geometrical analyses together with interpretation of the fossil, the manus of NSM PV 20379 was reconstructed with the metacarpals arranged in an 'L' shape in proximal view. This arrangement allows the second digit to be parallel to the rotational plane of the elbow joint. The second digit bracketed by digits I and III leads the manus to direct anterolaterally. Digits I, II and III seem to be arranged for exerting a powerful stroke by extending the elbow joint. This restoration is significantly different from the previously suggested reconstructions of the manus, where the manus directs anteriorly as is often the case with mammals.

Most cerapods seem to have had a similar manual configuration: the manus apparently is smaller than the pes, it has long and robust metacarpals II and III, ungual terminal phalanges at digits I to III, reduced digits IV and V, and a divergent metacarpal V. It is therefore reasonable to assume that the manus of *Triceratops* retained the plesiomorphic state of the forelimb of bipedal, basal cerapods. Evidence from the footprints show that the Cerapoda, such as ornithopods and ceratopsids, directed the manus laterally in quadrupedal locomotion. Reduction of outer digits in length and the bipedal locomotion were present in the basal Cerapoda. A shift from bipedal to quadrupedal locomotion occurred independently at least two times within Cerapoda, such as Iguanodontoidea and Neoceratopsia. In Neoceratopsia, despite the shift to quadrupedalism and significant increase in body size, the basic features of the manus remained.

Wednesday Evolution Symposium Poster

UNDERSTANDING THE NATURE OF SCIENCE: EVOLUTION THROUGH EXPLORATION IN K-12 CLASSROOMS

GABOARDI, Mabry, Florida State Univ., Tallahassee, FL

The public argument surrounding evolution cannot be resolved until a much more fundamental problem is addressed; many members of our society lack a basic understanding of the nature of science. Education is the key to reversing this situation. Students must be involved in the process of science, and be taught to explore and interpret data. Unfortunately the practice of engaged exploration is absent from most K-12 and undergraduate level laboratories and classrooms.

The NSF-funded GK-12 program currently links doctoral students to local public schools in order to further communication between the scientist, the teacher, and the students. Ideally, through the partnership, each gains a better understanding of the nature of science and how it can best be taught. Students in K-12 classrooms are encouraged to explore evolution by examining stratigraphic sequences, comparing fossils from their area with modern local fauna, and observing adaptations of modern animals. In each case, the student is the scientist, reaching her own conclusions based on data available. Only after students consider the data are current scientific opinions introduced. Classes decide whether these interpretations explain all data and discuss how ideas are revised in light of new data. Never are the students forced to agree with scientists' assessment of the data; in fact, the importance of informed questioning and peer review in the process of science are stressed.

Unfortunately most members of our society miss the process of exploration in science. This can make it very difficult for a scientist to explain his research and contribute positively in society. Instead of wondering, "Why doesn't the public agree with our interpretation of the data?" scientists should ask, "How can we better teach the nature of science so the public understands our interpretations?"

Wednesday 12:00

MONOPHYLY, DICHOTOMY OR NEITHER: INVESTIGATING 'LIPOTYPHLAN' PHYLOGENY USING GEOMETRIC MORPHOMETRICS

GABRIEL, Stefan, POLLY, P. David, Queen Mary, Univ. of London, London, United Kingdom

Recent hypotheses of 'lipotyphlan' relationships have fallen into two groups. Many phylogenies constructed from discrete morphological characters support the traditional view of 'lipotyphlan' monophyly. In contrast most trees produced using molecular data posit 'lipotyphlan' dichotomy with, tenrecs (Tenrecidae) and golden moles (Chrysochloridae) nested within the Afrotheria and, the remaining taxa remaining in a residual Eulipotyphla. We decided to approach this problem from a third perspective by using the continuous characters from a geometric morphometric analysis.

Nineteen landmarks were used to characterize the ventral side of the skull of a variety of 'lipotyphlans'. The taxa used included at least one genus from each of the extant 'lipotyphlan' families, plus the fossil taxa *Apternodus*, *Nesophontes* and *Oligoryctes*. These data were used to perform a Relative Warp analysis. Then the scores from this were used to construct a Maximum Likelihood tree with ContML.

The resulting tree failed to support either of the previous hypotheses of 'lipotyphlan' relationships. Whilst some families were well resolved (e.g. Soricidae and Chrysochloridae), others were not (e.g. *Oryzorictes* failed to group with the other members of the Tenrecidae). Nevertheless bootstrap values were generally high suggesting that there is a strong hierarchical structure to these data. This work will be extended by adding mandibular and dental data to see whether this improves the phylogenetic signal.

Saturday 8:45

BASAL SAUROPODOMORPH DINOSAUR TAXA *THECODONTOSAURUS* RILEY & STUTCHBURY, 1836, *T. ANTIQUUS* MORRIS, 1843 AND *T. CADUCUS* YATES, 2003: THEIR STATUS RE. HUMERAL MORPHS FROM THE 1834 FISSURE FILL (UPPER TRIASSIC) IN CLIFTON, BRISTOL, UK

GALTON, Peter, Univ.of Bridgeport, Bridgeport, CT

Riley & Stutchbury erected *Thecodontosaurus* in 1836 for a dentary with 21 teeth from a Rhaetian fissure fill in Clifton. In 1840 they figured the type jaw, two isolated teeth as *Paleosaurus cylindrodon* and *P. platyodon*, and unassigned isolated postcranial bones. *Thecodontosaurus* is the type genus of *T. antiquus* R & S vide Owen, 1842. In 1908 Huene recognized *Palaeosaurus platyodon* as a phytosaur and figured the best preserved dinosaur bones, referring gracile ones to *T. antiquus* and robust ones to *T. cylindrodon*. These bones are now referred to the basal prosauropod/sauropodomorph *T. antiquus* with the two morphs representing a sexual dimorphism. Many bones were destroyed in 1940 but a few articulated partial juvenile skeletons, one with a skull, were described from a Rhaetian fissure fill in South Wales as *T. caducus* Yates, 2003.

The deltopectoral crest of isolated Clifton humeri is anteroposteriorly high and markedly asymmetrical in lateral view with a short edge distal to the prominent apex. The apex is at 40% of humeral length in gracile ones and at +50% in robust ones of the same size. However, the former position is plesiomorphic for prosauropods, the latter derived, and no other prosauropod species has such a marked dimorphism. The deltopectoral crest of the humerus of the associated forelimb and girdle (YPM 2195) is low and symmetrical with a rounded apex at 25% of length so, whatever the status of the gracile and robust humeri, Clifton postcrania cannot be used to diagnose *T. antiquus*.

Thecodontosaurus is diagnosed by a short deep dentary but, with the erection of *T. caducus, T. antiquus* has no autopomorphies. However, the diagnostic differences were based on Clifton postcrania so *T. caducus* is a junior synonym of *T. antiquus*. Some of the Clifton bones are Plateosauria incertae sedis, most are Prosauropoda incertae sedis, and the Welsh humeral morph (low asymmetrical crest with prominent apex at 40% of length) is not represented. The recognition of four humeral morphs indicates a high diversity of prosauropod dinosaurs from the British Rhaetian.

Wednesday 3:45

EARLY CRETACEOUS CHORISTODERES FROM WESTERN LIAONING, CHINA: TAXONOMIC DIVERSITY AND PHYLOGENETIC RELATIONSHIPS

GAO, Ke-Qin, Peking Univ., Beijing, Peoples Republic of China; FOX, Richard, Univ. of Alberta, Edmonton, AB, Canada; KSEPKA, Daniel, American Museum of Natural History, New York, NY

The world-renowned Jehol Group has produced the most diverse and well-preserved choristodere fauna yet discovered. Three distinct ecomorphotypes, each represented by multiple species, are known from the Lower Cretaceous Yixian and Chiufotang formations of Liaoning, China. These include a large, slender-snouted group (*Ikechosaurus*-like simoedosaurids), a small short-snouted group (monjurosuchids), and a diminutive long-necked group (*Hyphalosaurus* and a related form).

Monjurosuchus is of historical importance as the first tetrapod known from the Jehol Group. Originally described as a primitive archosaur in the 1940s, it was later misattributed to the Rhynchocephalia until recent recognition of it a choristodere. New discoveries show that *Monjurosuchus* is part of a family containing at least three genera recognized from both the Yixian and Chiufotang formations. The Monjurosuchidae share several semi-aquatic adaptations.

A unique long-necked choristoderan clade is represented by hundreds of specimens from the Yixian Formation. *Hyphalosaurus* and a second undescribed taxon are characterized by a small skull and 19-24 cervical vertebrae. These aquatic choristoderes exhibit extreme convergence with Triassic sauropterygians, although unlike viviparous pachypleurosaurs, *Hyphalosaurus* laid soft-shelled eggs. Intact embryos, juveniles and adults provide a complete ontogenetic series for this taxon.

A third distinct ecomorphotype is known from two large *Ikechosaurus*-like simoedosaurids from the Chiufotang Formation. Although classified in the Simoedosauridae, these taxa have slender, elongate jaws, as in the more gavial-like Champsosauridae.

The results of a phylogenetic analysis incorporating data from Jehol choristoderes place the Monjurosuchidae and the long-necked clade outside the Neochoristodera. The diversity and phylogenetic positions of the Jehol choristoderes suggest that a significant but previously unknown radiation of the group occurred in Asia during or prior to the Early Cretaceous. Diversity, abundance, and morphological disparity indicate choristoderes were an ecologically important component of the Jehol Biota.

Saturday 9:45

ISOTOPIC INTERPRETATION OF FAUNAL RELATIONSHIPS FROM MIDDLE PLEISTOCENE HOMINID BEARING LOCALITIES IN THE SIERRA DE ATAPUERCA, NORTHERN SPAIN

GARCIA, Nuria, Universidad Complutense de Madrid, C. Geologicas, Madrid, Spain; FERANEC, Robert, Stanford Univ., Stanford, CA; ARSUAGA, Juan Luis, Centro (UCM-ISCIII) Evol. y Comportamiento humanos, Madrid, Spain; BERMUDEZ DE CASTRO, Jose Maria, Museo Nacional de Ciencias Naturales, Madrid, Spain; CARBONELL, Eudald, Universidad Rovira y Virgili, Tarragona, Spain

The Sierra de Atapuerca (Northern Spain) is a complex karst system with different cavities rich in fossils. These caves are well known for their hominid-bearing localities of Pleistocene age. In particular, Sima de los Huesos (SH), dated to about 400 ka, has yielded the most important collection of Middle Pleistocene human fossils. This site also produced thousands of carnivore remains, especially of *Ursus deningeri*. Human presence has also been identified at two other localities, Trinchera Galeria (TG) and Trinchera Dolina (TD, level 10) by the presence of stone tools and hunted ungulate remains. All three of these sites are roughly of similar age.

This study aims to determine ecological associations of fauna present about 400 ka in the Atapuerca sites to better understand the context in which humans lived. To resolve faunal ecology, we analyzed carbon isotope values from enamel carbonate of carnivores from SH together with ungulates from TG and TD. A total of six different species were analyzed including, *Cervus elaphus*, *Dama dama*, *Equus caballus*, *Panthera leo*, *Ursus deningeri*, and *Vulpes vulpes*. Carbon isotope results from all 47 enamel samples were more negative than -10‰ implying dominance of C_3 vegetation near the localities. Significant differences observed in $\delta^{13}C$ value among the six species suggest the use of different resources. For the herbivores, *C. elaphus* and *E. caballus* had similar $\delta^{13}C$ values (mean = -11.4‰ for both), while *D. dama* was significantly more negative (mean = -13.7‰). These values suggest *D. dama* inhabited a more closed habitat than either *C. elaphus* or *E. caballus*. The $\delta^{13}C$ values for the carnivores *P. leo* (mean = -13.2‰) and *V. vulpes* (mean = -12.5‰) were similar, while *U. deningeri* was significantly more negative (mean = -15.4‰). The negative $\delta^{13}C$ values observed for *U. deningeri* corroborate previous studies suggesting that it was primarily herbivorous and lived in forested environments. These data provide a framework for understanding Middle Pleistocene human ecology in the Sierra de Atapuerca.

Saturday 3:45

A NEW GENUS AND SPECIES OF LAMBEOSAURINE HADROSAUR (DINOSAURIA: ORNITHOPODA) FROM THE LATE CAMPANIAN CERRO DEL PUEBLO FORMATION, COAHUILA, MEXICO

GATES, Terry, SAMPSON, Scott, Univ.of Utah/Utah Museum of Natural History, Salt Lake City, UT; EBERTH, David, Royal Tyrrell Museum of Paleontology, Drumheller, AB, Canada; HERNANDEZ RIVERA, Rene, Instituto Dr Grologia Dpto de Paleontologia, Mexico City, Mexico; AGUILLO, Martha, Museuo del Desierto, Saltillo, Mexico; DELGADO-JESUS, Carlos, Secretary of Public Education Dept of Paleontology, Saltillo, Mexico

Recent study of the Upper Cretaceous Cerro del Pueblo Formation, Coahuila, Mexico by the international Parras Basin research team has begun to document and reveal the diversity of late Campanian nonmarine vertebrates, including several taxa of dinosaurs. Hadrosaurs are the most common dinosaurs in this fauna. A partially articulated individual collected from a marine-influenced calcareous mudstone represents a new genus of lambeosaurine, the first new genus of crested hadrosaur identified from North America in over 80 years. Despite the apparent incomplete development of the crest, the new specimen possesses an array of autapomorphies that distinguishes it from all other lambeosaurines. These include: distinctive jugal with multiple characters; relatively broad, stout quadrate with hypertrophied pterygoid process; a rostrally-positioned supraorbital crest; and tongue-in-groove contact between the nasals and prefrontals. Lambeosaurinae characters present in this specimen include a tall, nearly symmetrical maxilla with prominent anterior maxillary shelf and a supraorbital crest composed of the premaxilla and nasal bones. Phylogenetic analysis posits this taxon as the most basal lambeosaurine from North America. Preliminary comparison of our specimen to *Lambeosaurus laticaudus* (Campanian El Gallo Formation, Baja California), one of the few described Cretaceous dinosaurs from Mexico, reveals key differences in premaxillary and maxillary morphology. Two other North American lambeosaurines have been recovered from approximately coeval strata—*Parasaurolophus tubicen* from New Mexico and *Hypacrosaurus altispinus* from Alberta, Canada—supporting the hypothesis that late Campanian dinosaurs in the Western Interior of North America exhibited pronounced provincialism.

Poster Session A

HIGH-RESOLUTION 3-D SCANNING OF DINOSAUR FOOTPRINTS: HOW HIGH IS HIGH ENOUGH?

GATESY, Stephen, Brown Univ., Providence, RI; BROWN, Chris, WALLACE, Steve, CANTOR, Gabriel, Worcester Polytechnic Institute, Worcester, MA; SHUBIN, Neil, Univ. of Chicago, Chicago, IL; JENKINS, Farish, Harvard Univ., Cambridge, MA

Late Triassic theropod trackways from East Greenland preserve impressions of pedal skin. Individual integumentary tubercles created small, shallow concavities that are difficult to describe and compare. Scanning offers a solution for capturing surface information quantitatively. Datasets can be used to create polygonal surfaces that are easily viewed and rendered as photo-simulations using widely available 3-D software.

The degree of resolution that is required to fully capture a cutaneous impression's biological signal may be explored by high-resolution 3-D scanning. Large sedimentary deformations from whole digits and digital pads are obvious to the unaided eye, but how small is the finest feature left by a dinosaur's skin? To determine the minimum scale at which the footprint's texture differs from adjacent rock, we used a custom-built scanning laser microscope to sample multiple areas of a track. 1.5 mm x 1.5 mm regions were scanned at 0.05 mm intervals at a vertical resolution of 0.025 mm. These data were compared using Scale-Sensitive Fractal Analysis (SSFA), a method for characterizing a surface's complexity. We used SSFA to calculate the increase in relative area that occurs as the data are virtually tiled by triangular patches of decreasing size. Area-scale plots reveal the scale at which sediment molded by skin contact deviates from untouched sediment outside the track. 3-D scanning and SSFA are promising techniques for objectively identifying, characterizing, and comparing minute trace fossils such as skin impressions.

Poster Session A

IS *EUROTAMANDUA* A PANGOLIN? A RECONSIDERATION OF ITS AFFINITIES TO XENARTHRA, PHOLIDOTA AND PALAEANODONTA

GAUDIN, Timothy, Univ.of Tennessee Chattanooga, Chattanooga, TN

In a previously published analysis of the phylogeny of xenarthran anteaters (Xenarthra, Vermilingua), Gaudin and Branham attempted to assess the putative vermilinguan affinities of the enigmatic Eocene taxon *Eurotamandua*, from the Messel fauna of Germany. *Eurotamandua* was coded for 107 skeletal characters based strictly on published descriptions and illustrations. The results of the study suggested that *Eurotamandua* was not a close relative of vermilinguans, but might be a xenarthran closely related to the Pilosa, a clade including both anteaters and sloths. Subsequent to the publication of that study, an opportunity arose for firsthand examination of all the known material of *Eurotamandua*. Gaudin and Branhams 107 characters were rescored based on this examination. Thirteen characters scored as unknown in the previous study were coded, and the codings for an additional 23 characters were changed. Six characters had to be modified to accommodate novel conditions observed in *Eurotamandua*. The modified data matrix was reanalyzed using the original methodology, with the Eocene palaeanodont *Metacheiromys* as an outgroup. In the two most parsimonious trees that resulted (TL=230, CI=0.64, RI=0.68), *Eurotamandua* was either the sister group to Pilosa or the sister group to Xenarthra as a whole. At least eight additional steps were required to incorporate *Eurotamandua* within Vermilingua. When extant pangolins were added to the analysis, *Eurotamandua* could be placed with equal parsimony as the sister taxon to Xenarthra, the sister taxon to a clade including pangolins and *Metacheiromys*, or as the sister taxon to *Metacheiromys*. The results of this reanalysis lend additional support to several recent studies

that claim *Eurotamandua* is not a xenarthran and may be more closely related to pangolins and/or palaeanodonts.

Saturday 11:30

A STRATOCLADISTIC METHOD FOR ASSESSING DIVERGENCE ESTIMATES

GEISLER, Jonathan, Georgia Southern Univ., Statesboro, GA

Although paleontological data is essential in estimating divergence times among taxa, current methods that assess the quality of these estimates focus on fossil abundance not phylogeny. Stratigraphic debt, as calculated in stratocladistics, can be used to assess estimates of divergence ages. This is accomplished by extending each node, one at a time, to the next oldest stratigraphic interval. The increase in stratigraphic debt, as compared to the total debt of the most parsimonious trees, is referred to as the potential stratigraphic debt (PSD). If a phylogeny and the fossil record are reasonably accurate, then the larger the PSD, the better the divergence estimate. Since each node is extended by the same amount, the PSD is a function of the number of separate ghost lineages that must be extended.

Molecular clock studies often choose a few paleontological-based divergence ages for calibration points, and then use an evolutionary model to estimate the ages of the remaining nodes on the tree. In many cases, molecular estimates imply that vast portions of the fossil record are missing, such as with the supposed Mesozoic radiation of placental mammals. Calculations of PSD's on recent mammalian phylogenies suggest that two branching points are particularly reliable: 1) a split between Cetacea and Hippopotamidae at 53.5 Ma and 2) the divergence between Rodentia and Lagomorpha at 62 Ma. Pushing either of these nodes back in time would entail stratigraphic debt over several lineages. If an age of 62 Ma for the rodent-lagomorph split is accepted by molecular-clock studies, much of the discrepancy between paleontological and molecular estimates for the divergence ages among placentals would disappear.

Wednesday 10:45

SEMICIRCULAR CANAL SHAPE IN SECONDARILY AQUATIC NON-SYNAPSID AMNIOTES: TRACKING MAJOR TRANSITIONS IN LOCOMOTION

GEORGI, Justin, SIPLA, Justin, Stony Brook Univ., Stony Brook, NY

The vertebrate vestibular system is stimulated by movements of the head. Linear accelerations are sensed by the utricular system and rotational accelerations are sensed by the semicircular canals. Synthesis of this sensory information into a 3-dimensional representation of head movement is required for precise control of muscular reflexes which stabilize the head, eyes, and trunk during locomotion.

Previously, we reported on correlations between the morphology of the semicircular canals and two major locomotor transitions with archosaurs: the transition from terrestrial locomotion to powered flight within Theropoda, and the transition from bipedal to quadrupedal locomotion in various dinosaurian groups. Here, we focus on a third locomotor transition within a broader vertebrate context: the transition from terrestrial to secondarily aquatic locomotion across non-synapsid amniotes.

Using Computed Tomography (CT) to examine the morphology of the semicircular canals in fossil and modern taxa, we compared closely related terrestrial and secondarily aquatic taxa within Anapsida, Lepidosauria and Archosauria. Via shape analysis, the aspect ratio (height divided by length) of the anterior semicircular canal is shown to correlate with the range of aquatic and terrestrial behaviors within these three groups. Low aspect ratio canals are found in aquatic taxa ranging from the crocodilian *Metriorhynchus*, to the mosasuar *Tylosaurus*, and the pleurodire *Chelus*. In contrast, higher aspect ratio canals are found in the more terrestrial taxa such as the "sphenosuchian" *Junggarsuchus*, the terrestrial members of *Varanus*, and terrestrial anapsids such as the members of *Geochelone*. Semi-aquatic taxa, such as extant crocodilians, exhibit canals with an intermediate aspect ratio.

Wednesday 10:30

MICROANATOMY OF THE RADIUS AND LIFESTYLE IN AMNIOTES

GERMAIN, Damien, LAURIN, Michel, CNRS, PARIS, France

Radial cross-sections of 49 species of extant and two species of extinct amniotes of known lifestyle have been studied in order to assess the relationship between lifestyle (aquatic, amphibious or terrestrial) and bone microanatomy, and infer the lifestyle of three extinct amniotes. Most compactness profile and body size parameters exhibit a phylogenetic signal. An ecological signal exists in most compactness profile parameters and in the cross-section maximal diameter. A linear discriminant analysis is performed with these parameters to distinguish the various lifestyles. The resulting discriminant function based on taxa of known lifestyle is used to infer the lifestyle of three extinct amniotes. These predictions are generally congruent with classical paleoecological interpretations. The early nothosaur *Pachypleurosaurus* is infered as amphibious. This tends to confirm that early nothosaurs retained at least limited terrestrial locomotor abilities and that the shift to a highly specialized lifestyle in sauropterygians appeared later, with the first plesiosaurs, in the late Triassic. The therapsid *Lystrosaurus* is also infered as amphibious. There has been a long debate about the lifestyle of this animal and it has been suggested that features previously thought to reflect aquatic adaptations are also compatible with a fossorial behavior. Nevertheless, these two lifestyles are not incompatible, as shown with many extant amniotes, both amphibious and fossorial. The inferred aquatic lifestyle of *Ophiacodon* confirms former interpretations based on morphology or qualitative bone histology. A confirmation of the fairly aquatic lifestyle of *Ophiacodon* tends to support Romer's ideas that amniotes were primitively aquatic and became terrestrial later. This kind of model could be very useful to infer the ancestral lifestyle of amniotes and other early limbed vertebrates.

Saturday 4:45

OSTEOLOGY OF *NOTHRONYCHUS* SP., A LATE CRETACEOUS (LOWER TURONIAN) THERIZINOSAURID DINOSAUR FROM SOUTHERN UTAH

GILLETTE, David, Museum of Northern Arizona, Flagstaff, AZ; ALBRIGHT, L. Barry, Univ. of North Florida, Jacksonville, FL; TITUS, Alan, Grand Staircase-Escalante National Monument, Kanab, UT; ZANNO, Lindsay, Univ. of Utah, Salt Lake City, UT

The discovery of a therizinosaurid dinosaur in the marine Tropic Shale of southern Utah produced a nearly complete skeleton that closely resembles *Nothronychus mckinleyi* from slightly younger rocks in western New Mexico. Ammonites recovered with the bones refer them to the *Mammites nodosoides* ammonite Biozone (circa 92.4 ma). The disarticulated skeleton is one of the more complete therizinosaur specimens known. It includes representative cervical and dorsal vertebrae, complete sacral and caudal series, six chevrons, complete forelimb and hindlimb except for several phalanges, ribs, and gastralia. No cranial elements were recovered. The specimen is a mature adult, approximately the same size as the holotype skeleton of *N. mckinleyi*, but differs sufficiently in osteological detail to warrant the description of a new species. Vertebral pneumaticity is limited to cervicals and anterior dorsals. The sacrum is ankylosed into a synsacrum with six fused sacral vertebrae and united neural spines that form a continuous, low ridge; ilia that are expanded horizontally as separate preacetabular and postacetabular wings; and a downward directed acetabulum. The pubes are considerably larger than the ischia and possess a greatly enlarged distal boot. Pubic shafts are united with the ischia proximally and distally, together forming an enlarged obturator foramen. The reduced caudal series contains 22 or 23 vertebrae, in articulation only slightly longer than the synsacrum, and 1.7 times the length of the femur. The caudal vertebrae are short, the centra shorter than tall cranially, and only slightly longer than tall caudally. The forelimbs possess three enlarged, tightly curved unguals. The rear limbs are massive, with large femora, short tibia (roughly 85% the length of the femur), and four functional metatarsals and digits. Gastralia were distally flattened and expanded, and united at the midline in overlapping contacts. The presence of a number of derived therizinosaur features indicates that *Nothronychus* represents an advanced member of the clade in contrast to previous proposals of a more primitive phylogenetic status for this genus.

Friday 8:15

NEW SKELETON OF *BASILOSAURUS ISIS* (MAMMALIA, ARCHAEOCETI) FROM THE MIDDLE-TO-LATE EOCENE OF WADI HITAN, EGYPT

GINGERICH, Philip, ZALMOUT, Iyad, Univ.of Michigan, Ann Arbor, MI; ATTIA, Yousry, Egyptian Mineral Resources Authority, Maadi, Cairo, Egypt; ANTAR, Mohamed Sameh, ABUELKHAIR, Gebely, Egyptian Environmental Affairs Agency, Fayum, Egypt

One hundred years ago Beadnell described *Basilosaurus isis* from "Zeuglodon Valley" in Egypt based on a single dentary. This year we completed excavation of the first full skeleton of this 16-18 meter long serpentine species. The new skeleton comes from the type area, now called Wadi Hitan, in western Fayum Province. Advantages of complete specimens are obvious for functional interpretation and for exhibition. The new skull, dentition, and postcranial skeleton are exceptionally preserved, with postcranial bones well mineralized. Virtually all of the skeleton is present. Numerous partially weathered skeletons of *B. isis* can be observed in Wadi Hitan, where they were deposited in shallow marine sediments (some preserving abundant mangrove rhizoliths) during the Bartonian-to-Priabonian or middle-to-late Eocene low sea stand. Many Wadi Hitan skeletons have vertebrae preserved in articulation, indicating burial in a low energy environment, and some bones bear epizooans indicating long postmortem exposure before burial. The newly excavated skeleton is unusual in having thoracic through caudal vertebrae disarticulated and juxtaposed to some degree, suggesting disturbance by currents and scavengers, but all vertebrae except terminal caudals appear to be present. The skeleton lies near the top of a thick bed of fine sandstone, and it is overlain by a highly-bioturbated, silty clay shale. It is preserved on a thin centimeter-thick bed of blood-red, hematite-rich sandstone full of selachian teeth. This bed is unusual in preserving distal phalanges hitherto unknown in basilosaurids. A more or less linear pattern of alignment of vertebrae is characteristic of *Basilosaurus*, in contrast to the circular pattern observed for *Dorudon*, which suggests a different conformation of trunk musculature and a distinct mode of swimming.

Friday 10:15

FRICTION-INDUCED KERATINIZATION AND THE ORIGIN OF BOSSES AND HORN CORES IN EXTINCT FOSSORIAL MYLAGAULIDS (RODENTIA: APLODONTOIDEA: MYLAGAULIDAE)

GOBETZ, Katrina, James Madison Univ., Harrisonburg, VA; BEATTY, Brian Lee, Univ. of Kansas, Lawrence, KS

Head-lift digging in modern fossorial animals entails forceful lifting of the rostrum against the substrate (i.e., the ceiling of a burrow) and puts tremendous pressure on the thin skin covering the nasal bones. Protective keratinized integument has evolved convergently among amphibians (burrowing frogs), reptiles (amphisbaenids and burrowing snakes), and mammalian insectivores (golden moles), marsupials (notoryctids), and rodents (mole-rats). These

instances of nasal armor model similar evolution of keratin structures in mylagaulids, a rodent family endemic to North America, highly adapted to the subterranean/fossorial niche, and extinct by c. 5 Ma. Mylagaulids are the only small mammals to have evolved horn cores.

Mylagaulid morphology suggests scratch-digging with the forelegs, combined with head-lift-digging adaptations such as broad, flat skulls and wide occiputs with scars for levator neck muscles. In golden moles, scratch-digging allows for greater upward force created by the head as the limbs move downward.

The hornless mylagaulid *Pterogaulus* has abundant nasal foramina, indicating heightened blood supply to thick skin or keratin on the anterior nasals. Similar foramina occur in modern diggers with keratin shields on the rostrum, such as the blind mole-rat *Spalax*. Later-appearing mylagaulids such as *Umbogaulus* have nasal bosses with thickened, rugose bone, possibly from secondary ossification.

Comparison with modern diggers and stress tuberosities in human bone suggests that persistent head-lift friction induces an injury response in bone. Repeated damage to bone incurred by digging, exceeding the rate of normal repair, would form microcracks and eventually promote healing and thickening to form a callus. Selective pressure for bone that could heal and remodel quickly might result in genetic integration of bosses in derived mylagaulids. Further selective pressures in some species could co-opt pre-existing armor into horn cores for secondary uses.

Wednesday 12:30

THE STRUCTURE OF THE UNIVERSE THROUGH THE EYES OF THE BIBLE: A PERSONAL PILGRIMAGE FROM A YOUNG-EARTH "SCIENTIFIC CREATIONIST" POSITION

GODFREY, Stephen, Calvert Marine Museum, Solomons, MD; SMITH, Christopher, Univ. Baptist Church, East Lancing, MI

Creationism is doomed because the Bible does not present an objective scientific account of the origin or structure of the universe. Instead, Genesis records a phenomenological universe—that is, it describes how things appear. This primitive cosmology is established in the first Chapter of the Book of Genesis and remains the same throughout the Bible.

The Bible presents a flat earth below a solid dome-shaped sky. Above this solid sky, the author of Genesis believed that there was a quantity of liquid water—remnants of the primordial watery chaos. When dry land appears in the Genesis creation account, the process is not driven by gravity, instead the waters were simply "gathered together"—held that way by God.

Another way in which the creation account confounds modern cosmological expectations is that God set the sun, moon, and stars *in* the dome of the sky. Today we would place them *beyond* the sky—outside our atmosphere. Even if we grasp the idea that the Genesis author is picturing a solid sky, we might still imagine these lights shining through from the back, but the account says quite clearly that they are *in* the dome. The particular means by which they are attached is not specified, nor is the means by which they move through the sky. Nevertheless, to the naive observer, it is exactly where they appear to be.

Aristotle's cosmology displays a level of complexity significantly beyond that of Genesis. Discoveries by Copernicus, Kepler, Newton, Einstein, and others, demanded new cosmologies that transcended and improved upon the more primitive one before it. Consequently, we are now so far removed from the observational cosmology of Genesis that there will be no return to it as a starting point from which to understand the scientific origin and nature of the universe and the origin and diversity of life on this planet.

It is doubtful that many would want to begin their scientific investigations in any field with the premise that the earth is flat and the sky is a solid dome above it. The Bible, in part, is about the need for good people, not a guide to good science.

Poster Session B

MORPHOLOGICAL CHANGE AND ADAPTIVE SHIFT IN THE EUROPEAN *PLESIADAPIS-PLATYCHOEROPS* LINEAGE (MAMMALIA, PLESIADAPIFORMES)

GODINOT, Marc, EPHE, Paris, France; GHEERBRANT, Emmanuel, CNRS, Paris, France

A new species of *Plesiadapis* is described from the early Eocene of Le Quesnoy (Oise, France). It remarkably fills the gap between the Paleocene *P. tricuspidens* from Berru, and the early Eocene *P. russelli* from Meudon. These species have close phylogenetic relationships and are best interpreted as a single Paris Basin lineage leading to later *Platychoerops* species. The entire lineage documents an adaptive shift: the Paleocene evolutive trend leading to *P. tricuspidens* emphasized bunodont cheek teeth and tricuspidated upper incisors; the Eocene evolution of the lineage increased cheek teeth crests and secondarily simplified the upper incisors. The morphological change is linked with an increase in size, and can be interpreted as an adaptive shift toward a more folivorous diet. Several fossil samples also document high morphological variations for some of the evolving characters.

Friday 11:30

THE BASAL CROCODYLOMORPH *MACELOGNATHUS VAGANS* FROM THE UPPER JURASSIC MORRISON FORMATION: NEITHER A DINOSAUR NOR A CROCODILE

GOEHLICH, Ursula, Univ. of Munich, Munich, Germany; CHIAPPE, Luis, Natural History Museum of Los Angeles County, Los Angeles, CA; CLARK, James, GeorgE Washington Univ., Washington DC; SUES, Hans-Dieter, National Museum of Natural History, Washington DC

Macelognathus vagans was described by O.C. Marsh in 1884 on the basis of a mandibular symphysis from the Morrison Formation of Wyoming. Often considered a dinosaur and more recently referred to Crocodylia, the systematic position of this taxon has remained enigmatic—its taxonomic identification has been hampered by its fragmentary nature.

A collection of new fossils from the Fruita Palaeontological Area (Morrison Formation, Colorado) sheds new light on the systematic placement of *Macelognathus vagans*. This new material consists of several partial skeletons including two mandibles that are morphologically identical to the holotype of *Macelognathus vagans*. Yet, other bones within this new collection exhibit derived features of "sphenosuchians"—predominantly late Triassic-early Jurassic outgroups of Crocodyliformes, sometimes grouped within a monophyletic Sphenosuchia. On the basis of this new material the enigmatic *Macelognathus vagans* can be confidently identified as an "sphenosuchian" crocodylomorph.

The new material also augments the known stratigraphic distribution of "sphenosuchians". Previously known from the Late Triassic to the Middle Jurassic, the re-interpretation of *Macelognathus vagans* as a "sphenosuchian" constitutes the youngest definitive occurrence of these basal crocodylomorphs.

Poster Session A

THE CONTRASTING EOCENE-OLIGOCENE RECORD OF *CARCHAROCLES* (*CARCHARODON*) FROM WASHINGTON-OREGON AND BAJA CALIFORNIA SUR

GONZALEZ-BARBA, Gerardo, Universidad Autonoma de Baja California Sur, La Paz, Mexico; GOEDERT, James, Univ. of Washington, Seattle, WA

The Eocene-Oligocene record of *Carcharocles* (*Carcharodon*) from Washington and Oregon consists of only a few rare and mostly fragmentary teeth. A middle Eocene tooth crown 18 mm high is assigned to *Carcharocles auriculatus disauris* (Agassiz, 1843), from the Lookingglass Formation near Agnes, Curry County, Oregon. A late Eocene specimen from sandstone near Quilcene, Washington, consisting of the edge of a tooth 53 mm tall with a very small part of the root, and a specimen from the Keasey Formation in Oregon are both tentatively assigned to *C. sokolowi* (Jaekel, 1895). A latest Oligocene specimen from the top of the Pysht Formation is the base of a tooth, mostly the root, that is 59 mm wide and not complete. One side of the base has two lateral denticles, 5 and 7 mm wide respectively; the crown is worn away. Another small fragment of a tooth from the Lincoln Creek Formation is of early Oligocene age. We assign the teeth from the Pysht and Lincoln Creek formations to *C. angustidens* (Agassiz, 1843).

The Eocene-Oligocene record from Baja California Sur consists of four teeth, two complete (22 mm wide and 19 mm tall, and 15 mm wide and 6 mm tall) and two crowns without the root, of Early Eocene *C. auriculatus disauris* from the partially Ypresian Tepetate Formation at the Arroyo El Conejo locality. From the Tepetate and Bateque formations (La Paz and San Ignacio Lagoon areas), Lutetian-Priabonian age, are 483 teeth of *C. sokolowi*, between 70 mm wide and 80 mm tall, corresponding to an anterior tooth position, and 15 mm wide and 13 mm tall corresponding to a lateral tooth position. The late Oligocene record of *C. angustidens* is from the San Gregorio Formation in the area of La Purisima and the El Cien Formation, from the Isthmus of La Paz and Tembabichi areas with fewer than 100 teeth from 70 mm wide and 95 mm tall (corresponding to an anterior position) and 23 mm wide and 20 mm tall (corresponding to an upper posterior position).

The contrasting abundances of teeth between the areas discussed implies a preferred temperate climate for species of this genus throughout the Cenozoic in this part of the Northeast Pacific Basin, and is in accordance with the depositional areas for these rocks being widely separated geographically since at least early Eocene time.

Student Poster Session

A PRELIMINARY ANALYSIS OF CRANIAL SUTURE VARIATION IN *ALLOSAURUS*

GOODCHILD DRAKE, Brandon, Wyoming Dinosaur Center, Cheyenne, WY

The cranial sutures of theropods represent rich potential for both functional and structural information regarding their specific taxa. However, few theropods other than *Allosaurus* have enough well preserved specimens to allow any meaningful statistical analysis. This study will lay out the preliminary steps by focusing on the frontal bone in *Allosaurus* and looking at a variety of ratios (frontal length to width, suture length width, etc.) in order to relate them quantitatively using interval statistical methods. Though preliminary, there are two hypotheses that can be directly tested using this method. First, disarticulated frontal elements, such as those found at Cleveland-Lloyd, may be pieced together by matching sutures (as sutures must generally be mirror representations of each other to be functional). Secondly, bimodal or multivariate distribution of interval data may lend itself to new interpretations as to the functional

morphology of the frontal suture. The multitude of curated *Allosaurus* specimens provides a rare opportunity to utilize statistical methods to further enhance our knowledge of the taxa.

Poster Session B

PUBLICATION TRENDS IN THE JOURNAL OF VERTEBRATE PALEONTOLOGY

GOODWIN, H. Thomas, Andrews Univ., Berrien Springs, MI; PAYNE, Tracy, Andrews Univ., Berrien Springs, MI

We used the database GeoRefS to investigate temporal publication patterns in the *Journal of Vertebrate Paleontology* (JVP), supplemented by data collected manually from selected JVP volumes and excluding conference abstracts. Data were binned into multiyear categories for analysis (1981-84, 1985-89, 1990-04, 1995-99, 2000-04). A sharp increase in number of papers per year between 1990-04 and 2000-04 correlated inversely with an equally sharp decline in relative abundance (RF) of papers treating North American fossils (from 68-33%). Papers on South American, European, Asian, and African vertebrates simultaneously increased in RF, peaking in 2000-04 (15-20% per continent).

RF of mammal papers peaked in 1985-89 (45%) and declined subsequently. Dinosaur and non-dinosaur reptile papers generally increased in RF through time, amphibian papers were stably represented, and fish papers (composite of agnathan and gnathostome "fish") were best represented in early volumes (23% in 1981-84). RF of stratigraphic coverage likewise shifted through time, with Cenozoic best represented from 1981-89 (> 50%) and Mesozoic from 1990-2004 (> 40%).

Topical trends were more difficult to assess because of potential variation in how papers are coded in GeoRefS. Nevertheless, papers treating taphonomy-paleoecology or biogeography appeared to peak in RF during 2000-04 (15% each), whereas papers concerned with cladistics peaked in RF during 1995-99 (30%) with subsequent decline (21% in 2000-4). Curiously, papers on evolution showed highest RF before 1985 and after 1994 (>20%) but substantially lower RF between 1985 and 1994 (8-12%).

Preliminary analysis of selected JVP volumes suggested several demographic trends. Most notable were increased RF of papers 1) with non-North American primary authorship, 2) that cite governmental or institutional funding sources, and 3) that were done collaboratively (multi-authored and/or multi-institutional).

Romer Prize Session, 9:45

MAJOR SHIFTS IN MORPHOLOGICAL INTEGRATION AND MODULARITY IN THE EVOLUTION OF THE MAMMALIAN SKULL

GOSWAMI, Anjali, Univ.of Chicago-CEB Field Museum Geology Dept., Chicago, IL

Associations among functionally or ontogenetically-related traits have been presumed to be a major influence on morphological evolution. The study of morphological integration, via quantitative analyses of trait correlations, allows for analysis of broad patterns of trait associations in extant and fossil taxa, with data that are directly comparable to developmental and quantitative genetic studies. I present analyses of cranial integration for 108 species of extant and fossil mammals, including monotremes, marsupials, and placentals. 3D data were gathered for 59 landmarks to assess cranial modularity and test the relationship of cranial integration to several major influences on cranial morphology: phylogeny, diet, encephalization, and heterochrony.

Cranial modularity is conserved across therian mammals, with 6 discrete groups of traits. The anterior oral/nasal, molar, and basicranial groups are strongly integrated, while the orbit and zygomatic/pterygoid groups are weakly integrated, probably reflecting differences in developmental complexity (interactions of multiple tissue types). Cranial vault integration is variable across taxa and mainly reflects phylogeny, rather than hypothesized general trends due to encephalization. Monotremes display only two modules (anterior oral/nasal and basicranium), with little correlation among other landmarks, demonstrating that modularity has shifted during mammalian evolution.

Cranial integration is related to phylogeny and diet, but clades vary in the influence of these two factors. Within Carnivora, caniforms show stronger correlations with diet, but feliforms possess stronger correlations with phylogeny. Primates demonstrate strong correlations with both diet and phylogeny at the ordinal and sub-ordinal levels, but vary in smaller clades. Diet and integration are not correlated in any marsupial clade, but phylogeny and integration are strongly correlated across australodelphian marsupials and within Dasyuromorphia. These differences lay the foundation for future explorations of the macroevolutionary significance of integration, providing a methodology that unites paleontology with genetics and development.

Friday 11:30

FIRST CRETACEOUS LUNGFISH FROM TANZANIA — AN ENIGMATIC CERATODONTID FROM THE RUKWA RIFT BASIN

GOTTFRIED, Michael, Michigan State Univ., East Lansing, MI; O'CONNOR, Patrick, Ohio Univ., Athens, OH; ROBERTS, Eric, Idaho State Univ., Pocatello, ID; STEVENS, Nancy, Ohio Univ., Athens, OH; CHAMI, Remegius, Antiquities Unit, Dar es Salaam, United Republic of Tanzania

Ceratodontid lungfishes from Africa are well-established in the fossil record on the basis of toothplates from a variety of (primarily northern and western) African sites, but none has previously been reported from the Cretaceous of Tanzania. Current fieldwork in the Rukwa Rift Basin (RRB) of western Tanzania has developed a diverse Cretaceous vertebrate fauna from Unit I of the Red Sandstone Group. Reconnaissance prospecting in 2004 at the northern end of the basin resulted in the recovery of a well-preserved lungfish toothplate, found ~120m above the base of a >200m section of interbedded sandstones, conglomerate lenses, and oxidized mudstones that represent braided streams and associated floodplains. This is the first Cretaceous lungfish toothplate from Tanzania (a fragment of cosmine-ornamented lungfish dermal bone was recovered earlier from the southern end of the RRB), and it exhibits differences in overall morphology with respect to previous African Cretaceous ceratodontids.

The specimen consists of an upper left toothplate (National Museums of Tanzania NMT 04289) that measures 17.8mm in length by 6.2mm in maximum breadth, and that has five well-developed ridges separated by deep clefts. A sixth ridge may be present along the incomplete posterior edge. The first (anteriormost) ridge diverges at an acute angle from the others, which are subparallel to one another and extend across the entire occlusal surface of the toothplate. This morphology is distinctly different from "typical" African ceratodontids (e.g., *Ceratodus africanus*), which are shorter and broader in proportion, and which have radiating ridges set at distinct angles to one another. The configuration of the ridges, and slender proportions, of NMT 04289 closely resemble toothplates of *Neoceratodus*, including the extant species *N. forsteri* (which has a fossil record extending back to the Early Cretaceous of Australia). Although the problematic taxonomy of fossil ceratodontids precludes a conclusive assessment, it is nonetheless clear that NMT 04289 indicates greater diversity and biogeographic complexity for African ceratodontid lungfishes.

Friday 8:45

THE PLACODERM ENDOCRANIUM AND ITS VARIATIONS

GOUJET, Daniel, Museum National D'Histoire Naturelle, Departement Histoire de la Terre CP38, Paris, France

Placoderms are considered as the sister-group of all other gnathostome vertebrates. One of their major feature is the perichondrally ossified braincase allowing a detailed investigation of their endocranial external and internal morphology including the nervous and vascular systems. Among placoderms, the braincase basic composition differs from all other gnathostomes in the presence of a fissure through which the optic nerve is passing. It results in a braincase made of two separate units: a nasal capsular bone and a single posterior orbito-otico-occipital unit. These two components could be either separate or fused even within a single taxon. Except in Antiarchi and Phyllolepida, the endocranium is known in all other placoderm groups. A high degree of variation is observable in shape and morphology among Arthrodira and Acanthothoraci for example. This leads to draw a parallel with what has been observed in other gnathostomes (Chondrichthyes and Osteichthyes). These variations affect principally the position and development of nerve openings and vessels course relative to braincase processes. Their consequences in terms of structural evolution will be exposed and commented.

Poster Session B

POLYPTERIDS (OSTEICHTHYES:POLYPTERIDAE) AS ENVIRONMENTAL PROXIES IN THE CENOMANIAN (LATE CRETACEOUS) OF EGYPT

GRANDSTAFF, Barbara, Univ.of Pennsylvania, Philadelphia, PA; SMITH, Joshua, Washington Univ., St. Louis, MO; LACOVARA, Kenneth, Drexel Univ., Philadelphia, PA; TUMARKIN-DERATZIAN, Allison, Vassar College, Poughkeepsie, NY; ABDEL-GHANI, Medhat, Egyptian Geological Museum, Cairo, Egypt

Histology of ganoid scales from the Cenomanian Bahariya Formation in Egypt confirms that polypterids are preserved in these circa 97 Ma paralic sediments. Extant polypterids live only in freshwater habitats. Fossil polypterids are otherwise found exclusively in continental deposits. The sectioned scales were recovered from site BDP2000-19 ("Jon's Birthday"), interpreted as a tidal inlet sequence deposited along a mesotidal, low wave-energy coast. The scales show little postmortem abrasion, and do not appear to have been transported any significant distance prior to their incorporation in the tidal inlet lag. The Bahariya polypterids probably lived in freshwater microhabitats near the site of deposition. The tidal inlet sediments lie well above the fluvial beds in the basal Bahariya Formation. Reworking from these older sediments is unlikely.

Freshwater microhabitats exist in modern nearshore environments. Barrier islands support interdunal freshwater bogs and ponds. Modern mangrove forests can have associated freshwater ponds, colonized by salt-intolerant species. Nearshore freshwater microhabitats probably also existed in northern Africa during the Cenomanian transgression, as suggested by preservation of relatively unworn polypterid scales in paralic sediments of the Bahariya Formation at Bahariya Oasis. The preservation of aquatic plants (water lily and floating ferns) in these paralic sediments has also been used as an indicator of nearby freshwater habitats. Small crocodilians (*Libycosuchus*) and turtles may also have utilized freshwater habitats on the Bahariya coast.

Wednesday 3:30

NEW EVIDENCE FOR NON-*PLACERIAS* DICYNODONTS IN THE LATE TRIASSIC (CARNIAN-NORIAN) OF NORTH AMERICA

GREEN, Jeremy, North Carolina State Univ., Raleigh, NC; SCHNEIDER, Vince, North Carolina Museum of Natural Sciences, Raleigh, NC; SCHWEITZER, Mary, CLARKE, Julia, North Carolina State Univ., Raleigh, NC

Dicynodontia (Anomodontia, Therapsida) had a global distribution in the Permian and

thrived until the Late Triassic. They were arguably the most successful herbivorous therapsids. The Late Triassic dicynodonts included large bodied forms of the clade Kannemeyeriinae, such as *Kannemeyeria*, *Stahleckeria*, and *Placerias*. *Placerias* has been regarded as the most widely distributed of the Late Triassic dicynodonts and to date is the primary Late Triassic (Carnian-Norian) dicynodont recognized from North America.

Here we report non-*Placerias* dicynodont fossils from the Late Carnian (Deep River Basin; Sanford Sub-Basin; Pekin Formation) in North Carolina. One locality yielded an articulated partial postcranium, complete from just anterior to the sacral region, and another locality yielded a partial mandible preserving the articular. Comparison of the new specimens to *Placerias* revealed that both are diagnostically different from *Placerias*, based on the morphology of the iliac crest in the postcranium and sulci on the articular of the jaw. Both finds are consistent with Kannemeyeriinae, in which *Placerias* is placed. The morphology of the iliac crest of the associated specimen shows greater affinities to Kanneyeyeriini and Stahleckeriini rather than Placeriini. The morphology of the isolated articular appears to be much more highly derived than other members of Kannemeyeriinae.

This new material alters the known biogeography and diversity of Carnian Kannemeyerid dicynodonts and yields insight into the origin and dispersal of these latest forms. In addition, the Late Triassic saw the advent of newly evolved herbivorous forms such as rhyncosaurs and gomphodont cynodonts. The new dicynodont specimens further our understanding of how the last dicynodonts to live in North America adapted to compete with the changing ecological conditions of the Late Triassic.

Poster Session A

RECONSTRUCTION OF THE SKELETON OF *STAURIKOSAURUS PRICEI* COLBERT, 1970 (DINOSAURIA, THEROPODA): USE OF 3D LASER SCANNER AND THREE-DIMENSIONAL VIRTUAL MODELING TO RECONSTRUCT FOSSIL VERTEBRATES

GRILLO, Orlando, AZEVEDO, Sergio, Museu Nacional / UFRJ, Rio de Janeiro, Brazil

New methods of advanced graphic computer, which include computer tomography, 3D laser scanner and software for three-dimensional animation, are being used in studies of biomechanics, physiology and anatomy of extinct vertebrates, substituting or complementing traditional methods. The 3D laser scanners allow to digitalize the shape of bones and to create a model that can be manipulated in a virtual environment.

In this work, we used a 3D laser scanner associated to graphic editor software to reconstruct the skeleton of the oldest Brazilian theropod, *Staurikosaurus pricei*, of the Upper Triassic from Rio Grande do Sul (Santa Maria formation). Preserved parts of the holotype (MCZ 1669) include: mandibles, one isolated cervical, almost complete sequence of dorsal vertebrae, the two sacral and 36 caudal vertebrae, complete pelvis, right and left femurs, tibias and fibulas.

The method allowed correcting deformations and fractures caused by post-depositional effects. Distortions on the curvature of the femur and on the shape of the pubis were corrected using reference lines or planes, tangent to surfaces of the fossil bones. These allowed discovering in which direction the deformation occurred and to revert it.

Regression lines for height and length measurements of the caudal vertebra centrum allowed positioning the preserved sequences of the middle region of the tail (assuming a total of 47 caudal vertebras). Results indicate that its total length is of 135 cm and that the transverse processes were present at least until the 25th caudal vertebra.

Non-preserved bones (cranium, arms and feet) were reconstructed on the basis of *Herrerasaurus ischigualastensis* and will be useful for an accurate estimating of the corporal mass and center of mass of *Staurikosaurus*.

This process of reconstruction of the skeleton is important to make the virtual model employable on studies of locomotion. The skeleton, completely articulated, allowed to determine the most probable appearance of *Staurikosaurus* and to estimate its total length to be 225 cm. Animations of the 3D bones are available in the website.

Poster Session A

TAXONOMIC UTILITY OF HADROSAURID POSTCRANIAL MATERIAL ANALYZED USING MULTIPLE MORPHOMETRIC TECHNIQUES

GUENTHER, Merrilee, Univ. of Pennsylvania, Philadelphia, PA

Hadrosaurs are among the most abundantly sampled dinosaur taxa. The cranial morphology of hadrosaurs is generally well resolved, but there has been less taxonomic clarity with respect to postcranial morphology. The full potential for collections of hadrosaurs has not been realized, in part because much of the postcranial material cannot be used with taxonomic certainty. This data set provides one of the best opportunities for morphometric studies on dinosaurs.

Morphometric methods are applied to gain a better understanding of the postcranial variability among hadrosaurid taxa and within a taxon and to provide a quantitative basis for addressing taxonomy. Because hadrosaurid taxa are based primarily on cranial characters, only material associated with diagnostic cranial material is used. Twelve North American hadrosaurid genera are included in the study, with some taxa including multiple specimens, while others are restricted to the single type specimen.

Several morphometric methods including: Least Squares Theta-Rho Analysis, Resistant-Fit Theta-Rho Analysis, Euclidean Distance Matrix Analysis, thin-plate splines, and eigenshape analysis are used to analyze the shape of postcranial elements. The purpose of using several methods is to consider the morphology at several different levels, identifying differences both in the element as a whole and for specific characters of the element.

Morphometric methods provide us with the opportunity not only to taxonomically differentiate isolated elements, but also to relate the elements to each other, thereby reconstructing limbs. Such an approach then allows us to identify the taxonomic variability of entire limbs and interpret that variability from a functional morphology perspective. Several methods identify changes within an element and therefore, indicate how specific muscle attachment sites may vary. This allows, for example, for a quantification of previously qualitatively recognized differences in the forelimbs and hind limbs, at least to the subfamily level.

Saturday 8:45

PALEOGENE BATS (CHIROPTERA) FROM FAYUM PROVINCE, EGYPT

GUNNELL, Gregg, Univ.of Michigan, Ann Arbor, MI; SIMONS, Elwyn, Duke Univ., Durham, NC; SEIFFERT, Erik, Oxford Univ., Oxford, United Kingdom

Fossil bats from the Paleogene of Afro-Arabia are extremely rare and include isolated records from Tunisia, Tanzania, Egypt, and Oman. Two species, *Philisis sphingis* (Family Philisidae) and *Vampyravus* (=*Provampyrus*) *orientalis* (Family Uncertain), were previously described from the upper Jebel Qatrani Formation (early Oligocene, Rupelian) and represent the only known Paleogene bats from Fayum Province in northern Egypt. Continued fieldwork in the Birket Qarun and Jebel Qatrani formations has produced several new bats ranging in age from the latest middle Eocene through the early Oligocene. Included in these samples are five new taxa representing some of the largest and smallest known African microchiropterans.

The earliest records of bats in the Fayum sequence come from Birket Qarun Locality 2 (BQ-2) which is approximately latest middle Eocene (Bartonian-Priabonian boundary) in age. *P. sphingis* is present at BQ-2 along with a much larger philisid with cheek teeth in the size range of the large extant microchiropteran, *Macroderma gigas*(Australian Ghost Bat). In addition to the two philisids, a single upper molar from BQ-2 represents a new nycterid rhinolophoid microchiropteran. Somewhat higher in the Fayum sequence, three new genera of bats are represented from Quarry L-41 in the lower part of the Jebel Qatrani Formation (late Priabonian). One genus represents a philisid similar to *P. sphingis* but it is smaller and retains p3 which is apparently lost in *P. sphingis*. A second taxon represents a moderate sized megadermatid rhinolophoid. A third taxon is represented by a single, tiny dentary with cheek teeth rivaling those of the smallest known extant bat, *Craseonycteris*, in size. This small L-41 species is of unknown affinities. Finally, there are two additional specimens of *P. sphingis* from Fayum Quarry I in the upper Jebel Qatrani Formation, one of which preserves the previously unknown lower third molar.

These new specimens from Fayum document a relatively broad diversity of the endemic African bat family Philisidae and also indicate that at least two modern bat families (Nycteridae and Megadermatidae) existed in north Africa by the late Eocene.

Poster Session A

FORELIMB TO HINDLIMB STRUCTURAL PROPORTIONS PREDICT LOCOMOTOR BEHAVIOR IN BIRDS

HABIB, Michael, RUFF, Christopher, Johns Hopkins Univ., Baltimore, MD

Despite the wide range of locomotor adaptations in birds, little detailed attention has been given to the relationships between the quantitative structural characteristics of avian limbs and bird behavior. In particular, differences in relative strength between the forelimb and hindlimb bones across species have not been systematically investigated. We generated data from peripheral quantitative CT scans of the humerus and femur of 191 avian skeletons, representing 23 species of extant birds in 17 families. The sample includes terrestrial runners (both volant and flightless), arboreal perchers, hindlimb-propelled divers (both lift and drag based swimmers), forelimb-propelled divers, and dynamic soarers. The hindlimb-propelled diving class included a recently flightless island form.

Our results demonstrate not only that locomotor guilds can be differentiated in most cases based on forelimb to hindlimb strength proportions, but also that structural proportions are often more informative than length proportions for determining behavior and locomotion. Recent flightless forms, for example, are more easily distinguished by structural ratios than by length ratios. Furthermore, a proper phylogenetic context is important for correctly interpreting structural characteristics, especially for recent flightless forms (whose morphological differences are most pronounced when compared to closely related, volant taxa). Some of the most extreme adaptations to loading are seen in aquatic forms. For example, penguins have forelimbs adapted to very high loads, and thus comparatively high forelimb to hindlimb strength ratios.

The methods used in this study are highly applicable to fossil taxa, for which morphology is known but behavior is not. The use of forelimb to hindlimb ratios is particularly useful in paleontology not only because it generates strong signals for many locomotor guilds, but also because analyzing such ratios does not require knowledge of body mass, which can be hard to estimate reliably for fossil taxa.

Saturday 4:00

USING VARIATION IN MODERN POPULATIONS TO EXAMINE ANCIENT ONES: A MORPHOMETRIC APPROACH TO SPECIES AFFINITY

HALL, Justin, Washington Univ., St Louis, MO

Within every higher vertebrate species there is variation between individuals. Determining levels of intraspecific variation in the fossil record has been problematic and led to uncertainty in classification of taxonomic levels. This problem is compounded by small sample sizes, which create the possibility that individual differences between specimens will appear more pronounced than they might have been in the actual population.

Determining gender is best done with soft-tissue anatomy in recent specimens. These features are absent in the vast majority of fossils. Establishing a baseline of how much variation exists in the skeletal anatomy of a modern population is an important step to evaluating potential variation in fossil populations.

Varanid lizards are a diverse group of predominantly predatory reptiles. They range from *Varanus brevicaudis* (Total Length = 17-20cm, Mass = 8-20g) to *V. komodoensis* (Total Length = 3m, Mass = 150 kg). A large sample of recent *Varanus* lizards was examined using traditional and geometric morphometric techniques to analyze the variation present in species that make up this genus. Discriminant function analysis and geometric morphometric techniques were used to identify different morphs in the population. The morphs were then compared with specimens of known gender and approximately known age to identify subtle sexual dimorphic and ontogenetic changes among varanids. This established a baseline of how much difference occurs in these predatory terrestrial reptiles; which can then be used to help predict how much variation should be present to separate different specimens into different species.

Poster Session A

ACTIVITY PATTERN AND MORPHOLOGY OF THE VISUAL SYSTEM IN LIZARDS

HALL, Margaret, SUNY College at Stony Brook, Stony Brook, NY

Visually dependent animals must adapt to the extremes of light availability imposed by activity pattern. There is evidence that dependence on photopic (plentiful light) and scotopic (low light) conditions markedly impact the gross anatomy of the eye and orbit. However, it is unclear whether and to what degree phylogeny affects this relationship. To test this, measurements of eye and orbit size and shape in both nocturnal and diurnal lizards are analyzed. The results show consistent differences between photopic and scotopic eyes in visually dependent lizards. Photopic eyes have enlarged posterior chambers that allow larger retinal area, potentially maximizing the number of photoreceptor cells and thereby increasing visual acuity. Scotopic eyes tend to have enlarged anterior chambers to maximize photon collection, thereby increasing sensitivity. Importantly, analyses of the bony orbit, sclerotic ring, and skull height show similar patterns to the eyeball data, indicating that activity pattern analysis may be possible for fossil specimens. The current data suggest that activity pattern may be more important than phylogenetic affinity in determining eyeball and orbit size and shape in lizards.

Study groups include representative species of Agamidae, Chamaeleonidae, Iguanidae, Gekkonidae (including Gekkoninae and Eublepharinae), Xantusiidae, and Varanidae.

Poster Session A

NEW OSTEOLEPIFORMS FROM THE MIDDLE DEVONIAN OF NORTHERN UTAH

HALL, Patricia, ELLIOTT, David, Northern Arizona Univ., Flagstaff, AZ

The Water Canyon Formation of northern Utah is well known for its extensive Early Devonian vertebrate fauna. However, the Middle Devonian fauna from the upper part of the formation has yet to be described although it is known to contain pteraspidomorphs, arthrodires, antiarchs, and sarcopterygians. Until recently the known sarcopterygians consisted only of fragmentary dipnoan and osteolepid material, consequently the recent discovery of articulated osteolepiforms greatly increases our knowledge of this fauna. The specimens occur at one level at the base of the middle Devonian section and appear to represent a mass death event. Mud cracks at the event horizon indicate that a small body of water dried up killing a school of osteolepiforms that lived there. The entire extent of the horizon is unknown but it appears that a large number of articulated individuals may be preserved.

Initial study of this material indicates that it represents a new species of the osteolepiform *Thursius*, which is otherwise known from the Middle and Late Devonian of Greenland, Scotland, Canada, Australia, and China. This material thus greatly increases the known distribution of the genus, and of osteolepiforms in general, as none have previously been described from the western US. Although closely related to *Osteolepis* itself, *Thursius* differs in having a more posteriorly positioned first dorsal fin, a deeper orbital notch, and distinct ratios of skull morphometrics.

The Osteolepiformes are generally accepted as being closely related to the tetrapods although the exact nature of that relationship is unclear, and it is uncertain if they are themselves a monophyletic group. These uncertainties stem in part from a lack of well-preserved material and so these new specimens have the potential to resolve some of the current problems relating to tetrapod evolution.

Student Poster Session

NEW DATA ON THE OCCURRENCE AND DISTRIBUTION OF *PTYCHODUS* FROM THE UPPER CRETACEOUS OF TEXAS

HAMM, Shawn, Wichita State Univ., Wichita, KS

The occurrence of the chondricthyan hybodontoid genus *Ptychodus* is reported from two localities within the Atco Formation (Lower Coniacian) of Texas. Six species of *Ptychodus* have been recovered, and different tooth positions are represented within each taxon. Specimens of *P. latissimus*, *P. mammillaris*, *P mortoni*, *P. whipplei*, *P. martini*, and *P. sp*. were recovered from within six to seven meters above the Austin/ Eagle Ford contact in the Atco Formation (Lower Coniacian) of Texas. The Atco Formation is a coarse-grained facies composed of alternating beds of chalky marl, chalky limestone and shale stringers with abundant phosphatic nodules. Deposition took place during the initial transgression phase of an epicontinental seaway that covered the mid-continent of North America during the Coniacian, Santonian and Campanian stages of the Late Cretaceous. The shallow warm tropical marine environment that existed during deposition of the Atco Formation was an ideal environment for many selachians including the shark genus *Ptychodus*.

The ptychodontid fossils collected from the Atco Formation provide new information regarding the geographic and stratigraphic distribution of the Ptychodontidae within the Western Interior Seaway. For example, the appearance of *P. latissimus*, *P. martini*, and *P. sp*. in the Atco Formation represents the earliest stratigraphic occurrence of these species in North America, indicating that they migrated northward from Europe and South America.

Friday 8:00

FIN SPINES, SCALES, TEETH, AND PREDICTION OF EARLY JAWED FISH STRUCTURE

HANKE, Gavin, The Royal British Columbia Museum, Victoria, BC, Canada; WILSON, Mark, Univ. of Alberta, Edmonton, AB, Canada

Mid- to late Palaeozoic sharks and holocephalians have bizarre cranial armor (cephalic spines and enlarged denticles, frontal claspers, and dorsal brushes with enlarged denticles), and teeth which range from crushing and incisor-like tooth-plates to the stiletto-like teeth of many early piscivorous sharks. Despite this diversity, there still is an expectation that the earliest chondrichthyans will be anatomically conservative. *Doliodus problematicus*, from eastern Canada, and *Antarctilamna prisca*, from the Southern Hemisphere, present recent challenges to this expectation since both have pectoral fin spines yet are thought to be chondrichthyans. Paired fin spines were thought to be an acanthodian characteristic, regardless of whether other features were contradictory. Some problematic Early Devonian gnathostomes from northern Canada, have a variety of scale types, may have teeth, have an anal fin spine, and have a range of pectoral, prepectoral, pelvic, and prepelvic spines. These taxa were thought to be chondrichthyans based on isolated scales, but their body fossils show an acanthodian fin spine complement. These deviant fishes suggest that our present approach, where we "shoe-horn" stratigraphically older taxa into a select few clades, underestimates biodiversity early in the fossil record.

Poster Session B

MAMMOTH REMAINS FROM BANKS AND MELVILLE ISALNDS, NORTHWEST TERRITORIES: THE EASTERN LIMIT OF BERINGIA

HARINGTON, Charles, Canadian Museum of Nature, Ottawa, ON, Canada

Two mammoth (presumably woolly mammoth, *Mammuthus primigenius*) fossils from northwestern Banks and southwestern Melville islands, Northwest Territories, Canada, have been radiocarbon dated to the Last Glacial Maximum (LGM) (21,000 BP and 22,000 BP, respectively). They are not only the northernmost mammoth records for North America, but indicate that the Mammoth Steppe and Beringia extended eastward at least to Ballast Brook, Banks Island (74.3°N, 123.1°W), and possibly to the Cape James Ross area of Melville Island (75.7°N, 114.4°W).

The specimens, a tibia and a tusk, probably represent woolly mammoth herds that moved northeastward from the Mackenzie Delta region when large tracts of sea bottom were exposed off the Beaufort Sea coast and the west coast of Banks Island (largely clear of glacial ice then), and when worldwide sea level had dropped about 120 m during the LGM. Evidently herb tundra, rich enough to supply the mammoths' needs, characterized the regional landscape then.

It is proposed that the term "Beringia" be used in the broad sense where evidence exists for a land connection between Asia and North America, regardless of the cause(s) and its supposed westerly or easterly limits. Further, the term "isthmus" seems preferable to the commonly used "land bridge"—thus "Bering Isthmus" rather than "Bering Land Bridge". It is also proposed that Beringia be used in a standardized way with its geological age designated in brackets following, e.g. "Beringia (Early Pliocene, 5 Ma)," and "Beringia (Last Glacial Maximum, about 20,000 BP)."

Poster Session A

PHYLOGENETIC ASSESSMENT OF A MANIRAPTORAN FROM THE MORRISON FORMATION

HARTMAN, Scott, LOVELACE, David, WAHL, William, Wyoming Dinosaur Center, Thermopolis, WY

WDC DML001 was collected in east-central Wyoming in 2000. The delicate nature of the

bones required extremely meticulous preparation, as well as computed tomography scanning, before description was possible. The associated skeleton represents approximately 60% of an individual, including significant portions of the skull, axial column, and appendicular skeleton. Total length is estimated to be less than 1.5 meters. WDC DML001 has a pneumatic quadrate, well-developed semilunate carpal, and an elongate forelimb and manus. The specimen exhibits numerous troodontid synapomorphies, including nutrient foramina that lie within a deep groove on the external surface of the dentary, and an antorbital fossa with distinct rim. Fusion of the neural arches suggest the animal was at or near full grown. Other phylogenetically important characters include: slightly constricted tooth roots, a T-shaped lacrimal, extreme reduction of the fibula, and the presence of an arctometatarsalian pes.

WDC DML001 is the most complete maniraptoran yet described from the Morrison. Phylogenetic analysis strongly supports inclusion of this Jurassic age specimen within the Troodontidae. As such, it unambiguously establishes that non-avian maniraptorans date back to the age of the oldest described fossil birds.

The presence of troodontids in North America and archaeopterygians in Europe during the Late Jurassic suggests that maniraptorans were already widespread through the northern hemisphere by this time. Limb proportions and pedal morphology of the specimen are strongly suggestive of a terrestrial lifestyle. The age of WDC DML001 supports the close phylogenetic relationship between birds and deinonychosaurs, while its functional morphology is consistent with a terrestrial origin of flight.

Poster Session A

DINOSAUR EGGSHELL FRAGMENT ORIENTATIONS AS TAPHONOMIC SIGNATURES

HAYWARD, James, Andrews Univ., Berrien Springs, MI

Dinosaur eggshell fragments, locally abundant at numerous sites throughout the world, were once considered to be relatively insignificant trace fossils. Recent studies with extant avian dinosaur eggshell, however, have demonstrated that fragment weathering, dispersion patterns, and orientation yield valuable evidence concerning depositional environments.

This report focuses on information derived from eggshell fragment orientations. Experiments and observations confirm that distinct ratios of concave-surface-up to concave-surface-down fragments typify specific depositional and transport histories: for example, a 6:4 up-to-down ratio is common to eggshell fragments that surround nest sites, recently hatched eggs, and depredated eggs; a 2:8 up-to-down ratio characterizes fragments transported by water and wind; and a 1:1 up-to-down ratio typifies fragments transported by turbidity currents.

The existence of these and other taphonomic signatures suggests that excavations of dinosaur bones, nests, and eggs should be accompanied by careful attention to the information content of surrounding eggshell fragments.

Wednesday 5:30

***ARCHAEOPHIS PROAVUS* AND THE EVOLUTIONARY HISTORY OF PALAEOPHIID SNAKES**

HEAD, Jason, Smithsonian Institution/Queen Mary Univ.of London, Washington, DC

Palaeophiidae is a clade of predominately marine snakes possessing a trans-oceanic distribution from the latest Cretaceous to the late Eocene. They are one of the most speciose extinct snake lineages, and possess a fossil record that is comparatively dense but consists exclusively of incomplete vertebral remains. In the absence of cranial material or complete postcranial skeletons, the interrelationships of Palaeophiidae are poorly understood, and the status of the clade within Serpentes is effectively unknown. *Archaeophis proavus* Massalongo 1859 is represented by a single complete, badly crushed skeleton including soft tissue preservation from early Eocene (Ypresian) marine sediments of Monte Bolca, Italy. The taxon has been considered related to paleophiids, making it the keystone for understanding the evolutionary history of Palaeophiidae, but this hypothesis has not been explicitly tested.

Examination of *Archaeophis* after recent preparation provides characters that allow determination of systematic relationships. Vertebral morphology and small body size of *Archaeophis* indicate that it represents a juvenile growth stage, and comparisons with other palaeophiids suggest that *Archaeophis* is nested within, and has taxonomic priority over, other established palaeophiid taxa. Phylogenetic analysis of *Archaeophis* with snakes as well as varanoid and mosasauroid outgroup taxa indicates that palaeophiids are basal alethinophidians, based on characters from the palate and anterior skull roof. Ecomorphological comparisons between Palaeophiidae and other extant and extinct marine snakes indicates highly disparate adaptations to marine habitats in at least four separate oceanic radiations.

Friday 1:45

STRATIGRAPHICAL CONGRUENCE OF THE DINOSAUR FOSSIL RECORD

HEATHCOTE, Julia, BARRETT, Paul, The Natural History Museum, London, United Kingdom; WILLS, Matthew, Univ. of Bath, Bath, United Kingdom

The completeness and congruence of the dinosaur fossil record as a whole was investigated quantitatively for the first time, using three existing metrics: the Stratigraphic Consistency Index (SCI), the Relative Completeness Index (RCI) and the Gap Excess Ratio (GER). Recent phylogenies for the Ankylosauria, Stegosauria, Pachycephalosauria, basal Ceratopsia, Ceratopsidae, basal Ornithopoda, Iguanodontia and Hadrosauridae were compared, along with two competing phylogenies each for the Theropoda, Sauropoda and Prosauropoda. Most of these clades (e.g., Theropoda, Ankylosauria) were found to be both complete and congruent, whereas others (e.g., Stegosauria, Prosauropoda) were poor in both respects. Differences in each index were helpful in comparing potential sources of weaknesses or conflict in the various phylogenies (e.g., the conflicting positions of *Euhelopus* in sauropod phylogenies). Other effects explored included i) differing taxon inclusion in alternative phylogenies, ii) alternative placements of taxa in competing phylogenies, and iii) the effects of ghost lineage duration on stratigraphical congruence. As a whole, the fossil record of Dinosauria was found to be moderately good, generally showing a low degree of completeness but a high degree of congruence between existing phylogenies and stratigraphy.

Poster Session A

THE TRIASSIC-JURASSIC NON-EVENT: PATTERNS AND PROCESS OF TETRAPOD EXTINCTIONS ACROSS THE TR/J BOUNDARY

HECKERT, Andrew, LUCAS, Spencer, New Mexico Museum Of Natural History & Science, Albuquerque, NM

Impact-based theories for tetrapod extinctions across the Tr/J boundary (TJB) are seriously flawed. If K/T boundary (KTB) extinctions are an acceptable model of impact-related extinctions, the TJB extinctions differ substantially in pattern, and presumably in process. The fossil record of almost every major tetrapod clade differs in its response to the two events. Turtles (anapsids) were essentially unaffected by either the TJB or the KTB, yet the anapsid procolophonids became extinct at or near the TJB. Synapsids thrived in the wake of the KTB, yet larger-bodied synapsids were in prolonged decline prior to the TJB, and probably went extinct soon after it. Tritylodonts and, possibly, morganucodontids were the only substantive post-TJB radiation of synapsids; other Early Jurassic mammals remained at relatively constant levels of diversity across the TJB. Diapsids show the greatest divergence from the KTB model. Marine reptiles (ichthyosaurs and plesiosaurs) thrived across the TJB but became extinct at the KTB. Pterosaurs became extinct at the KTB, but diversified across the TJB. Semiaquatic archosaurian predators (crocodiles, choristoderes, champsosaurs) survived and even thrived across the KTB, yet the ecologically similar phytosaurs declined during the Late Triassic and were extinct by the TJB. Terrestrial archosaurs (dinosaurs) became extinct at the KTB. One clade of terrestrial archosaurian herbivores (aetosaurs) and one or more of predators ("rauisuchians" *sensu lato*) were extinct by the TJB. However, the apparently terrestrial sphenosuchians not only survived but diversified. Dinosaurs survived, and continued to diversify across the TJB.

Global correlations also demonstrate that the TJB is remarkably "leaky." Groups once thought to have gone extinct at the TJB have been found (in refugia?) in strata millions of years younger than the TJB. Similarly, mammals, sauropods, and large ceratosaurian theropods, among others, are now known from rocks of Late Triassic age, undermining the idea of "ecological release" at the TJB. We therefore favor biological, not extraterrestrial, hypotheses to explain vertebrate faunal turnover across the TJB.

Poster Session A

A REPORT ON UNGUALS IN THE HIND PADDLE OF A POLYCOTYLID PLESIOSAUR

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Although plesiosaurs have been known for well over a century, complete phalangeal formulas have yet to be ascertained due to the lack of preserved unguals. Herein, we present a revised phalangeal formula and report on an unusually complete hind paddle that possesses ungual phalanges. The new formula is based on further preparation of a Polycotylid plesiosaur from the Pierre Shale of Wyoming. This specimen consists of a nearly complete post-cranial skeleton with intact pectoral and pelvic girdles, distally incomplete forelimbs, and well-preserved, nearly complete hind paddles.

The left hind paddle is the most complete, possessing unguals on digits I, II, III, IV (?), and V. The less complete right hind paddle also has a higher phalangeal formula than previously described, although the unguals are missing. The new phalangeal formula of the hind paddles is ascertained to be I-12, II-17, III-19, IV- 16 (?), V-15. The questionable count on digit IV is due to post mortem damage across the penultimate phalange. The identification and description of these unguals allow us to identify the terminus of the digits and provide for a more accurate phalangeal count.

Poster Session A

FLOATING POINT: A COMPUTATIONAL STUDY OF BUOYANCY, EQUILIBRIUM, AND GASTROLITHS IN PLESIOSAURS

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Three-dimensional mathematical/computational models of three types of plesiosaur (*Liopleurodon*—short neck, *Cryptocleidus*—medium neck, and *Thalassomedon*—long neck) were used to investigate aspects of their flotation and stability. Equivalent models of an extant alligator (*Alligator mississippiensis*) and leatherback sea turtle (*Dermochelys coriacae*) were used as tests. With full lungs, and uniform tissue densities of 1,050 g/l, all five models would float at the surface, with the alligator and sea turtle models replicating the depths of immersion and inclinations observed in living forms. The head of a floating *Thalassomedon* would have been able to break the water surface (to facilitate breathing) only if it either dorsiflexed its neck or had a neck density less than 1,000 g/l. The idea that plesiosaurs could maintain their necks

above the water surface in a swan-like manner is rejected due to unbalanced buoyancy forces acting on the body. The oblate bodies of *Cryptocleidus* and *Liopleurodon* provided effective passive mechanisms for righting the body if perturbed by waves at the surface, but the almost circular cross-section of the *Thalassomedon* body was ineffective in self-righting. Impractically large amounts of gastroliths were needed to initiate sinking. With the lungs 50% inflated,10kg of stones were still required in a 218kg *Cryptocleidus* to produce negative buoyancy, and the idea that gastroliths were for control of buoyancy and equilibrium is rejected. However, gastroliths equal to 1% of body weight in a *Thalassomedon* model were effective at damping out buoyant oscillations of the neck when at the surface.

Poster Session A

A NEW PELOBATID ANURAN FROM THE EOCENE ELKO FORMATION OF NEVADA

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A new, small pelobatid anuran is represented by a small collection of fairly well-preserved and for the most part articulated to closely associated fossils recovered from the middle Eocene Elko Formation near Elko, Nevada. The Elko Formation is divided into three informal members, lower, middle, and upper, and was deposited primarily under warm, temperate conditions in a fluviolacustrine system of a broad, shallow basin extending over a large area of present-day northeastern Nevada. The fossils were preserved in a sandy limestone unit near the base of the middle member, which lies about 100 m above a unit yielding a radiometric date of 46.1 Ma.

A phylogenetic analysis suggests that the new pelobatid is the most primitive pelobatid currently known and differs from all other pelobatids in the following autapomorphies: 1) alary process of premaxilla is broad-based and forms a laterally-deflected, straight blade whose transverse axis in an articulated skull would be oriented in a near parasaggital plane; 2) pars acromialis of scapula is triangular with an anteriorly directed apex positioned at the level of the dorsal rim of the glenoid fossa; and 3) urostyle length exceeds that of the vertebral column.

The new pelobatid is the oldest known member of its family that exhibits burrowing specializations in its skeleton. Thus, like extant pelobatids, it very likely could avoid high daytime temperatures and periods of dryness by constructing a burrow in which it aestivated. The ability of early Tertiary pelobatids to presumably avoid drought by aestivating in burrows is thought to be a preadaptation for hibernation in burrows to survive subfreezing temperatures resulting from global cooling that began in the Middle Eocene.

Poster Session A

THE PIRAPOZINHO SITE—A TAPHOFACIES STUDY

HENRIQUES, Deise, AZEVEDO, Sergio, CAPILLA, Ramses, PETROBRAS/CENPES, Rio de Janeiro, RJ., Brazil; SUAREZ, Jose, Universidade Estadual Paulista, Presidente Prudente, Brazil

The Pirapozinho site (Sao Paulo, Brazil) is informally known as Tartaruguito due to the spectacular preservation and abundance of turtle fossils. The analyzed litologic facies present cyclic alternations of mudstone and sandstone layers. The basal one (clay sediment) presents several fragments including fish and reptile material (Class III B—fragmented isolated bones). In the subsequent sandstone layers, which are intercalated with some mudstone, and eventually some clay pellets, are several articulated bones representing different classes of degrees of articulation (I—articulated skeletal material, II—partially articulated skeletal material and IIIA—disarticulated complete bones). In the uppermost layer, it is observed a large fragmented turtle bone material, probably a result of a slight reworking of the material, due to a canal erosion (Class III B—fragmented isolated bones).

Based on some geological studies and on the great concentration of the testudine material, that supposedly indicates that individuals were once agglomerated around a body of water, till their death, some authors indicate a semi-arid condition to the region. Nevertheless, some turtle materials present an internal stratification and a disarticulated internal condition, and others remained totally articulated, as proved by a tomographic exam. The crocodylia material, that was probably carried into the river by fluctuation and deposited at the local, was preserved articulated. The presence of a clay layer, small pellets of clay and the small cross bedding sedimentary structures indicate that wet periods were also occurring.

Sedimentary and tomographic analyses of the internal structures of different turtle material indicate that there exists a time-averaging process, the fossil assemblage representing more than one episode. A climatic transition phase, from a humid to a semi-arid condition, is speculated to the Pirapozinho site (Presidente Prudente Formation), dated as Campanian-Maastrichtian. The typical semi-arid condition would only have been established at the Bauru Basin during the end of the Cretaceous period (Maastrichtian), as it is observed in Marilia Formation.

Poster Session A

MITIGATION OF NATURAL AND HUMAN-INDUCED CHANGES TO NEW MEXICO'S MOST IMPORTANT JURASSIC BONEBED

HESTER, Patricia, Dept. of the Interior Bureau of Land Management, Albuquerque, NM

The Bureau of Land Management (BLM) recently stabilized and protected an important Late Jurassic bone bed. New Mexico Museum of Natural History (NMMNH) locality L-3282, informally known as the 'Peterson Quarry', was discovered on BLM land during uranium prospecting expeditions to Jurassic and Cretaceous outcrops west of Albuquerque. The quarry represents New Mexico's most important Jurassic locality. When discovered, dinosaur bones were eroding out of a channel sandstone in the Brushy Basin Member of the Upper Jurassic Morrison formation. In 1989, excavation by NMMNH volunteers began under a BLM permit and continues today. Over the last 16 years, excavations have produced over 72 jackets and hundreds of sauropod and theropod bones and teeth. Proximity to Albuquerque makes the quarry an ideal outdoor laboratory to showcase field activity associated with collection of large fossil bones.

The quarry location in an arroyo bottom created a challenge for ongoing excavation. Portions of quarry have been subject to flood events. This interaction with occasional surface water affected the preservation of material collected. In the mid 1990s, overburden was removed by backhoe and excavation continued away from the arroyo bottom. Bone preservation has improved as excavation extended outside of the recent channel. Rock debris removed from the wash with a small backhoe was used to form a berm that can deflect periodic flow events away from the quarry. Cleaning out the wash re-established the grade to allow through flow and prevent ponding.

Public demand for landscape rock in Albuquerque had created a human induced threat to the quarry. Recent illegal landscape rock collection along the old jeep trail leading to the quarry called for immediate response. A gate and short fencing project blocked access to unauthorized vehicles. Construction of a pedestrian walk through allows hikers access to the short scenic hike to the quarry. By taking these measures, the quarry will remain open and accessible for excavation, future study and opportunity for outdoor learning activities for years to come.

Saturday 4:00

REVISED HORN RECONSTRUCTIONS FOR EXTINCT RHINOCEROTID TAXA: SEPARATING THE CONTRIBUTIONS OF DERMIS AND EPIDERMIS TO HORN RUGOSITIES

HIERONYMUS, Tobin, WITMER, Lawrence, Ohio Univ., Athens, OH

Recent work on the skin of extant rhinoceros has led to the development of a mechanistic model for the osteological correlates of rhinoceros horn attachment, which relates grossly visible bony features of the "horn rugosities" to specific characters of the dermis that provide attachment for the epidermal horn. The projecting texture of rugosity that characterizes most of the nasal and frontal horn rugosities is formed by metaplastic ossification of the reticular dermis and the investing fascia of the dermis, respectively. Similar textures of rugosity on the facial bones of extant taxa such as *Hippopotamus* and *Potamochoerus* that lack epidermal horns indicate that projecting rugosity is in itself only associated with the presence of a thickened and well-organized dermis, and is not necessarily indicative of a horn. Instead, the presence of an epidermal horn is associated with specific larger-scale patterns of rugosity and vascularity. Large nasal horns such as those found in *Ceratotherium* and *Diceros* are associated with a peripheral zone of projecting rugosity around the nasals. The center of the nasal rugosity is often grossly smooth, but is perforated by numerous branches from the lateral nasal arteries, which traverse from within a novel nasal sinus to the surface of the nasal bone. Frontal horns are associated with two adjoining fields of tangentially-oriented rugosity. Absence of epidermal horns, as in female *Rhinoceros sondaicus*, is associated with absence of rugosity. The facial integument of several extinct rhinos, notably *Diceratherium*, *Menoceras*, and *Acerorhinus*, has been reconstructed using these osteological correlates. These findings have bearing on the evolutionary role of the integument in agonistic behaviors, species recognition, sexual display, etc.

Poster Session B

ANATOMY AND PHYLOGENETIC POSITION OF THE PALEOCENE CROCODYLIAN *AKANTHOSUCHUS LANGSTONI*

HILL, Robert, New York College of Osteopathic Medicine, Old Westbury, NY; LUCAS, Spencer, New Mexico Museum of Natural History and Science, Albuquerque, NM

Akanthosuchus langstoni is a poorly known crocodylian represented by a few postcranial elements and approximately 200 unusually ornamented osteoderms. The paucity of available material pertaining to *A. langstoni* has hindered interpretations of its lifestyle and phylogenetic affinities, because such interpretations for fossil crocodylians have been traditionally based on morphology of the skull instead of the evolutionarily conservative postcranial skeleton. Here, we use available morphological data to assess the phylogenetic relationships of *A. langstoni*, and present new information on the morphology of crocodylian osteoderms.

The range of intraorganismal variability in crocodylian osteoderm morphology is extensive, and multiple distinct morphotypes can be identified in individuals of several extant and extinct species. Thin sections of *A. langstoni* osteoderms demonstrate the presence of three histologically distinct regions, arranged in layers from superficial to deep. Growth marks in sections of the holotype osteoderms reveal that the individual was at least eight years old, and that its small size might be attributable to it not being fully mature.

Cladistic analyses indicate that *A. langstoni* is unequivocally nested within Alligatoroidea, and may be more closely allied with alligatorines than with caimanines. The hypothesis that *A. langstoni* represents the postcrania of the Paleocene crocodylians *"Navajosuchus"* or *Ceratosuchus* is unsupported. Although *A. langstoni* may be regarded as a "wildcard" taxon that causes a decrease in phylogenetic resolution, its higher-level relationships can be ascer-

tained. Additional characters of the integument and osteoderms may be crucial in adding resolution at poorly understood nodes of crocodylian phylogeny.

Friday 11:00

OSTEOLOGY, SYSTEMATICS, AND BIOGEOGRAPHY OF FOSSIL AND LIVING OSTEOGLOSSID FISHES (TELEOSTEI: OSTEOGLOSSOMORPHA), WITH A DESCRIPTION OF NEW FORMS AND A REVIEW OF THE BIOGEOGRAPHIC RELATIONSHIPS OF THE CLADE MEMBERS

HILTON, Eric, Smithsonian Institution Div of Fishes, Washington, DC; FOREY, Peter, The Natural History Museum, London, United Kingdom

The family Osteoglossidae is a group of basal teleostean fishes that includes extant members such as the arowanas (*Osteoglossum* and *Scleropages*; South America, Australia, Asia), the pirarucu (*Arapaima*; South America), and the Nile arowana (*Heterotis*; Africa). The African butterfly fish (*Pantodon*; Africa) is closely allied to and sometimes included in Osteoglossidae, although it is often placed in a separate monotypic family and is a particularly problematic osteoglossomorph taxon, as shown by recent morphological and molecular analyses. All extant members of Osteoglossidae are primary freshwater fishes and thus have been used as a classic example of vicariance biogeography. There is also a rich fossil record of the family, which extends to at least the Late Cretaceous and includes representatives in North America and Europe. Several fossil osetoglossid taxa are known from undisputed marine environments (e.g., *Brychaetus*, from the Eocene London Clay), and there appears to have been multiple marine invasions in the Osteoglossomorpha generally. In this talk, we will present new data on the comparative osteology of fossil and living osteoglossids (e.g., the presence of a third hypural supporting the ventral lobe of the caudal fin in two species of *Scleropages*). We will also review the fossil record of the family, which ranges from specimens of indeterminate taxa (e.g., fragments of scales from several Cretaceous and Cenozoic localities) to well preserved and abundant taxa (e.g., *Phareodus* from the Eocene Green River Formation). New records and newly discovered marine fossil taxa will be described and incorporated into a systematic and biogeographic analysis of the family.

Poster Session B

ALLOMETRIC SCALING OF THE FOOT AND BODY MASS ESTIMATES IN EXTINCT DIVING BIRDS

HINIC-FRLOG, Sanja, Univ.of California Davis, Davis, CA

Body mass is an essential parameter for biomechanical analyses and measurements of intrinsic properties such as metabolic rate and muscle efficiency. An estimate of body mass of extinct animals can be obtained through regression analysis using body mass and linear measurements of bones. Though such scaling relationships are well studied in birds, effects of habitat and migration have not been rigorously tested. It is possible that allometric constants may differ if only the birds that are closely associated with aquatic habitat are considered, or if data from a single season are analyzed. This study examines how habitat limitation (diving vs. non-diving birds) and seasonal variation of body mass (migratory vs. non-migratory birds) effect scaling relationships. Significant differences in such relationships may influence body mass estimates of extinct birds.

Body mass and foot morphometrics were obtained from ornithology collections and adapted from the literature. The allometric equation obtained from 158 bird species for tarsometatarsus length ($y = 0.459x^{1.951}$) was significantly different from those obtained for femur ($y=0.022x^{2.730}$) and tibiotarsus ($y = 0.007x^{2.641}$). Circumference-based allometric equations did not significantly differ among the foot bones ($y=3.2923x^{1.9884}$). The new allometric constants obtained by using tarsometatarsus length showed negative scaling with body mass in divers and non-divers equally. This suggests that scaling of the tarsometarsus is not limited by aquatic habitat.

An independent test of allometric relationship between body mass and tarsometatarsus length was performed using life-history data. This method accounts for year-round variation of body mass by comparing migrants to non-migrants. There was a significant difference in allometric relationships of body mass and tarsometatarsus length between three migrant ($y=0.031x^{2.103}$) and four non-migrant species ($y=0.008x^{2.541}$). This indicates that seasonal body mass variation in migratory birds is significant and should be accounted for in studies using allometric scaling.

Poster Session A

SYSTEMATIC POSITION OF *PROTOSPHARGIS VERONENSIS* CAPELLINI, AN ENIGMATIC SEA TURTLE FROM THE LATE CRETACEOUS OF ITALY

HIRAYAMA, Ren, Waseda Univ., Shinjuku-ku, Tokyo, Japan

Protosphargis veronensis is an enigmatic sea turtle (Testudines; Cryptodira; Chelonioidea) from the Late Cretaceous (Campanian or Maastrichtian) near Verona, Italy. Its highly reduced ossification of carapace and plastron suggested closed affinity with Cenozoic Dermochelyidae, whereas otherwise poorly diagnosed data have hampered its inclusion within modern analysis.

Recent observation of the holotype of *P. veronensis* deposited in the Capellini Museum of Bologna Univ. reveals several hitherto unknown important characters such as 1) lateral process of pubis is small as those of Cheloniidae, 2) thyroid fenestra is large and confluent as in cheloniids, 3) femoral trochanters are separated, not connected by bony ridge unlike in Dermochelyidae, Protostegidae, or advanced cheloniids. One tree was obtained through PAUP analysis (Version 4.0) by using 105 characters of 24 taxa (5 outgroups and 19 chelonioids). Tree length is 227, and consistent index is 0.519. *Protosphargis* is here shown as a sister taxon of *Allopleuron hoffmani*, an aberrant Late Cretaceous cheloniid from Netherlands and Belgium. Thus, it is concluded *Protosphargis* is a cheloniid closely related with *Allopleuron*, both of which are characterized by highly reduced shell ossification. Pronounced shell reduction seems three times independently acquired in each family of chelonioids.

Saturday 11:00

DETERMINING THE PRESENCE AND METABOLIC PATHWAYS OF GRASSES IN THE SOUTHEASTERN UNITED STATES DURING THE MIDDLE MIOCENE

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The C_4 grasslands of the North American Great Plains slowly appear around 23 Ma. An apparent global expansion of C_4 grasses occurred near the end of the Miocene (7-5 Ma); however, ungulates began adapting hypsodont tooth morphologies conducive to grazing by the beginning of the Barstovian land mammal age (~15.8 Ma). During this time, C_4 grasses may not have been abundant enough to be responsible for this adaptive radiation. To explain this 8-11 million year gap between the appearance of hypsodont teeth and C_4 grass expansion, C_3 grasses may have been extensive throughout the Great Plains resulting in the dietary driving force behind the grazing adaptations. The small abundance of C_4 grasses before the Miocene/Pliocene expansion is well documented in the Great Plains region while the existence of C_3 grasses is not conclusive. Conversely, in the southeastern region of North America there is ambiguity concerning both the onset of C_4 grasses and existence of C_3 grasses. To contribute to the record of C_4 grass expansion across North America, as well as address the possible driving forces behind hypsodont tooth adaptation in grazing ungulates, this study analyzes the stable carbon isotopic signatures of fossil ungulate teeth and phytoliths from the middle Miocene of southeastern North America. Phytoliths are microscopic silica bodies containing carbon dioxide inclusions within grasses recently shown to reflect the $\delta\ ^{13}C$ ratio of the plant. Stable carbon isotope analysis of these phytoliths may reveal whether grasses present were C_4 and/or C_3 plants. Our $\delta^{13}C$ values of early Barstovian hypsodont ungulate teeth in this region reveal a diet consisting primarily of C_3 plants. The $\delta\ ^{13}C$ values of fossil teeth can distinguish between C_3 and C_4 plants, but cannot determine whether the C_3 plants were grasses or browse. Phytoliths, therefore, may be a valuable tool in distinguishing between a C_3 browse diet and a C_3 grazing diet for the early Barstovian ungulates of southeast North America.

Poster Session A

DIGITIZING DINOSAURS: NEW TECHNIQUES FOR THE MICROSCRIBE 3D DIGITIZER

HOHLOCH, Alexander, MALLISON, Heinrich, Tübingen Univ., Tübingen, Germany

A three-dimensional digitized representation of a large bony element may offer the researcher significant advantages over casts or real bones. However, creating 3D computer files can be time consuming and expensive, and the resulting files are often difficult to handle due to their size. When only large elements are digitized a low resolution can be chosen to minimize file size, but this results in the inability to study structures that include small as well as large bones (e.g., ankles, wrists). We improve on previous techniques for data collection with the Microscribe 3D digitizer to facilitate file creation and editing of the finished bone models. This includes the design of an easy to assemble and transportable holder for small to medium sized fossils, new methods for the in-program digitizing procedure that make additional editing in separate programs unnecessary, reducing time and financial demands, and allow a significant increase in size range of bones that can be digitized. Now, it is possible to both exactly digitize bones down to a diameter of only a few centimeters as well as bones larger than the range of the digitizer arm. Additionally, complex shapes such as costae and vertebrae can now be digitized with relative ease. Also, we detail a procedure for marking the extent of surface features such as rugosities.

Poster Session B

ON THE SKULL OF *RADINSKYA* (MAMMALIA, ?PHENACOLOPHIDAE) AND ITS AFFINITIES

HOLBROOK, Luke, Rowan Univ., Glassboro, NJ

The genus *Radinskya* is known from a single skull from the late Paleocene of China. It was first described tentatively as a phenacolophid with possible affinities to perissodactyls. Subsequent studies addressing perissodactyl phylogeny have often treated *Radinskya* either as the sister-taxon or as an outgroup to perissodactyls, or they included it in order to test hypotheses of perissodactyl origins. These later studies generally have based the scores for characters for *Radinskya* either on the original published description or on casts of the original material. Reexamination of the type skull reveals that a number of cranial characters have been incorrectly scored by some of these studies. The skull of *Radinskya* is re-described here, adding some new information to the original description, emphasizing some features noted in the original description but missed by subsequent studies, and discussing the phylogenetic implications of this information. Though it retains many ancestral eutherian traits, *Radinskya* displays two possible cranial synapomorphies with perissodactyls: posteriorly broad nasals with a roughly transverse nasofrontal suture, and a mastoid exposure restricted to a small, triangular

area on the lateral aspect of the skull. These features support the notion that *Radinskya* is an important taxon for understanding perissodactyl origins.

Romer Prize Session, 10:15

EVOLUTIONARY PATTERNS OF THE ORBITOTEMPORAL REGION OF ARCHOSAURS: IMPLICATIONS FOR NEUROANATOMY AND INTRACRANIAL MOBILITY

HOLLIDAY, Casey, Ohio Univ., Athens, OH

The orbitotemporal region is a structurally complex, functionally dynamic, and phylogenetically informative cephalic space built by elements of the palate and braincase, trigeminal nerves, adductor muscles, and other topologically conservative structures. However, little is known about the region's anatomy and evolution in Archosauria. Tests of similarity and congruence among soft and bony adductor chamber contents were conducted in a large survey of extant and fossil archosaur taxa. Numerous soft-tissue structures and osteological correlates characterize this region, which support robust evaluations of character transitions in the fossil record. Iterative losses of the epipterygoid—though within disparate feeding systems—occurred along the lines to Crocodylia and Neornithes, as well as within at least three terminal non-avian dinosaur clades (e.g., Ornithopoda, Ceratopsidae, and Sauropodomorpha). Complementing these changes, neomorphic bony walls of the laterosphenoid (e.g., the avian pila antotica spuria) developed between the ophthalmic nerve and more lateral structures (e.g., the maxillary nerve) within several of these clades, altering the topology of the cavum epiptericum and temporal fossa as well as impacting the functional properties of the palatocranial junction. Associated modifications in muscular structures of the region (e.g., the preotic pendant) include the development of a complex, multidirectional suite of protractor muscles in Ornithopoda, the loss of m. levator pterygoideus through Tetanurae, and a hypertrophied m. protractor pterygoideus in Tyrannosauridae. These characteristics signify adaptations for maintaining intracranial rigidity via a passive, soft-tissue, stay system, which is interpreted to be a plesiomorphic feature from which birds exapted powered kinesis. These transitions apparently evolved abruptly in the terminal clades and offer few interpretable intermediate stages. However, a mosaic of structural patterns in Neosuchia and Maniraptora indicate that this region's character suite may yield phylogenetic resolution of the respective origins of the crown archosaur clades.

Wednesday 12:15

NEW GEOLABIDID LIPOTYPHLANS AND BODY MASS DISTRIBUTION OF "INSECTIVORAN-GRADE" MAMMALS IN THE EARLY EOCENE OF WYOMING

HOLROYD, Patricia, Univ. of California, Berkeley, CA; STRAIT, Suzanne, Marshall Univ., Huntington, WV

Prior studies of early Eocene (Wasatchian) lipotyphlan body mass distributions suggest that, like modern lipotyphlans, most species are between 7 and 20 g. However, both smaller and larger taxa are underrepresented. Truncation of the smaller end of this mass spectrum is due to taphonomic factors, and it has been suggested that the larger end of the mass spectrum is occupied by proteutherians.

Screenwashing in earliest Eocene quarries in the Bighorn and Washakie basins of Wyoming has yielded diverse assemblages of small "insectivoran grade" mammals, including abundant lipotyphlans and rarer geolabidids, erinaceoids, palaeoryctids, parapternodontids, apatemyids, and cimolestans. Among these are two new geolabidid species closely related to the smallest insectivore, *Batodonoides*, as well as additional specimens of *B. vanhouteni* that confirm its diminutive mass (<2 g). These new geolabidids add to the diversity at the small end of the lipotyphlan body mass scale.

Analysis of these fossils provides insights into the structure of body mass distributions of early Eocene lipotyphlans. Extant mammals show considerable conservatism in body mass among closely related taxa. Consequently, there is a significant phylogenetic component to lipotyphlan body mass distribution. Specifically, soricids are highly diverse, closely cluster in body mass, and produce the mode of very small body mass (7 g) in extant lipotyphlans. Examination of body masses estimated from m1 size in early Eocene lipotyphlans indicates that their distribution generally shows this same conversatism among closely related taxa and that most early Eocene lipotyphlans occupy the same range of sizes seen in soricids, smaller tenrecs, and selected talpids. Just as diverse soricids drive the shape of the extant distribution, speciose nyctitheriids clustering between 7 and 10 g dominate the early Eocene lipotyphlan faunas. Nonetheless, the *Batodonoides* clade is unusual for its very small size with respect to other geolabidids, giving the family an unusual bimodal size distribution. These findings suggest that either the very small size of *Batodonoides* spp., or other geolabidids' larger size, represent a substantial departure from the norm.

Poster Session A

IN THE SHADOW OF CATASTROPHE: PHYLOGENY, PALEOECOLOGY, AND FAUNAL TURNOVER OF CAMPANO-MAASTRICHTIAN DINOSAURS OF WESTERN NORTH AMERICA

HOLTZ, Thomas, Univ.of Maryland, College Park, MD

The North American West contains an unparalleled sequence of dinosaur assemblages from the middle Campanian through the end of the Maastrichtian (Judithian, Edmontonian, and Lancian NALMAs). This sequence represents the best potential case for recognizing changes of diversity and paleoecology within the non-avian dinosaurs. However, most work to date have examined these changes with reference to the terminal Cretaceous extinction, rather than as a possible record of transitions within dinosaur history independent of the K/T event.

Previous studies of dinosaurian faunal diversity have been based solely on direct observed presence of species. This analysis adds to the observed record by recognizing the presence of ghost lineages inferred by recent phylogenetic analysis of the dinosaurian taxa in question. While in some cases immigration might be reasonably inferred to explain the appearance of a lineage into the study region, in others (notably the Ceratopsidae as a whole and particular subclades of other major taxa) the known record of that clade is entirely within western North America.

Overall diversity is highest in the Judithian, but most clades remain present in the Lancian. The most notable cases of diversity changes occur in the most speciose clades, Hadrosauridae and Ceratopsidae. In each of these, taxa with longer snouts (long-snouted hadrosaurines and Chasmosaurinae) preferentially survive into the Lancian, while their shorter-snouted relatives (short-snouted hadrosaurines, Lambeosaurinae, and Centrosaurinae) show greatly reduced survival rates into the Maastrichtian. These faunal changes occur millions of years prior to the K/T impact, are well before the initiation of Deccan Traps volcanism, and are arguably before the onset of the Maastrichtian Regression. Furthermore, although they document the extinctions of particular groups within dinosaurs, related taxa show no signal of decline. Thus, instead of representing some mode of "gradual extinction," these diversity changes seem to record a faunal transition within western North American ornithischians. One possible scenario consistent with the observations would be preferential survival of certain taxa to floristic changes, but other scenarios cannot be discounted.

Wednesday 4:00

WHY ARE THERE SO FEW KINDS OF APLODONTIDS? THE RELATIVE ROLES OF CLIMATE, VEGETATION, AND COMPETITION IN THE DECLINE OF A LINEAGE

HOPKINS, Samantha, Univ. of California Berkeley, Berkeley, CA

The Aplodontidae are a clade of rodents which were an important component of late Oligocene and early Miocene ecosystems, especially in North America, but which declined through the middle and late Miocene, leaving only a single extant species. Understanding the reasons for lineage decline can provide an understanding of the macroevolutionary mechanisms underlying the assembly of the modern fauna. Recognizing how natural processes affect lineage decline in the past helps us recognize the difference between background extinction and human-driven extinctions. This study considers the potential influence of climate change, floral change, and competitive replacement in driving the decline of the aplodontid rodents. Using a single, monophyletic clade to consider the question reduces the effect of differential response of more distantly related taxa to the same environmental stimulus.

Because many recent studies of diversity have suggested that biological interactions may be important in driving diversity dynamics, particular emphasis is placed on the test of competitive replacement. The results of this analysis find that, at least for this clade, climate change does not seem to have been important in shaping diversity patterns. There is no correlation between global climate and diversity of aplodontids, either within ecomorphological groups or in the entire clade. A significant negative correlation between two different proxies for the proportion of grass in Great Plains ecosystems and the species richness of aplodontids in that region suggests that the rise of grasslands and the increasing dominance of C_4 vegetation may have played a role in the decline of aplodontids. Patterns of co-occurrence and of morphological change through time indicate competitive exclusion of allomyine aplodontids by flying squirrels and of fossorial castorids by mylagaulids. However, the decline of aplodontids through the late Miocene cannot be attributed with certainty to any of the causes suggested here. It may be that the extinction of all but one lineage of aplodontids was simply a function of random effects in speciation and extinction.

Saturday 4:15

A NEW *TRICERATOPS* CRANIAL GROWTH SERIES

HORNER, John, Museum of the Rockies, Bozeman, MT; GOODWIN, Mark, Univ. of California, Berkeley, CA

This cranial growth series of ten *Triceratops* skulls (30-205 cm long) in MOR and UCMP collections from the Late Cretaceous Hell Creek Fm, Montana, allows a comprehensive reevaluation of cranial anatomy and ontogeny. Previous assessments are limited to an isolated juvenile postorbital horn. Nearly all anatomical and behavioral studies of *Triceratops* have been based on adult skulls. Three of the *Triceratops* skulls were collected during the 1999-2004 Hell Creek Project.

UCMP 154452 (30 cm long) is a new ontogenetic end member and the smallest *Triceratops* skull yet known. A recapitulation of the juvenile and adult characters of more basal ceratopsids, such as *Protoceratops*, occurs in the braincase where the supraoccipital bisects the exoccipitals along the braincase roof. In adult *Triceratops*, the exoccipitals unite dorsally to exclude the supraoccipital from the braincase. The posterior margin of the juvenile frill is distinguished by 17 scallops. Epoccipital ossification begins in skulls ca. 50 cm long. The smoother margin of the subadult and adult saddle-shaped frill is ornamented by 17-19 epoccipitals. Basal skull length (caudal limit of basioccipital to tip of rostral bone) increases from 45% in juveniles to 70% in adults. Postorbital horns are expressed early in ontogeny and curve posteriorly in juve-

niles and subadults. An increase in remodeling rates ventrally causes the horns to reverse direction and procurve in adults. The triangular epinasal horn overgrows the paired nasal bones and displays a range of variation in shape and profile. Deep vesicle grooves indicate the horns and frill were covered with hard keratin.

The growth of large, anteriorly directed postorbital horns, a massive nasal horn, and ossified epoccipitals, may have signaled sexual maturity. These developments and the early expression of postorbital horns support the hypothesis that cranial ornaments in *Triceratops* were at least as important for species recognition and visual communication as they may have been for sexual display and agonistic behavior.

Poster Session B

PHYLOGENETIC ANALYSIS OF LATE CENOZOIC *TAPIRUS* (MAMMALIA, PERISSODACTYLA)

HULBERT, Richard, Univ.of Florida Florida Museum of Natural History, Gainesville, FL; WALLACE, Steven, East Tennessee State Univ., Johnson City, TN

Phylogenetic analysis of six species of late Cenozoic *Tapirus* from North America and the four extant species of *Tapirus* using 30 cranial, nine dental, and two postcranial characters and three outgroups (*Miotapirus*, *Plesiotapirus*, *Paratapirus*) produced a single most parsimonious cladogram. Synapomorphies of *Tapirus* include infraorbital foramen located dorsal to P3 or P2, presence of an anteromedial maxillary process and a posterior process on the lacrimal, and a procumbent i1 that is larger than i2. The late Clarendonian *Tapirus johnsoni* is the sister taxon to all remaining members of the genus in the analysis. The latter form two clades. One is composed of the late Miocene *Tapirus webbi* from Florida and two extant species from South America, *T. terrestris* and *T. pinchaque*. The second consists of the extant species *T. bairdii* and *T. indicus* and the North American fossil taxa *T. veroensis*, *T. haysii*, an undescribed late Blancan species from Florida, and *Tapiravus polkensis*. The Hemphillian *T. polkensis* lies deeply within the crown clade of *Tapirus*, and is therefore transferred to that genus from *Tapiravus*. These results are in accord with those of molecular phylogenies of extant taxa.

Key synaphomorphies for the *T. webbi-T. terrestris-T. pinchaque* clade are a relatively long postcanine diastema and a slender, knob-like posterior process on the lacrimal. The clade that includes *T. bairdii* and *T. veroensis* is united by having a triangular interparietal and a deep groove for the meatal diverticulum on the nasal and frontal bones.

Poster Session A

EXPERIMENTAL ESTIMATION OF THE NUTRITIONAL VALUE OF POTENTIAL FOOD PLANTS OF HERBIVOROUS DINOSAURS, WITH SPECIAL EMPHASIS ON SAUROPODS

HUMMEL, Juergen, Zoological Garden Koeln, Koeln, Germany; SUEDEKUM, Karl-Heinz, Institute of Animal Science, Bonn, Germany; CLAUSS, Marcus, Department of Zoo Animals, Exotic Pets and Wildlife, Zurich, Switzerland

Like large extant herbivores, plant-eating dinosaurs very likely had the ability to digest plant matter with the help of symbiotic microbes, irrespective of the actual site of the fermentation chamber (foregut vs. hindgut). It is also highly probable that these microbes worked in a way comparable to extant gut microbes. One variable of the digestive process that must have been considerably different for the herbivorous dinosaurs, however, was the types of plants that they fed on. Large extant herbivores make little use of the plant groups that were only available in the Jurassic, which included conifers, ferns, and cycads, and no information is available on their degradability in the digestive tract of herbivores.

To assess nutritional value, 75 samples of potential dinosaur food plants were analyzed for their nutritional composition (proximate analysis). Since information on the energy content of plant matter can only be gained through data on its degradability, an in vitro fermentation system (modified Hohenheim gas test) was used to evaluate the fermentative characteristics and thus the energy content of the plants. Degradability and the degradation rate of the food plants were calculated via an exponential model.

The results of the fermentation experiments turned out to be quite dissimilar among the plant groups. The Araucariaceae, Ginkgo, and the basal angiosperms were among those with a high degradability, while results for other conifers and ferns were variable. Cycads had a relatively low degradability. The different species of Araucaria showed a degradation pattern of high degradability, but a low fermentation rate.

In vitro fermentation results are compared to data from modern plant groups such as grasses or angiosperm browse (i.e., dicot leaves), and their relevance and potential consequences for the digestive physiology of the largest herbivores ever, the sauropod dinosaurs, are discussed.

Poster Session A

EXTINCT MOOSE-ELK (*CERVALCES*): PHYLOGENETIC INFORMATION REVEALED THROUGH MASS SPECTROMETRY

HUMPULA, James, Michigan State Univ., East Lansing, MI; BUCKLEY, Mike, Univ. of York, York, United Kingdom; STAFFORD, Thomas, Univ. of Wisconsin, Madison, WI; VOORHIES, Michael, HUNT, Robert, CORNER, George, Univ. of Nebraska-Lincoln, Lincoln, NE

DNA and proteins are the most paleontologically informative molecules in fossils. Using two MALDI mass spectrometry techniques, we previously demonstrated the survival of intact protein (osteocalcin) in >55 ka bones from permafrost. Here we 1) address the survival of osteocalcin in powdered bone during storage (-80° C) and 2) provide a complete osteocalcin sequence for a 13,475 Ka *Cervalces* from Big Bone Lick, KY. The fossil's sequence is compared to that of modern moose (*Alces alces*) and elk (*Cervus elaphus*), which were sequenced using Edman and MALDI-MS (MS/MS and Peptide Mass Fingerprinting (PMF)). The monoisotopic mass of the molecular ion for osteocalcin from *Cervalces* is 5548, the same as that for moose and elk. This suggests that all three organisms share similar sequences, which is confirmed with MS/MS data from intact osteocalcin and two peptide residues (36-49 and 32-49; m/z 1702 and 2139 respectively). We are currently obtaining DNA data to better describe the phylogenetic relationships among the extinct and living genera.

Student Poster Session

CERATOPSID DINOSAURS FROM THE JAVELINA FORMATION (MAASTRICHTIAN), BIG BEND NATIONAL PARK, TEXAS

HUNT, ReBecca, Texas Tech Univ., Lubbock, TX

A bone-bed in the middle part of the Javelina Formation (Maastrichtian) in Big Bend National Park, Texas, preserves the fragmentary remains of three ceratopsid dinosaurs. The site yielded parts of about 30 identifiable postcranial bones, mostly limb and girdle elements, belonging to two adult and one juvenile individual. The bone accumulation occurs in the upper part of an abandoned stream channel deposit and appears to be a lag assemblage comprised of large immobile parts of the skeletons from which the smaller elements had been removed by running water. In general form and proportions the postcranial skeleton is similar to that in *Pentaceratops sternbergi*, and is less robust than in *Torosaurus latus* or *Triceratops horridus*. A few cranial elements were preserved, including two dentaries and part of a parietal. The parietal fragment is comparable in form to a more complete specimen referred to the ceratopsid *Torosaurus utahensis* that had been collected nearby and at about the same stratigraphic level. It seems likely that the partial skeletons belong to the same species, and if so, provide new information about this poorly known taxon.

Thursday 3:00

SIX YEARS LATER AND A DEEP CRETACEOUS RADIATION OF CROWN PLACENTAL MAMMALS IS STILL UNLIKELY

HUNTER, John, Ohio State Univ.- Newark, Newark, OH

The time of origin of crown placental mammals is a subject of continuing controversy. Molecular clock estimates of divergence time imply a diversification of crown placentals deep in the Cretaceous prior to the undoubted appearance of crown placental orders in the early Cenozoic. In 1999, Foote et al. assessed the probability of early divergence time estimates for their consequences for fossil preservation and found them extremely unlikely. More recent molecular estimates are upwardly revised (first split at ~104 Ma) compared to the earlier attempts that were tested (first split at ~129 Ma). Meanwhile, paleontological discoveries have increased the precision of placental ordinal appearances, documented new morphology, and provided occurrence data from under-sampled regions of the world, but have not extended unambiguous crown placental lineages deeper into the Cretaceous. Using the same general approach as Foote et al., the probability of the current upwardly revised molecular divergence-time estimates is assessed. The gap between the molecular clock "origin" for crown placentals and their appearance in the fossil record is 19-39 myr depending on the phylogenetic interpretation of the zhelestids and zalambdalestids, enigmatic eutherians from the Cretaceous of Asia. Assuming exponential growth (exponential growth is more likely than other models to find early origins plausible) to 8-13 lineages at first appearance in the fossil record, the implied sum of species-durations is 64-182 lineage-million years (Lmyr). Even under a very low 0.03 per Lmyr preservation rate (empirically based on Late Cretaceous mammals), the probability of complete non-preservation (P) is only 0.0042-0.1468. Restricting the analysis to the 5-10 Laurasian lineages, in keeping with "Garden of Eden" scenarios and better Late Cretaceous sampling in the northern continents, improves the fit somewhat (P = 0.0297-0.3096), but these scenarios are plagued by numerous problems. Nevertheless, current molecular divergence time estimates are more compatible than previous estimates with Late Cretaceous mammal preservation, and further upward revisions would be likely to improve the fit even further.

Poster Session A

RISING FROM THE DUST: AN *ALLOSAURUS'* JOURNEY TO THE 21ST CENTURY

HUNTER, Kalyca, BREITHAUPT, Brent, Univ. of Wyoming Geological Museum, Laramie, WY

In 1894 frontier paleontologist Wilbur Clinton Knight was named curator of the museum at the Univ. of Wyoming. Knight hired a well-known fossil collector, William H. Reed in 1896. Reed was employed to help in the collection of fossil material for the university. Between 1894 and 1898, the collections of the museum were increased greatly. Over 70 tons of plant and giant reptile fossils from around the state were accumulated to constitute the second largest American Jurassic fossil collection in the late 1800s. Creatures ranging from fish to marine reptiles and dinosaurs from around the world, could be found in the Geological Museum's collections at that time. During the 1890s a partial *Allosaurus* skeleton was found by William H. Reed. The animal was collected from the Upper Jurassic Morrison Formation near the Colorado border in a little known location named Red Mountain. The skeleton is from an adult

Allosaurus fragilis. It consists of the left leg with a partial foot, hip bones and several dorsal vertebrae.

In the early 1900s the Hall of Science was built as the third major building on the UW campus to accommodate the storage needs of the Geological Museum. The *Allosaurus* fossil was displayed in the museum in a state of the art upright mount for about 15 years. After a flood in the museum, it was placed in storage. In 1991, the museum was involved in the excavation of another *Allosaurus* from northern Wyoming. During this time all allosaurid material in the collections was removed from storage to be compared to the new *Allosaurus* nicknamed "Big Al." Reconstruction on Reed's *Allosaurus* began in 2003. The goal is to reconstruct the original mount of the *Allosaurus* as it was at the beginning of the last century and provide an opportunity for museum visitors and researchers to again view and study this specimen.

Poster Session B

ALLIGATOR CEREBRUM OCCUPIES LESS THAN HALF OF CORRESPONDING ENDOCAST REGION: IMPLICATIONS FOR RELATIVE FOREBRAIN SIZE IN DINOSAURS INCLUDING _TYRANNOSAURUS REX_

HURLBURT, Grant, Royal Ontario Museum, Toronto, ON, Canada

In dinosaurs other than small theropods, the portion of the endocast corresponding to the cerebrum (hereinafter called cerebrocast) has a smooth rounded appearance. This has given rise to an assumption that actual cerebrum volume may have corresponded to cerebrocast volume in dinosaurs. However, the cerebrocast of alligators has similar contours, yet the cerebrum occupies only 38% of cerebrocast volume in the largest alligators studied. Cerebrum was 40-48 % of brain mass, and the cerebrocast was 34-47% of endocast volume. The study used a size series of alligators (N=11) ranging from 1.6 m TL (snout to tail tip length), which is the smallest sexually mature size, to 3.8 m TL, the largest size commonly encountered. With increasing body size, the brain-endocast ratio declined from 68% to 32%; and the cerebrum-cerebrocast ratio from 72% to 38%. Bird Encephalization Quotients use the equation BEQ = MBr/(0.117 x MBd^0.590); Reptile EQs the equation REQ = MBr/(0.0155xMBd^0.553) *Tyrannosaurus rex* has the largest brain size of any dinosaur, other than small theropods. It has a BEQ ranging from 0.153 to 0.205, using brain-endocast ratios of 0.37. The Log10 of 0.2046 (-0.689) is more than three SDs (-0.544) below the mean Log BEQ (0.000) of Recent Birds (N=174). The REQ range of *T. rex* is 1.53 to 2.573 (Logs= 0.186 to 0.410), approximating one (0.188) to two (0.385) SD above the Log REQ range of Recent reptiles. Compared to the residuals of the log-log (cerebrum to brain) equation for Recent reptiles, *T. rex* lies between 2 and 3 SDs above the mean. Compared to residuals of both (1) the log-log ? (cerebrum to (brain-less-cerebrum) equation and (2) the log-log (cerebrum to body mass) relationship for Recent reptiles, *T. rex* is slightly more than 3 SDs above the mean. Relative brain size of *T. rex* is within the range of Recent reptiles and outside that of Recent birds; relative cerebrum size ranges from 2 to slightly more than 3 SDs above that of Recent reptiles.

Poster Session A

A THERIZINOSAURID DINOSAUR FROM THE UPPER CRETACEOUS MIFUNE GROUP IN KYUSHU, JAPAN

IKEGAMI, Naoki, Kyushu Univ. / Mifune Dinosaur Museum, Fukuoka / Kumamoto, Japan; TOMIDA, Yukimitsu, National Science Museum, Shinjuku, Tokyo, Japan

A partial braincase (preserving the supraoccipital, exoccipital, basioccipital, basisphenoid, and parasphenoid), three isolated teeth, and the shaft of a left humerus of a therizinosaurid dinosaur were discovered from the Upper Cretaceous Mifune Group (Cenomanian-Turonian) in central Kyushu. These remains were recovered from multi-taxa bone-bearing beds, which has been interpreted as fluvial channel and floodplain deposits.

The Mifune therizinosaur shows that the basisphenoid is extremely swollen and pneumatic, and the basipterigoid process is reduced as in other therizinosaurs (*Erlikosaurus* and *Nothronychus*). However, the braincase of the Mifune therizinosaur displays some differences from the other therizinosaurs: three branched passages for the exit for the hypoglossal nerve on the postero-ventral wall of braincase unlike the other therizinosaurs but as in troodontid and ornithomimosaur, lack of a depression on the exoccipital unlike *Erlikosaurus*, and presence of a low nuchal crest along the midline of the supraoccipital unlike *Nothronychus*.

Teeth of the Mifune therizinosaur are similar to *Erlikosaurus* but differ from *Segnosaurus*. One of the isolated teeth is from the anterior dentary and has subcircular cross section, lacking denticles on the anterior and posterior margins. The other two are posterior dentary teeth and have lanceolate crown with basal constriction and large denticles on the anterior and posterior margins. The shaft of left humerus is twisted and preserves "protuberance" on the posterior surface. The presence of the protuberance is common in derived therizinosaurs such as *Erlikosaurus*, but is not seen in primitive therizinosaurs like *Alxasaurus*.

Although the Mifune therizinosaur shows affinities with *Erlikosaurus*, some features in the braincase may suggest that this is a new taxon.

Saturday 2:45

A NEARLY COMPLETE SKELETON OF A BABY SAUROPOD FROM THE LOWER MORRISON FORMATION OF THE HOWE STEPHENS QUARRY, WYOMING: "LITTLE STEPS" INTO DIPLODOCID ONTOGENY AND TAXONOMY

IKEJIRI, Takehito, Dept of Geosciences, Hays, KS; SCHWARZ, Daniela, Naturhistorisches Museum Basel, Basel, Switzerland; BREITHAUPT, Brent, Univ.of Wyoming, Laramie, WY

A nearly complete skeleton of a juvenile sauropod from the Lower Morrison Formation (Late Jurassic, Kimmeridgian) of the Howe Stephens Quarry, Bighorn Basin, north-central Wyoming is described. The specimen consists of articulated mid-cervical to mid-caudal vertebrae and most appendicular bones, unfortunately the skull and jaws are missing. The shoulder height is approximately 67 cm, and the total body length is estimated to be less than 200 cm. Besides the body size, the following morphological features indicate that this specimen is ontogenetically very young; (1) unfused centra and neural arches from all the presacral and sacral to the nine anterior most caudal vertebrae, (2) unfused coracoid and scapula, (3) open coracoid foramen, and (4) relatively smooth articular surfaces on the limb, wrist, and ankle bones. The specimen exhibits a number of diplodocid features, such as a very elongate slender scapular blade posteriorly with a gradually expanded distal end dorsoventrally, a total of nine dorsal vertebrae, and the presence of the posterior centroparapophyseal lamina in the posterior dorsal vertebrae. Although three diplodocid genera, *Diplodocus*, cf. *Apatosaurus*, and cf. *Barosaurus*, have been found in the quarry, an identification of this specimen at the generic level is challenging due to a large degree of ontogenetic variation. Furthermore, unusual features observed in the specimen also make the identification difficult, such as (1) very large scapula relative to body size, (2) relatively elongate centra in the dorsal vertebrae: Elongation Index (length/width ratio) = 1.6, (3) relatively long cervical ribs, reaching 1.5-2 times the centrum length, (4) short massive neural spines in the sacral and anterior caudal vertebrae, reaching maximum 1.5 times the height of the centrum, and (5) relatively long tibia and fibula with a fibula/femur ratio of 0.78. Although the first two features may result from ontogeny, the latter three do not represent the typical juvenile conditions in sauropods, suggesting that this early juvenile specimen possibly represents a new diplodocid taxon.

Friday Fishes Symposium poster

FIRST REPORT OF A LUNGFISH (DIPNOI) TOOTH PLATE FROM THE UPPER JURASSIC MORRISON FORMATION

IMHOF, Margaret, TRUJILLO, Kelli, Univ. of Wyoming, Flagstaff, AZ

During a comprehensive paleontological survey of Colorado National Monument in the summer of 2004, we collected an isolated lungfish tooth plate from the surface of the Tidwell Member of the Upper Jurassic Morrison Formation. This occurrence is the first report of any lungfish fossil from this lowest member of the Morrison Fm. The material has been preliminarily identified as *Ceratodus fossanovum*, previously known only from upper parts of the formation at Quarry 9 and Ninemile Hill quarries in southeastern Wyoming. The presence of *C. fossanovum* so low in the section in western Colorado is significant because it extends both the geographic and stratigraphic range of the taxon and it adds to our understanding of the paleoenvironments of the Morrison Fm.

Friday 2:15

CRITICAL REVIEW OF THE LATE TRIASSIC DINOSAUR RECORD, PART 2: ORNITHISCHIA

IRMIS, Randall, Univ. of California Museum of Paleontology, Berkeley, CA; PARKER, William, Petrified Forest National Park, Petrified Forest, AZ; NESBITT, Sterling, Columbia Univ., Palisades, NY

Most purported ornithischians from the Late Triassic are known solely from dental remains; only *Pisanosaurus mertii* from Argentina is also known from postcranial material. As *Revueltosaurus callenderi* is now recognized as a suchian archosaur instead of an ornithischian dinosaur, the Triassic ornithischian record needs reevaluation. Because *Revueltosaurus* teeth are convergent with ornithischian teeth, some characters previously thought to diagnose ornithischian teeth can no longer be used as such. A cingulum is the only potential dental synapomorphy for Ornithischia; however, dental characters in general must be regarded as dubious.

Our re-examination of proposed Triassic ornithischians found that the teeth of *Crosbysaurus*, *Galtonia*, *Lucianosaurus*, *Pekinosaurus*, *Protecovasaurus*, *Technosaurus*, and *Tecovasaurus* all lack a cingulum and possess no other unequivocal synapomorphies of Ornithischia. These taxa may represent a variety of basal archosaurs. Portions of the holotype of *Technosaurus* may be related to the basal dinosauromorph *Silesaurus*; the posterior portion of the lower jaw is referable to *Shuvosaurus*. Although there are some similarities between the teeth of *Pisanosaurus* and heterodontosaurids, the presence of a cingulum on the teeth of the former cannot be confirmed; synapomorphies of the postcrania can only constrain *Pisanosaurus* to Dinosauriformes. Dentary characters are also equivocal. Therefore, the ornithischian affinities of Pisanosaurus are unconfirmed. A specimen assigned to cf. *Heterodontosaurus* sp. from the Late Triassic of Argentina is poorly preserved, fragmentary, and shares several dental character-states with heterodontosaurids, but better material is required to confirm this assignment. Currently, no Triassic footprints can be assigned to the Ornithischia.

There are no definite ornithischians in the Triassic, even though ghost lineages based on published phylogenies predict their presence. Either Triassic ornithischians were extraordinarily rare, they lived and died in environments not preserved in available Upper Triassic strata, or our phylogenetic placement of the Ornithischia needs reassessment.

Poster Session B

DENTITION OF LATE PALAEOZOIC XENACANTHOID SHARK *BRANSONELLA*

IVANOV, Alexander, St Petersburg Univ., St Petersburg, Russia

Bransonella is a genus of peculiar sharks described by the isolated teeth and known from the Lower Carboniferous to the Lower Permian marine deposits of various regions. Teeth of *Bransonella* have a strong ornamented crown and a rounded base with large apical button and compact semilunar basal tubercle. The crown is tricuspid mainly but sometimes the central cusp is absent. The height of central cusp can reach once of lateral cusps but it is always narrowed laterally in the cross section. The ornamentation of the crown is chevron-shaped reaching the base. The cusps contain the wide pulp cavity, the orthodentine surrounding and the external thick enameloid layer. The apical button occupies the most occlusal part of the base. The *Bransonella* dentition shows weakly developed heterodonty. Some variation is observed in the height of central cusp, in the inclination degree of crown, in the shape of base and basal tubercles, in the width of apical button and basal tubercle. The *Bransonella* teeth are possessed of typical xenacanthiform features as the base structural and the diplodont crown. However, such ornamentation does not occur in another xenacanthiform sharks but is known in the Devonian phoebodontiform *Jalodus*. The dentition of *Bransonella* demonstrates the presence of some features probably related with the common origin of xenacanthiform and phoebodontiform. *Bransonella* has to belong to xenacanthoid sharks and is a sister-group of xenacanthiforms.

Wednesday 2:15

THE VERTEBRATE PREPARATION LABORATORY AS A MULTI-DISCIPLINARY, MULTI-FUNCTIONAL SPACE (OR, OTHER INTERESTING PROJECTS I'VE WORKED ON)

JABO, Steven, Smithsonian Institution National Museum of Natural History, Washington, DC

The Vertebrate Paleontology Preparation Laboratory at the NMNH uses tools and techniques that adapt well to projects outside of vertebrate fossil preparation. The VP Lab often fields requests from other divisions within Paleobiology, such as the preparation of fossil plants, mollusks or crinoids. But occasionally, projects not directly associated with paleontological research come along. These requests come from a variety of disciplines within the museum community, including Mineralogy, Forensic Anthropology, Vertebrate Zoology, Public Affairs, Exhibits, and Development. Additionally, as a federally funded institution located in Washington, DC, the Smithsonian is in a unique position to interact with governmental representatives and other Federal offices such as Fish and Wildlife, BLM, the FBI and law enforcement. As a result of working on these other projects, lab personnel have the opportunity to broaden their skill levels and acquire new skills as each project brings with it its own challenges and a need for innovative and appropriate responses. Projects from outside the department also provide an opportunity to introduce others to the adaptability of preparation laboratory methodologies to suit their own needs. In the ever-changing environment of museums and research institutions, this recognition can help highlight the continued necessity of the vertebrate preparation lab and, potentially, the ability to support its staff and infrastructure.

Wednesday 11:15

TEACHING EVOLUTION AT THE UNDERGRADUATE LEVEL

JACOBS, Louis, Southern Methodist Univ. Dept of Geological Sciences, Dallas, TX

The teaching of evolution is simply one aspect of the teaching of science. As in all teaching, a respectful recognition of the intellectual level of the student by the instructor must be coupled with an enthusiasm for learning to produce an atmosphere that is conducive and open to ideas. Beginning the teaching of evolution with social or political controversies that surround it can be delicate from a teaching perspective because it can lead to the introduction of red herrings that move the focus, learning about evolution, to the periphery of a conversation (without a scientific) basis. The elements necessary for the understanding of evolution at the undergraduate level are the fundamental principles of superposition and its corollaries of faunal and floral succession, geologic time and its measurement, genetics and heredity (including DNA structure and function), plate tectonics, ecology and paleoecology, biogeography, and classical Darwinian evolution including natural selection as a mechanism. It is not enough to provide information alone because the topics can appear disjointed and unrelated. Clear and obvious relationships between disparate scientific disciplines are required to minimize a narrowness of view that inhibits appreciation of evolution as a unifying concept.

Wednesday 5:15

TURTLE CAROTID CIRCULATION: A CHARACTER ANALYSIS CASE STUDY

JAMNICZKY, Heather, Univ.of Calgary, Calgary, AB, Canada; BRINKMAN, Donald, Royal Tyrrell Museum of Palaeontology, Drumheller, AB, Canada; RUSSELL, Anthony, Univ. of Calgary, Calgary, AB, Canada

The bony canals of the turtle skull associated with the cranial circulation have long been considered integral to our understanding of turtle systematics, both extinct and extant. Recent phylogenetic analyses employing a variety of data sets suggest alternatives to the traditional arrangement of crown turtles, and may have implications for extinct members of the clade. A quantitative reassessment of both bony structures and the turtle cranial circulation revealed that the initial, qualitative description of these characters is in need of revision. Further, the constraints of nominalism and a focus on size alone may be confounding systematic analyses. High-Resolution X-Ray Computed Tomography (HXCT) allows more thorough documentation of cranial circulatory patterns within intact skulls and allows digital dissection of those skulls without damage to valuable fossil specimens. Evidence gathered using HXCT of extant specimens suggests a re-interpretation of primary homology among internal carotid branches in crown turtles, and subsequent re-evaluation of the phylogenetic utility of characters drawn from these features. Developmental data are employed to further understand the origins of circulatory novelty and pattern divergence within a clade whose members present, overall, a highly conserved *bauplan*. Character analysis such as this, employing information gleaned from multiple investigatory techniques and the soft-tissues available for investigation in extant organisms, are necessary for effective homology determination and the generation of robust phylogenies for use in higher-level evolutionary inference in palaeontology.

Wednesday Mammal Evolution Symposium poster

CONVERGENCES IN SCAPULA MORPHOLOGY AMONG SMALL BOUNDING MAMMALS

JANIS, Christine, SECKEL, Lauren, Brown Univ., Providence, RI

A peculiar feature of the scapula in rabbits is the presence of a long, slender, backwardly directed metacromion process, which serves as a lever arm for the insertion of the acromiotrapezius and levator scapulae ventralis muscles. This muscle anatomy, in combination with a portion of the pectoralis muscle that wraps around the anterior portion of the scapula in rabbits, probably enhances the effect of the scapula sling. It thus may represent an additional means of cushioning during landing on the forelimbs in rapid locomotion in a small bounding mammal that lacks the shock-absorbing tendons of larger, cursorial ungulates. We propose that the acromiotrapezius and levator scapulae ventralis muscles also act to stablise the pectoral girdle by resisting anterodorsal to ventrocaudal rotation when the body is moving over the forelimbs.

Investigations into the anatomy of other mammals revealed a similar scapula anatomy in all lagomorphs, and also in other placental mammals that share this type of gait: cursorial caviomorph rodents and elephant shrews. Quadrupedally bounding marsupials (peramelids) did not show this scapula anatomy, possibly due to developmental constraints in marsupial shoulder anatomy, but available illustrations of notoungulates revealed a similar type of metacromion process in some small, rabbit-like taxa such as Propachyruchos. Thus the scapula morphology of a long, slender metacromion process is an osteological correlate of the ecomorphological gait of quadrupedal bounding in small mammals, should provide evidence of this type of cursorial gait in extinct mammals.

Thursday 1:45

A RE-EVALUATION OF THE AGE ASSIGNMENT OF CATHEDRAL CAVE, NEVADA

JASS, Christopher, The Univ. of Texas at Austin, Austin, TX

A new paleontological excavation of Room 2 at Cathedral Cave took place during the summer of 2003. A primary goal of this fieldwork was to collect data that would either corroborate or refute a null hypothesis stating that a previous age assignment of 750-850 ka [middle Pleistocene (Irvingtonian)] was indicative of the true age of at least part of the deposit. The 2003 excavation encompassed a surface area of 1.5 x 2 m and the maximum vertical extent of the excavation was 76 cm below the surface of the cave floor. Excavation proceeded at arbitrary 5-cm intervals except in areas where natural sedimentary levels were distinguished.

Over 600 arvicoline rodent m1s have been recovered and identified from the 2003 excavation. Other than the new recovery of teeth of *Ondatra* (muskrat), the taxonomic composition of the arvicoline fauna is identical to that found previously. However, uranium-thorium dates on an *in situ* flowstone from near the base of the excavation preliminarily suggest a younger age for the assemblage than recognized on the basis of arvicoline biochronology. With the calculated error for the dates, the age near the base of the excavation may be as old as 160.1 ka or as young as 113 ka. Given this age range, Cathedral Cave appears to preserve a chronologic extension for *Microtus paroperarius* as well as extraordinarily young records of *Allophaiomys pliocaenicus*, *Phenacomys gryci*, and *Mimomys virginianus*. If these chronologic range extensions can be supported further through additional testing of the uranium-series data, then the degree to which these arvicoline taxa can be used to refine the age of faunal assemblages may be somewhat diminished.

Poster Session B

A CONTINUOUS PLIO-PLEISTOCENE VERTEBRATE RECORD FROM THE ANZA-BORREGO DESERT STATE PARK REGION, SOUTHERN CALIFORNIA: AN HISTORIC PRESPECTIVE

JEFFERSON, George, MARRS, Barbara, Anza Borrego Desert State Park, Borrego Springs, CA

The later part of the Anza-Borrego Desert State Park fossil record spans approximately 7 Ma, with no recognized breaks from the late Miocene through the late Pleistocene. Marine, fresh-water, and terrestrial assemblages include over 550 taxa ranging from pollen, brittle stars and colonial corals, to walrus and mammoths. Combined with long and complete sedimentary depositional sequences, these ecologically diverse fossil assemblages are an unparalleled North American paleontological resource. The Park's unique geologic setting along the west-

ern margin of the Salton Trough rift, provides a 25 Ma history of plate collisions, and continental crustal rifting and faulting. These events, together with the cutting of the Grand Canyon and deposition of a delta across the Trough by the ancestral Colorado River, and uplifting of the California Peninsular Ranges, have transformed the region from a northern extension of the ancient Sea of Cortez to deltaic estuarine and brackish waters, to a landscape of freshwater lakes and playas, streams, riparian woodlands and savannah-like brushlands, to the present arid Colorado Desert. The 249 species of marine organisms include carbonate platform, outer and inner shelf, and near shore tropical invertebrates and sharks, bony fish, sea turtle and marine mammals. These faunas predate the closing of the Isthmus of Panama. Spanning the Plio-Pleistocene and the Blancan-Irvingtonian boundaries in a 3.5 Ma conformable stratigraphic section, are some of the Park's richest and significant terrestrial fossil assemblages. 214 taxa of fresh water invertebrates, fish, amphibian, reptiles, birds and mammals are represented. Early vertebrate assemblages, and particularly lacertilians and rodents, reflect neotropic origins, and later assemblages exhibit holarctic affinities. The over 6 km-thick continuous depositional sequence contains several dated tephra and is temporally calibrated by paleomagnetic transects. The Anza-Borrego fossil record provides a unique opportunity to track climate, faunal and environmental changes through the Plio-Pleistocene of southwestern North America.

Poster Session B

DIFFERENTIATING PALEOECOLOGICAL PARTITIONING AND PRESERVATIONAL BIAS AMONG VERTEBRATE TRACE FOSSILS IN THE UPPER JURASSIC MORRISON FORMATION, BIGHORN BASIN, WYOMING: A CASE STUDY

JENNINGS, Debra, PLATT, Brian, HASIOTIS, Stephen, RETRUM, Julie, Univ.of Kansas, Lawrence, KS

Vertebrate trackways recently discovered in the Upper Jurassic Morrison Formation, Bighorn Basin, Wyoming, show differences in community composition, track quality, and associated facies. Taphonomical and preservational bias toward large vertebrate tracks and trackways makes it difficult to interpret paleoecological partitioning of organisms within assemblages of ichnofossils because trafficking by large vertebrates destroys traces produced by smaller organisms. Excellent preservation of tracks of both small and large vertebrates in the study area increases the likelihood that the observed assemblages represent the environmental preferences of different animals. Ichnofossils in sandbar deposits suggest that a diverse community of small dinosaurs, reptiles, and invertebrates frequented the exposed channel bars and banks. Large sauropod and theropod tracks are limited to trampled palustrine-lacustrine units and crevasse-splay deposits. Several trackways in the fluvial sandstone provide evidence of variable gait speeds. Variations in track quality and morphology correspond to changes in substrate saturation and clay content. Sauropod tracks in crevasse-splay deposits show changes in morphology matching changes in substrate saturation. Tracks in palustrine-lacustrine deposits vary in quality from completely trampled surfaces in wetter areas to preservation of distinct toe and pad impressions in areas where the carbonate mudstone was more cohesive.

Poster Session B

DIRE CIRCUMSTANCES IN LATE PLEISTOCENE RANCHO LA BREA: ENVIRONMENTAL FLUCTUATIONS REFLECTED IN CARNIVORE CRANIODENTAL MORPHOLOGY AND TOOTH WEAR

JETT, Kristin, McKENZIE, N. Ryan, OLSON, Joshua, ADAM, Peter, VAN VALKENBURGH, Blaire, Univ. of California, Los Angeles, Los Angeles, CA

Craniodental morphology associated with food acquisition and processing can provide insight into carnivore behavioral ecology. Craniodental features of temporally distinct conspecific populations can vary due to environmental conditions. For example, zygomatic breadth, canine size and carnassial (P4) length have previously been shown to increase in populations of carnivores that preferentially take larger prey. Previous studies of tooth wear indicate that North American Late Pleistocene carnivores experienced greater resource stress than extant counterparts and that stress varied over time. Here, we analyze temporal variation in craniodental morphology predictive of feeding behavior and degree of tooth wear in extinct dire wolves, *Canis dirus*, of Rancho La Brea, California.

Specimens were examined from Pits 13 (15,000 ybp) and 61/67 (12,000 ybp), covering the last glacial to interglacial transition in North America. Cranial size and relative blade length of m1 showed a significant increase from individuals of Pit 13 to Pit 61/67, while relative molar grinding area decreased. Tooth wear in a series of mandibles of known ontogenetic age also decreased, with Pit 13 individuals exhibiting greater tooth wear than those of Pit 61/67. Changes in dental shape and reduced tooth wear over time imply decreasing total carcass utilization and bone processing, both of which are expected to increase during times of environmental stress. Our results are consistent with previous studies of tooth breakage, with reduced fracture frequencies in Pit 61/67 as opposed to Pit 13 dire wolves. Taken together, dental wear, fracture, and morphometric data suggest a decline in competition among large carnivores, and increased food availability over the examined time span. Nevertheless, dire wolves declined to extinction within 2000 years, indicating a subsequent dramatic decline in environmental quality.

Wednesday 4:30

TWO NOTHOSAURIDS (REPTILIA, SAUROPTERYGIA) FROM THE ANISIAN (MIDDLE TRIASSIC) OF SOUTHWESTERN CHINA

JIANG, Da-yong, HAO, Wei-cheng, SUN, Yuan-lin, SUN, Zuo-yu, Peking Univ., Beijing, Peoples Republic of China; SCHMITZ, Lars, Univ. of California, Davis, Davis, CA

Similarity between Middle Triassic marine reptiles from southwestern China and the western Tethys realm has been proposed. In order to test this hypothesis, we have been collecting vertebrate fossils from the Pelsonian (middle Anisian) Panxian Fauna of Guizhou Province (southwestern China), which yields marine reptiles, including *Mixosaurus* (90% of individuals), a basal ichthyopterygian, a protorosaur, and two nothosaurids. We herein give a preliminary report on nothosaurid specimens.

The genus *Nothosaurus* is represented by a 348 mm long skull, exposed ventrally. The rostrum is marked by a distinctive constriction, and the maxilla carries paired fangs, which is a synapomorphy of *Nothosaurus*. The presence of five small maxillary teeth preceeding the fangs resembles the dentition of the coeval *N. marchicus*; however, the premaxillary teeth are different. Because data of the skull roof and the postcranium are lacking so far, it is identified as *Nothosaurus* sp.

The genus *Lariosaurus* is known from an almost complete skeleton with a preserved total length of 580 mm. The specimen can be identified as a representative of this genus based on three synapomorphies: the humerus is broadened at the mid-diaphysis, the ulna is broadened and slightly longer than the radius, and the manus has mild hyperphalangy. While the ratio of temporal fossa to orbit size corresponds in the range of *Lariosaurus*, the configuration of the postorbital bar differs. The postfrontal posteriorly forms the anteromedial margin of the upper temporal fossa and anteriorly narrows to enter the posteromedial margin of the orbit, where it separates the postorbital from the parietal. The postorbital forms a large part of the posterior orbital margin. The specimen is tentatively identified as a new species.

The *Nothosaurus* specimen is the second representative of this genus from southwestern China and outside the western Tethyan faunal province; the lariosaur is the oldest definite record of this genus known so far. The nothosaurids are a rare element in the Panxian Fauna, but further strengthen the paleobiogeographic affinities between Middle Triassic marine reptiles from South China and the western Tethys.

Poster Session B

HEMPHILLIAN CAMELIDS AND PROTOCERATIDS FROM SAN MIGUEL DE ALLENDE, GUANAJUATO STATE, CENTRAL MEXICO

JIMENEZ-HIDALGO, Eduardo, Universidad del Mar, Puerto Escondido, Oaxaca, , Mexico; CARRANZA-CASTANEDA, Oscar, Centro de Geociencias, Campus UNAM-Juriquilla, Queretaro, Mexico

The analysis of cranial and limb material recovered from several localities allowed us to significantly increase the knowledge of both groups in the area. Previously, only the camelids from the Rancho El Ocote locality were described.

The bearing strata consists of clay, sandy to silty clay with some lenses of volcanic ash and minor amounts of sand and gravel, which has been interpreted as floodplain and point-bar deposits. The associated mammalian fauna collected from the different beds indicates an age from the late early to the latest Hemphillian. Also, radiometric dates of 4.8 ± 0.2 Ma and 4.4 ± 0.3 Ma are available for two localities.

The camelid *Hemiauchenia vera* was identified from the late early to the latest Hemphillian, whereas *Alforjas* sp., *Megatylopus matthewi* and a small species of *Hemiauchenia* were recognized in the late and latest Hemphillian. The latest Hemphillian records of *Alforjas* sp. and *Megatylopus matthewi* are at present the youngest for North America, and together with the small species of *Hemiauchenia* are the southernmost records for this region.

The protoceratid *Kyptoceras*? sp. was identified in the latest Hemphillian. Its record is the first in the Pliocene of Mexico, extends the biochronologic range of Protoceratidae in the country from the middle Miocene to the earliest Pliocene and the paleogeographic range of Kyptoceratini from the Gulf Coastal Plain to central Mexico.

The latest Hemphillian tylopod species richness observed in San Miguel de Allende is higher than that of USA faunas, where three or four taxa are associated.

Previous studies of the probable feeding strategies of the identified taxa indicate that they were browsers or browser-like intermediate feeders. This suggests a significant component of shrubs and trees, in addition to grasses, in the study area during the Hemphillian.

Poster Session A

FUNCTIONAL ANATOMY OF THE BEAVER (*DIPOIDES STIRTONI*) FROM THE LATE MIOCENE OF OREGON

JOHNSON, Shawna, South Dakota School of Mines and Technology, Rapid City, SD; MARTIN, James, Rapid City, SD

A complete skeleton of a fossil beaver was collected from the Hemphillian Alkali Canyon Formation of the Dalles Group from a locality located just south of the town of Arlington, Oregon. Arlington is located in northeastern Oregon just south of the Columbia River. The locality was termed the Big Cut and was originally dug as an exploration for a proposed nuclear power plant. Funding for the nuclear project expired, and the locality was filled; today, the site exists under 30 meters of backfill. The specimen was taken to the Burke Museum,

Univ. of Washington, prepared by Beverly Witte, and found to be a complete skeleton.

The specimen is 99% complete, even possessing sesamoids. This beautifully preserved skeleton was osteologically compared to three extant taxa, *Castor canadensis*, *Ondatra zibethica*, and *Thomomys talpoides*, to determine functional morphology. After careful examination and comparison, the beaver is *Dipoides stirtoni*. *Dipoides stirtoni* probably lead a lifestyle similar to that of extant *Castor*, even though not directly phylogenetically linked. This conclusion indicates that *Dipoides stirtoni* is a product of parallel evolution.

Student Poster Session

A PALEOCLIMATIC LOOK AT THE EVOLUTION OF TORTOISES (TESTUDINIDAE) IN SOUTHWESTERN NORTH AMERICA

JONES, Cory, San Diego State Univ., San Diego, CA

Tortoises (Testudinidae), especially giant forms, have commonly been used as indicators of paleoclimate. The presence of giant, ancestral *Geochelone* in Eocene sediments in northern extremes of Canada has aided in the determination that tropical environments existed globally during that time. This is based partly on the fact that Giant tortoises, such as the modern day Galapagos tortoises, are unable to exist in regions that experience climatic extremes over an extended period. Temperatures that are too high result in overheating while long term exposure to temperatures below 13 & degC result in the loss of functionality of essential biological enzymes. Accordingly, these giants could not cope with extreme temperatures present in the deserts of the American Southwest. They did exist in this area until near the Pleistocene-Holocene boundary, when extreme desertification began.

To determine if tortoises can provide more detailed climatic information specific skeletal components of extant *Xerobates* and *Chelonoidis* from known localities were sampled to determine istopic-environmental correlations. Using these correlations stable isotopic variations in fossil tortoises have been interpreted to identify the timing of the major desertification of the American Southwest. Morphometric analyses of extant *Xerobates* and *Chelonoidis* along with extinct forms of *Xerobates* and *Hesperotestudo* were performed to analyze differences in shell morphology. Preliminary results show that as the climate became more extreme large tortoises were unable to cope with the climatic extremes that persisted. This resulted in an overall decrease in carapace length since the Pliocene, with the *Xerobates* becoming significantly smaller and the disappearance of the giant tortoise, *Hesperotestudo*.

Romer Prize Session, 10:30

PHYLOGENY AND ECOLOGY OF BASAL TURTLES

JOYCE, Walter, Yale Peabody Museum, New Haven, CT

Our understanding of the early evolutionary history of turtles (Testudinata) and their origin has long been limited by an inadequate appreciation of basal turtle ecology and by phylogenetic tree topologies based on simplifying assumptions regarding character evolution. In particular, the assumption that the different jaw closure mechanisms of pleurodires and cryptodires evolved independently forced the conclusion that the Triassic *Proganochelys quenstedti* was the only unambiguous stem turtle. Since the crown turtle clade is aquatic and *Proganochelys quenstedti* has also long been thought to be aquatic based on untested morphological correlations, close phylogentic relationships of turtles with other aquatic reptiles were argued to be more plausible.

A phylogenetic analysis was performed to test the primary assumptions that currently dictate turtle relationships. The data matrix used consists of 139 osteological characters with 174 derived character states for 45 fossil and 22 living species of Testudinata. The results of this analysis conflict with the prevailing consensus regarding the basal split of turtles, primarily by revealing that numerous turtles previously thought to be stem representatives of crown Cryptodira are more parsimoniously placed along the stem of crown Testudines. This topology implies that the pleurodiran jaw-closure mechanism must have evolved from a cryptodiran-type mechanism.

Assessing the ecology of ancient turtles has always proved problematic because there are only weak correlations between the habitat of a turtle and commonly used indicators such as shell morphology or depositional environment. Among many morphological characters that have been suggested for predicting habitat, relative hand length measured on living turtles proved to be a good predictor of turtle habitat independent of phylogeny in 71 species. Application of this correlation to fossil turtles shows that the turtle stem lineage must have lived predominantly on land. Therefore, the freshwater aquatic habitats so characteristic of living turtles cannot be taken as positive evidence for an aquatic origin of turtles but must rather be considered convergence.

Saturday 11:30

THE USE OF TOOTH WEAR EQUILIBRIUMS AS A TOOL IN ASSESSING ON UNGULATE HABITATS AND ENVIRONMENTAL CHANGE

KAISER, Thomas, Zoological Institute and Museum, Univ. Greifswald, Greifswald, Germany

Ungulates feed on a wide variety of vegetation types. Owing to the comparably low content of available nutrient components, in most mammals abrasive food requires extensive comminution by grinding. When present, the high degree of abrasiveness inherent to plant food mainly derives from phytoliths and grit contamination. Tooth wear is controlled by two major factors, attrition (tooth-tooth contact) and abrasion (food-tooth contact). The influence of these on the occlusal morphology of wear patterns leads to an equilibrium, which remains stable over considerably long periods of time. This equilibrium is therefore widely dependent upon the degree of abrasiveness of food comminuted. Both parameters, attrition and abrasion are also tightly related to the availability of certain plant food items in a given habitat. As an indicator of the attrition/abrasion equilibrium in herbivorous mammals, the morphology of cheek tooth apices is scored following the mesowear convention introduced by Fortelius and Solounias (2000). Wear signatures are correlated with those of extant ungulates with known diets and trophic reference taxa are identified for a fossil population under consideration. This leads to an assessment of the diet of extinct ungulates. The hypothesis tested here is whether taxa with a considerably wide trophic diversity (eg. extant zebras) can be employed as indicators for the structure of habitats and thus make it possible to differentially investigate the habitat parameters of extinct populations based on tooth mesowear.

As a comparative dataset zebra populations (*Equus burchellii*) from several African habitats and feral donkey populations from the Arabian Peninsula have been investigated for their mesowear signatures. Their habitats have precipitation means ranging from 100 mm (Arabia) to 1100 mm (Mozambique). It is found that dry environments shift the mesowear signature towards more abrasion, while the same species from a moister habitat shows more attrition. Mesowear is therefore found to indicate differential food availability in habitats and it is therefore considered a well suited tool for habitat characterization and tracing of climatic and environmental change.

Wednesday 2:45

NEW DATA ON THE CYNODONT FAUNA FROM THE TRIASSIC OF MADAGASCAR

KAMMERER, Christian, Univ. of Chicago, Chicago, IL; FLYNN, John, American Museum of Natural History, New York, NY; RANIVOHARIMANANA, Lovasoa, Universite d'Antananarivo, Antananarivo, Madagascar; WYSS, Andre, Univ. of California, Santa Barbara, Santa Barbara, CA

Recent fieldwork in the Middle/Late Triassic 'Isalo II' beds of southern Madagascar has produced a rich array of cynodont, dicynodont, rhynchosaur, and archosaur fossils. Cynodonts dominate in terms of species abundance. Here we report on new material and a new taxon of cynodonts from these deposits. A new specimen likely referable to *Menadon besairiei* includes the postcranium, which is intermediate in form between that of *Massetognathus* and *Exaeretodon*. The postcranial remains in this specimen are exceptionally preserved, retaining even such delicate elements as the cervical intercentrals. In particular, the pelvic and caudal elements are similar to *Exaeretodon*, but the expanded lumbar ribs are typical of earlier-diverging cynodonts. The skull of this new specimen, while fragmentary and edentulous, reveals several morphological details. A revised phylogenetic analysis confirms the position of this specimen (with the holotype of *Menadon*) as the the proximal outgroup to the clade consisting of *Exaeretodon* and *Scalenodontoides*. Additional traversodontid postcranial elements ar known from these deposits, although few are identifiable to species. One isolated pelvis may refer to *Menadon*, while another isolated pelvis similar to that of *Massetognathus* probably pertains to *Dadadon*. A new taxon of probainognathian is known from an isolated mandible. This mandible is unique in its extensively fused, upwardly curved symphysis. It is also unusual in having only two pairs of lower incisors, a condition known only in the tritheledontids among probainognathians. The 'Isalo II' cynodont fauna is extremely similar to that of the Santa Cruz do Sul of Brazil and contains faunal elements similar to both the Chañares and Santa Maria formations of Argentina.

Friday 8:15

TYPES OF TISSUES IN THE EXOSKELETON OF THE EARLY SILURIAN VERTEBRATES FROM SOUTH SIBERIA AND TUVA (RUSSIA)

KARATAJUTE-TALIMAA, Valentina, Institute of Geology and Geography, Vilnius, Lithuania; MEREDITH SMITH, Moya, Dental Institute KCL, London, United Kingdom; ZIGAITE, Zivile, Vilnius Univ., Vilnius, Lithuania

Early vertebrates are common in the Lower Silurian (Llandovery & Wenlock) of Tuva and South Siberia. The microremains appear in a wide range of facies of the Siberian Platform, including bar belt, restricted shallow shelf, brackish lagoon and coastal belt facies (Karatajute-Talimaa & Predtechenskyj, 1995) as well as in shallow water facies of Tuva. The micromaterial contains various taxa including Thelodonti (genera *Angaralepis*, *Laganellia*, *Talimaalepis*), Tesakoviaspida (genus *Tesakoviaspis*), Anaspida (new genus), Osteostraci (gen. indet.), Galeaspida? (*Ilimia* gen. nov.), Chondrichthyes (*Elegestolepis*, *Polymerolepis*?), Mongolepidida (*Udalepis* gen.nov.), Acanthodii (*Lenacanthus*, *Tchunacanthus*), as well as the microremains of an uncertain taxonomic assignation. The crown part of the early vertebrate scales and tesserae comprise three main tissue types and several subtypes: Dentine tissues: 1) Irregular thin canal dentine—*Loganellia asiatica*, *L.sibirica*, 2) Regular thin canal dentine (orthodentine)—*Angaralepis moskalenkoae*. 3), Thick canal dentine—*Talimaalepis rimae*, 4) Mesodentine—*Elegestolepis conica* , *Polymerolepis*? sp.nov., and 5) Cellular mesodentine—*Lenacanthus priscus, Tchunacanthus obruchevi*. Lamelline tissues: 1) Lamelline (simple)—*Udalepis forata*, *Tesakoviaspis concentrica*, 2) Conical lamelline—*Tesakoviaspis concentrica*. Aspidin—scales of new genus with typical anaspid morphology and histology (a well developed vascular canal system). The basal part of the exoskeletal microremains include another three tissue types: 1) Cellular bone with very simple bone cells—*Elegestolepis conica*, 2)

Cellular bone—Len*acanthus priscus, Tchunacanthus obruchevi* and 3) Aspidine (acellular bone)—Galeaspida? (*Ilimia* gen.nov.), Thelodonti, Tesakoviaspida, Mongolepida and Chondrichthyes.

Poster Session B

REMOTE DETECTION OF FOSSILS USING INFRARED SPECTROSCOPY

KAYE, Thomas, CAVIGELLI, Jean-Pierre, Tate Museum, Casper, WY

The field of geology has broadened its horizons outside our planet with the Mars rovers Spirit and Opportunity spending the last year doing autonomous analysis of that planet's mineralogy. With the detection of geologic processes indicating water once flowed on Mars, the next step would be detecting life in the form of fossils. Robot geologists must run autonomously and make decisions based on pre-programmed software. The Mars rovers utilize a thermal emission spectrometer to look for and characterize infrared spectral signatures and are able to automatically identify minerals at distances from tens to hundreds of meters. Libraries of Earth based mineral spectra exist and the rovers have now compiled a library of Mars mineral signatures, but no corresponding library of fossil spectra exists. This work represents the first step and looks to see if indeed fossils exhibit characteristic signatures in the infrared and if they are sufficiently distinct to allow for automated follow up observations. Material from the Cretaceous and Eocene are spectroscopically examined in the mid-infrared to determine their characteristics. The potential for discrimination from the background matrix is discussed. This work may have applications for identifying fossils in the field as the next generation of spectrometers become more portable and sensitive.

Wednesday 2:00

UNSOLVED MYSTERIES: SCULPTING THE SOFT TISSUE ANATOMY OF A TYRANNOSAUR BUST

KEILLOR, Tyler, Univ. of Chicago, Chicago, IL

Reconstructing the life appearance of a small tyrannosaur for display at the Burpee Museum in Rockford, Illinois, revealed some of the challenges artists face in executing a flesh restoration. The Burpee Museum assembled a team of paleontologists to act as advisors to the reconstruction, and the latest theories were applied to the process. The bust of this theropod, nicknamed Jane, was sculpted directly over a cast of the reconstructed skull. The skull itself proved a tremendous aid in determining the shape and placement of soft features such as nostrils, eyes, ear openings, and jaw muscles. The presence or absence of lips has not achieved scientific consensus, so the artist must perform extensive comparative anatomical observations to support the final rendering. The extent of jaw closure in the live tyrannosaur, (not the fossilized skull), may be important to understand, as this one variable can greatly impact the soft tissue features reconstructed around the mouth. The flip side of pursuing scientific accuracy can be the pressure to satiate the musuem-goer's desire to see a bloodthirsty monster. Ideally, the dinosaur can be presented realistically; neither injecting fantasy nor concealing the speculation necessary to flesh-out an extinct animal.

Wednesday 9:30

NEW EXTREMELY WELL PRESERVED PTEROSAUR SOFT TISSUE FROM THE ARARIPE BASIN (BRAZIL) AND DISCUSSION OF THE PTEROSAUR WING MEMBRANE

KELLNER, Alexander, Museu Nacional/UFRJ, Rio de Janeiro, RJ., Brazil; LINE, Sergio, Universidade Estadual de Campinas-UNICAMP, Campinas, Brazil; CAMPOS, Diogenes, DNPM, Rio de Janeiro, Brazil; GOBBO-RODRIGUES, Silvia, Museu Nacional/UFRJ, Rio de Janeiro, Brazil; SAYAO, Juliana, Museu Nacional/UFRJ, Rio de Janeiro, Brazil

Pterosaur soft tissue has been found in several specimens but most are preserved as impressions. Truly three-dimensional fossilized soft tissue was only reported in one calcareous nodule from the Romualdo Member (Aptian-Albian), Santana Formation and consists of the integument covering the body. Here we report a second specimen (MN 6575-V) with extremely well preserved soft tissue from this *lagerstaette*. The material is composed of a partial wing, cervical vertebrae and posterior region of the skull. The preserved soft tissue is located in an anterior position between the humerus and the radius and ulna, indicating that it is part of the propatagium. All identified structures are phosphatized, a common feature in this deposit. SEM analyses show several layers of sub-parallel closely packed fibers (=structural fibers) that are placed above each other but oriented in different directions, forming in some areas a criss-cross pattern. Structures compatible with axons are frequently observed adjacent to the muscle fibers. Other structures are occasionally found connecting muscle fibers and are interpreted as elastic fibers. Blood vessels are common, indicating that this region was extensively irrigated. The presence of structural fibers or actinofibrils has been reported in several pterosaur wing membranes but their true nature was unknown. MN 6575-V clearly shows that those structures in the propatagium are muscle fibers, and it is very likely that they were also de major component of the cheiropatagium (and uropatagium). This new specimen suggests that the pterosaur wing membrane consists of a multi-layered structure composed of two external layers of epidermis (with hair-like structures) and several internal layers of muscle fibers, which are oriented in more than one direction. Pterosaurs found in other deposits (e.g., Yixian Formation) show the same features supporting this model of the pterosaur wing membrane. The presence of muscle in the wing of pterosaurs would permit changes in the membrane tension during flight allowing an accurate control of flight movements. Additionally, it would also help to organize the membrane when the animal was not flying.

Poster Session A

WATER MOLES (DESMANINAE, LIPOTYPHLA) FROM THE PLIOCENE REUVER CLAY OF NORTH-WEST GERMANY AND THEIR DISTRIBUTION IN EUROPE

KERSTING, Roland, Univ. of Bonn, Bonn, Germany; MOERS, Thomas, Swedish Museum of Natural History, Stockholm, Sweden

The Hambach open-cast lignite mine (RWE Power AG, Cologne) in NW-Germany provides an excellent record of Neogene continental deposits. During the last few years, rich vertebrate faunas from the middle Miocene and the Pliocene/Pleistocene boundary have been found here. Faunas from the Pliocene Reuver Clay have been assigned to MN 16a of the European mammal zonation. In terms of diversity and the number of fossils, the Pliocene faunas from Hambach represent the richest Central European assemblage of small mammals from this time.

Today, two monospecific genera of semi-aquatic desmans are known: *Galemys pyrenaicus*, which is found in the Pyrenees and the northern part of the Iberian Peninsula, and *Desmana moschata*, found in Russia, Belarus, Ukraine and Kazakhstan. A much greater diversity is known from the fossil record. Desmans have been represented in Eurasia by seven genera since the late Oligocene (*Mygatalpa*, *Mygalea*, *Mygalinia*, *Storchia*, *Archaeodesmana*, *Desmana*, and *Galemys*). *Lemoynea biracularias* from the late Miocene of Nebraska is the only known desman from the New World.

On the basis of excellently preserved teeth, maxillary and mandibular fragments, three species from two genera are identified in the Pliocene Reuver Clay from Hambach: *Galemys kormosi*, *Desmana nehringi*, and *Desmana thermalis*. For *Galemys kormosi* and *Desmana thermalis* Hambach provides the oldest records. They are widespread in Europe during the Pleistocene, but rarely appear in older localities. *Desmana nehringi* is already known from localities older than Hambach. It is more common in Eastern Europe and seldom appears in Central and Western European localities.

Poster Session A

HOMINID AND OTHER VERTEBRATE FOOTPRINTS FROM THE LATE QUATERNARY STRATA OF JEJU ISLAND, KOREA

KIM, Jeong Yul, Korea National Univ. of Education, Chungbuk, Republic of Korea; KIM, Kyung-Soo, Chungbuk Science High School, Cheongwon, Chungbuk, Republic of Korea; KIM, Sam Hyang, Korea National Univ. of Education, Cheongwon, Chungbuk, Republic of Korea; LEE, ChangZin, Chungbuk National Univ., Cheongju, Chungbuk, Republic of Korea; LIM, Jong Deock, Seoul National Univ., Seoul, Republic of Korea

Numerous footprints attributable to hominids, artiodactyls, proboscideans, carnivores and birds occur in the upper Quaternary Hamori Formation, which is composed of tuffaceous sediments deposited on the shoreline environment. Hominid footprints are 21 to 25 cm long and are characterized by impressions of medial arch, heel, and ball. These are considered to be made by at least three humans including a child, a subadult, and an adult. Artiodactyl footprints are up to 7 to 8 cm in length and characterized by impressions of paired hooves. Diverse size ranges of footprints indicate herds of artiodactyla composed with juvenile, young, and adult. Footprints attributable to proboscideans are characterized by large circular tracks about 40 cm in diameter. Carnivore footprints are generally characterized by impressions of pad and toes. Diverse bird footprints are recognized on the basis of size, length/width ratio, interdigital angles, curvature of digits, and presence or absence of web and hallux. Fish trails, diverse invertebrate trace fossils, and body fossils are also observed. These fossils enable us to extend the geographic distribution of them uncommonly reported throughout the world and to interpret the paleoenvironment and paleoecology of the Homori Formation.

Poster Session A

BIRD TRACKS FROM THE CRETACEOUS HAMAN FORMATION OF CHANGSEON AND SINSU ISLANDS, SOUTH KOREA

KIM, Kyung-Soo, Chungbuk Science High School, Cheongwon, Chungbuk, Republic of Korea; KIM, Jeong Yul, Korea National Univ. of Education, Chungbuk, Republic of Korea; KIM, Sam Hyang, Korea National Univ. of Education, Cheongwon, Chungbuk, Republic of Korea; KIM, Ji Su, PARK, Tae Woan, HAN, Tae Hee, Chungbuk Science High School, Cheongwon, Chungbuk, Republic of Korea; LOCKLEY, Martin G., Univ. of Colorado at Denver, Denver, CO

Numerous well-preserved bird tracks were discovered from the Lower Cretaceous (Aptian-Albian) Haman Formation of Changseon and Sinsu Islands on the southern coast of Korea. The bird tracks, characterized by prominent posteriorly-directed hallux impressions and semi-palmate webs, are herein described as *Ignotornis yangi*. The ratio between length and width of *I. yangi* is 0.73 which is similar to that of *Hwangnipes choughi* from the Upper Cretaceous (Cenomanian) Uhangri Formation. However, *I. Yangi* is about 20-25% smaller than *H. choughi* and nearly similar in size to *I. mcconnelli* from the Dakota Sandstone. The development of the web of *I. yangi* is similar to *I. mcconnelli*. Additionally, birds tracks including *Jindongornipes kimi*, cf. *J.* ichnosp. and *Koreanaornis hamanensis*, pterosaur tracks, *Pteraichnus* ichnosp., sauropod and theropod tracks and dinosaur egg nests were also found. The bird tracks and trackways may show a range of behaviors such as seeking, chasing, and wavering which prob-

ably change depending on the trackways width. This track record can be particularly instructive in adding information on behavioral aspects of shorebirds and diversity and abundance in the middle Cretaceous.

Poster Session A

MESADACTYLUS AND OTHER NEW PTEROSAUR SPECIMENS FROM THE MORRISON FORMATION (UPPER JURASSIC) OF WESTERN COLORADO

KING, Lorin, Louisiana Delta Community College, Monroe, LA; FOSTER, John, Museum of Western Colorado, Grand Junction, CO; SCHEETZ, Rodney, Brigham Young Univ., Provo, UT

New specimens collected recently indicate the presence of the pterodactyloid pterosaur *Mesadactylus ornithosphyos* at the Kings View Quarry near Fruita and of indeterminate pterosaurs at the Mygatt-Moore Quarry in Rabbit Valley and the Uravan Site, all in western Colorado. The Kings View Quarry yielded juvenile *Camarasaurus*, juvenile *Stegosaurus*, a theropod tooth, crocodilian teeth, *Glyptops* shell, and an *Opithias* jaw. It also has produced a pterodactyloid right radius, right first wing phalanx, rib(?), and manual(?) phalanx (digit I, II, or III). The radius and first wing phalanx match those of *Mesadactylus ornithosphyos* from the Dry Mesa Quarry and are assigned to that species. This makes *Mesadactylus* the first pterosaur genus in the Morrison Formation to be identified at a site in addition to its type locality; all other Morrison pterosaurs are single occurrences. The pterosaur specimen from the Mygatt-Moore Quarry represents the first new species from that site in a number of years and is one of the few small vertebrates ever found at this locality, which has yielded thousands of bones over the years, mostly of *Apatosaurus*, *Allosaurus*, *Camarasaurus*, and *Mymoorapelta*. The Mygatt-Moore Quarry represents an apparent floodplain mud/water hole, and the pterosaur specimen consists of a single, hollow indeterminate wing bone shaft. The fragmentary specimen from the Uravan Site may be a "rhamphorhynchoid" and consists of many very fragmentary bones, apparently from a single individual.

Poster Session A

DINOSAUR REMAINS FROM THE LOWER TO MIDDLE CAMPANIAN WAHWEAP FORMATION AT GRAND STAIRCASE-ESCALANTE NATIONAL MONUMENT, SOUTHERN UTAH

KIRKLAND, James, DEBLIEUX, Donald, Utah Geological Survey, Salt Lake City, UT

Based on teeth collected during the search for microvertebrates, the Wahweap Formation has been noted as preserving North America's most diverse lower to middle Campanian dinosaur fauna, having nine taxa identified from teeth. Significant skeletal material has only recently become available for study, due to a systematic inventory of fossil localities in the lower sandstone and middle mudstone members of the Wahweap Formation in the southern Kaiparowits Plateau. Ceratopsian cranial remains indicate the presence of a long-horned centrosaurine of moderate size (skull length of ~ 1 m); the best preserved ot these skulls still awaits airlift out of the backcountry. A team from the Univ. of Utah working with the authors recovered a frontoparietal dome from a pachycephalosaur from the middle mudstone member. Although worn from transport, the specimen appears to represent a new species as it is unique in the possession of a narrow triangular nasal buttress. Additionally, several hadrosaur bone beds and/or associated skeletons have been identified. Excavations of these Wahweap fossil localities are only just beginning, and to date only one specimen identifiable to genus has been recovered. This is a complete jugal that compares best with Brachylophosaurus, which would represent the oldest and most southern occurrence of this Middle Campanian genus.

Poster Session B

REVISITING THE TAXONOMY OF DIADECTIDAE (COTYLOSAURIA: DIADECTOMORPHA): A PHYLOGENETIC APPROACH

KISSEL, Richard, REISZ, Robert, Univ. of Toronto, Mississauga, ON, Canada; BERMAN, David, Carnegie Museum of Natural History, Pittsburgh, PA

The Diadectidae, a clade of Permo-Carboniferous diadectomorph cotylosaurs, appear to represent the oldest known evolutionary radiation of high-fiber terrestrial herbivores. Members of this clade have a wide geographic distribution, are commonly found in continental sediments of the Laurasian part of Pangaea, and are currently represented by seven genera and thirteen recognized species. Although several new genera and species have been described during the last decade, little is known about the true taxonomic diversity of diadectids and the species level phylogeny of the clade.

Reported here are the preliminary results of the first phylogenetic analysis to incorporate all well-known diadectid species: *Ambedus pusillus*, *Orobates pabsti*, *Desmatodon hesperis*, *Diasparactus zenos*, and the six species currently referred to the genus *Diadectes*. In all trees produced thus far, *Diadectes absitus* and *Diadectes sanmiguelensis* consistently fall outside the clade formed by *Diasparactus zenos* and all other species of *Diadectes*. Furthermore, all of the characters cited in the original diagnosis of *D. sanmiguelensis*, and at least one in that of *D. absitus*, are shown to be primitive, appearing earlier in the evolutionary history of Diadectidae or present in the non-diadectid diadectomorphs *Limnoscelis* and *Tseajaia*. These preliminary results, not surprisingly, demonstrate that the currently accepted taxonomy of Diadectidae is in need of review, and until more data is gathered and diadectid interrelationships can be further tested by the authors, the assignment of *D. absitus* and *D. sanmiguelensis* to the genus *Diadectes* should be considered tenuous.

Saturday 9:15

BONE HISTOLOGY AND GROWTH OF THE PROSAUROPOD DINOSAUR _PLATEOSAURUS ENGELHARDTI_ MEYER,1837 FROM THE NORIAN BONEBEDS OF TROSSINGEN (GERMANY AND FRICK (SWITZERLAND)

KLEIN, Nicole, SANDER, Martin, Univ. of Bonn, Bonn, Germany

Predominately long- and flat bones of the prosauropod *Plateosaurus engelhardti* from the Norian localities of Trossingen and Frick were sampled for paleohistological study. Both localities yield rich material of adult individuals with a body size of 4.70 m to 10 m. Altogether 50 bones from approximately 27 individuals were sampled by different methods (coring, cross sectioning, analysis of existing fracture surfaces). Most bones consist of the laminar fibrolamellar complex, always cyclically interrupted by lines of arrested growth (LAGs). In some bones, the laminar fibro-lamellar complex changed in the exterior cortex to lamellar-zonal bone, later grading into avascular lamellar bone. Thus, growth was clearly determinated in *P. engelhardti*. Like most other dinosaurs *Plateosaurus engelhardti* shows high growth rates, indicating an advanced ('dinosaurian') physiology. On the other hand, *Plateosaurus engelhardti* shows a strong dependency on environmental conditions. Additionally, its final size is represented by a very broad range (between 6.5 m to 10 m). Both reflect a more reptilian growth pattern as is known from other dinosaurs. It marks the basal status of *Plateosaurus engelhardti*. Thus, in *Plateosaurus* the foundation is seen for the evolution of gigantism in sauropods.

Poster Session B

THEROPOD TEETH FROM THE BERRIASIAN OF ANOUAL (MOROCCO)

KNOLL, Fabien, Staatliches Museum für Naturkunde, Stuttgart, Germany; RUIZ-OMENACA, Jose Ignacio, Universidad de Zaragoza, Zaragoza, Spain

The locality of Anoual (Morocco) has produced one of the most diverse assemblages of Mesozoic microvertebrates in Africa. With respect to dinosaurs, both ornithischians and saurischians are very well represented. Precise identification of the theropod remains is difficult due to the incomplete nature of the specimens as well as to our poor knowledge of the systematics of this group during earliest Cretaceous times.

Exclusive of the teeth that cannot be identified beyond Theropoda, preliminary results suggest that all the specimens belong to coelurosaurs. Unserrated teeth have been assigned to Coelurosauria indet., whereas teeth recalling those of compsognathids and some dromaeosaurids and troodontids by the restriction of the denticles to the distal edge have been tentatively identified as Maniraptora indet. Other teeth having the mesial denticles smaller than the distal ones have been identified as Velociraptorinae indet. Finally, some teeth with grooved enamel could be related to "paronychodontids". Maniraptorans constitute the major fraction of the taxa sampled and possibly three distinct species of velociraptorines are present. Some of the largest specimens belong to this subfamily, but they are barely from middle-sized animals: most of the Anoual theropod record is from diminutive individuals.

In Africa, the Jema River localities (which have yielded teeth of indeterminate theropods and of an allosauroid) are distant from Anoual (Ethiopian) and somewhat older (tithonian). From both a paleogeographic and stratigraphic point of view, the closest theropod sites to Anoual are situated out of Gondwana, in the Iberian Peninsula. Nevertheless, only very few specimens have been recorded there to date and they are not suitable for precise systematic allocation. Merely the presence of Coelurosauria could have been established in the Galve area (Spain) in a level close to the Jurassic-Cretaceous boundary.

Poster Session B

ANATOMY OF _TOYOTAMAPHIMEIA MACHIKANENSIS_ (CROCODYLIA) FROM THE PLEISTOCENE OF JAPAN AND REASSESSMENT OF ITS PHYLOGENETIC STATUS

KOBAYASHI, Yoshitsugu, Hokkaido Univ. Museum, Sapporo, Japan; TOMIDA, Yukimitsu, National Science Museum, Tokyo, Japan

Toyotamaphimeia machikanensis from the Pleistocene sediments of the Osaka Group in Osaka Prefecture was originally described as a new species of a modern genus, "*Tomistoma machikanense*", but a later study recognized it as a new genus by having the largest maxillary teeth at 7th tooth position and suggested affinities with *Crocodylus*. Its phylogenetic position still remains unresolved because published anatomical data is limited to cranial features despite the completeness of the specimen (a nearly complete skeleton, missing most of caudals and parts of limb elements).

The anatomy of *Toyotamaphimeia* was re-examined, and a preliminary phylogenetic analysis was conducted with 164 characters for 63 taxa (two outgroups). The analysis produced 1128 most parsimonious trees of 532 steps. The strict consensus tree suggests that *Toyotamaphimeia* is placed within the clade of Tomistominae. This analysis demonstrates that the monophyly of Tomistominae is supported by four unambiguous synapomorphies: deep constricted splenial symphysis, dentary straight between fourth and tenth alveoli, suborbital fenestra without posterior notch, nasals excluded from naris, and nasals and premaxillae in contact. Three of them (excluding suborbital character) are present in *Toyotamaphimeia*, and are related to longirostry.

Although previous studies stated that the largest alveolus diameter in the maxilla of *Toyotamaphimeia* was the seventh tooth, the twelfth and thirteenth maxillary teeth are actually larger than the seventh. In the maxillae, posterior teeth are more closely placed than anteri-

or ones and meet with corresponding dentary teeth when the mandible is occluded, whereas the anterior teeth of the maxilla are placed lateral to the dentary teeth, suggesting that posterior jaws may have been used for crushing.

Saturday 11:45

TECTONICS-REGIONAL CLIMATE FORCING OF MIOCENE UNGULATE SPECIES DIVERSITY IN THE WESTERN UNITED STATES

KOHN, Matthew, Univ.of South Carolina, Columbia, SC; FREMD, Theodore, John Day Fossil Beds National Monument, Kimberly, OR

Species diversity is strongly correlated with habitat diversity. For the Miocene of the western US, tectonics and regional climate appear to have been major controls on habitat diversity, yielding a profound rise and subsequent fall in ungulate diversity. Diversity of artiodactyls and equids in the western US is well known to have increased through the Hemingfordian, reached a maximum in the Barstovian and Clarendonian, and then decreased gradually from the late Clarendonian to the present. Various explanations have been advanced for this pattern, including global and regional factors such as changing temperature, precipitation amount, or CO_2 levels, grassland expansion, floral-faunal coevolution, etc. However, global climate factors are (largely) irrelevant unless they can be shown to have had a regional effect, and all regional factors influencing habitat diversity must be considered. In the northwestern US, global climate change was manifested regionally by increased rainfall amounts, and a shift to increased seasonality by 16 Ma, with consistently high seasonality by 10 Ma. As indicated by paleosols, mid-Miocene productivity was probably only moderate, because a 800 m topographic barrier (the western Cascades) cast a significant rain shadow. Block faulting and rifting in the northern Basin and Range initiated ~20 Ma, and major extensional activity at 15-16 Ma must have radically increased topographic variability by the mid-Miocene. Modern studies show that highest species diversity occurs in areas with moderate rainfall (habitat mosaics) and high topographic variability, whereas low species diversity occurs with very high or very low rainfall (habitat coalescence) and low topographic variability. Thus the mid-Miocene maximum in species richness was plausibly a result of the coordination of moderate productivity plus topographic variability, in turn driven by global climate change and regional tectonics. The subsequent decrease in species diversity was due to regional drying, decreased productivity, and habitat coalescence, resulting from global cooling and increased topographic uplift of western ranges.

Friday 8:45

A NEARLY COMPLETE SKELETON OF *ERNANODON* (MAMMALIA, ERNANODONTA) FROM MONGOLIA: FUNCTIONAL ANALYSIS

KONDRASHOV, Peter, Northwest Missouri State Univ., Maryville, MO; AGADJANIAN, Alexandre, Paleontological Institute RAN, Moscow, Russian Federation

Ernanodon is an enigmatic Asian mammal that was known only from late Paleocene deposits of China. Here we document the first record of *Ernanodon* from Mongolia, represented by a nearly complete skeleton from the late Paleocene (Gashatan) of the Tsagan Khushu locality. New specimens give a unique opportunity to understand the lifestyle and habits of this rare mammal and reevaluate the arguments used to establish the phylogenetic relationships of this genus. Functional analysis revealed that *Ernanodon* had very strong forelimbs with large claws and used its forelimbs for scratch-digging. In this type of digging most efforts are used to: 1) flex (retract) the humerus; 2) extend the elbow joint; 3) pronate the arm; 4) fix the wrist to eliminate the rotation; 5) prevent extension of the digits (counter-flexion). Judging from the humeral and scapular morphology, major flexors (=retractors) of the humerus (m. teres major and m. ectopectoralis) were very well developed in *Ernanodon*. The extensors of the elbow joint were very well developed in *Ernanodon*, which is indicated by a large lateral epicondylar crest and elevated deltopectoral crest of the humerus. The estimated olecranon/ulna ratio in *Ernanodon* is about 35 %, which is 3-4 times greater than in scansorial mammals, but less than in subterranean diggers such as mole-rats (50-65 %). Mongolian *Ernanodon* had four sacral vertebrae. Its pelvis was completely different from that any of the known xenarthran by the nature of the sacro-pelvic articulation, absence of sacroischial fenestra and overall shape of the pelvic bones. The pelvis and femur of *Ernanodon* were very similar to the corresponding bones of palaeanodonts. Character analysis does not support the idea of referral of *Ernanodon* to Xenarthra. Dental, scapular, sacro-pelvic and femoral morphology differs substantially between these two groups. Numerous existing similarities of the postcranial skeleton of *Ernanodon* and Palaeanodonta are the result of both same origin and convergence, so we conclude that Ernanodonta and Palaeanodonta are sister-groups.

Student Poster Session

SOLVING TAXONOMY OF *PLATECARPUS* (SQUAMATA: MOSASAURIDAE) IN NORTH AMERICA, USING NEW SPECIMENS FROM THE LOWER PART OF THE SMOKY HILL CHALK MEMBER (UPPER CONIACIAN-LOWER SANTONIAN), NEAR UTICA, KANSAS, U.S.A.

KONISHI, Takuya, Univ. of Alberta, Edmonton, AB, Canada

Two exceptionally well-preserved specimens of *Platecarpus* at the Univ. of Alberta Laboratory for Vertebrate Paleontology, UALVP 24240 and UALVP 40402, are described for the first time. The specimens were collected from the Smoky Hill Chalk Member of the Upper Cretaceous, near Utica, west-central Kansas in the 1970s. At least one of the specimens shows mixed specific diagnostic characters according to the conventional classification scheme (Russell, 1967), by having two anteriorly diverging rows of mandibular nerve exits on one dentary and two parallel rows on the other, supporting the synonymyzation of *P. coryphaeus* with *P. ictericus*.

Contrary to most recent studies, however, this study suggests that there are three valid *Platecarpus* species in North America instead of two; i.e., *P. tympaniticus*, *P. ictericus*, and *P. planifrons*. The generic type, *P. tympaniticus*, is in a state of taxonomic flux due to both the lack of a formal specific diagnosis, and the limited and partially unprepared type and only specimen of the species. The fragmentary basioccipital-basisphenoid complex as well as the right quadrate associated with the specimen only exhibit generically diagnosable characters, providing no species-specific characters to compare it with other congeneric species. Due to the reasons mentioned above, the synonymization of *P. ictericus* with *P. tympaniticus* is rejected, and the two UALVP platecarpine specimens are assigned to *P. ictericus*.

Poster Session B

THE NEW AND IMPROVED *CAMARASAURUS LEWISI* (DINOSAURIA: SAUROPODOMORPH) TORSO

KOZISEK, Jacqueline, Univ. of New Orleans, New Orleans, LA

Camarasaurus is usually depicted with a bulky and round torso. However, *Camarasaurus lewisi* (BYU 9047) shows a relatively narrow and volumetrically smaller torso than previously believed. BYU 9047 was an excellent subject since twenty-one of the twenty-four ribs were preserved, and left ribs 10 and 11 were preserved articulated to the dorsal vertebrae.

The new torso shape was obtained by reconstructing the torso as both physical and digital models. The physical model allowed for manual manipulation of the dorsal vertebrae/rib articulation. The three-dimensional digital model allowed for the addition of muscle information, and afforded views from multiple angles that could not be studied in the physical model.

The new reconstruction has many implications for the functional morphology of the pectoral assembly, bulk density, and the overall morphology of this well-known animal.

Thursday 2:00

THE AGE OF THE HSANDA GOL FORMATION, MONGOLIA AND IMPLICATIONS FOR TIMING OF THE MONGOLIAN REMODELLING

KRAATZ, Brian, Univ. of California, Berkeley, CA; GEISLER, Jonathan, Georgia Southern Univ., Statesboro, GA

The Hsanda Gol Formation of Mongolia is best known for its prolific remains of Oligocene fossil mammals. It has added significance because it is the only Asian fauna of Oligocene age that has been dated radiometrically; local flood basalts within the formation (~31.5 Ma) have placed the fauna found below them within the early Oligocene.

This study presents the first detailed paleomagnetic analyses of sediments from the Hsanda Gol Formation, which further constrains its age as well as relevant East Asian Land Mammal Ages represented within the unit. Six stratigraphic sections from the localities of Loh and Tatal Gol, discovered by the Central Asiatic Expeditions in the 1920s, and Tatsin Gol were measured and sampled. All three localities show a persistent reversed zone below the local lava that we correlate to Chron C12r of the Geomagnetic Polarity Time Scale (GPTS). One section (Tatsin Gol), which spans a conformable transition between the Hsanda Gol Formation and underlying Elegan Formation, shows a an interval of normal polarity at the base of the Hsanda Gol Formation that we provisionally interpret as Chron C13n. Further study on the potential influences of flood basalts to the remnant magnetization of these sediments is needed before final conclusions can be made.

The possible appearance of Chron C13n at the base of the Hsanda Gol Formation would allow for a revised maximum age of 33.5 Ma to be attributed to the Hsanda Gol Formation, which in turn would also better constrain the age of the Hsandagolian Land Mammal Age. If correct, the Asian faunal change named the Mongolian Remodelling would be nearly synchronous with the Eocene/Oligocene boundary and is older than had been suggested based on biostratigraphic correlation to faunas within Europe.

Friday 1:30

RESULTS OF AN EXPERIMENT IN AVIAN TAPHONOMIC PROCESSES REVEAL A MECHANISM FOR THE SUB-AQUEOUS DEPOSITION OF BIRD REMAINS

KRAUSS, David, PETRUCELLI, Jillian, LINCOLN, Taylor, Boston College, Chestnut Hill, MA

Most animal fossils, including bird fossils, form when the carcass is deposited in an aqueous environment and subsequently buried by sediment. A fundamental dilemma in avian taphonomy is that birds float, making sub-aqueous deposition difficult. We have conducted a series of experiments in order to resolve this dilemma and believe that we have arrived at the most likely process for avian deposition. We obtained a quantity of dead birds (passerines and columbiforms) that we placed in bins containing one of a variety of sediment types with or without water. All of the birds placed in bins with water floated initially.

Birds that were allowed to decompose naturally while floating eventually sank. Non-pneumatic bones were dense enough to sink immediately, but pneumatic bones buoyed the entire carcass. It was determined that decomposition of the air sac membrane allowed water into the hollow bones causing them to sink. This conclusion was verified by observations in the lab. Although decomposition at the water's surface is a possibility, the 3-4 weeks it takes (during

summer) makes it extremely unlikely that many specimens fossilize in this manner.

We therefore experimented with other ways to keep bird carcasses submerged under natural conditions. We discovered that if a bird carcass lands on an exposed (not submerged) wet muddy bottom it will remain submerged even under turbulent water. Within a few seconds clay and mud soak into the bird's feathers forming causing the carcass to adhere to the bottom. This mechanism worked 100% of the time in our experiments while other mechanisms produced widely varying results.

Finally, specimens were covered with sediment and allowed to sit under pressure for approximately three years. We prepared these specimens as if they were real fossils and found a high correlation between the patterns of preservation in our samples and actual bird fossils. Comparison of our experimental results to actual fossils gives us a high degree of certainty that we have arrived at the primary taphonomic process involved in avian fossilization. These findings may bear significantly on the interpretation of paeloenvironments.

Saturday 9:00

PHYLOGENY AND FOSSIL RECORD OF SQUALIFORM SHARKS (CHONDRICHTHYES, NEOSELACHII)

KRIWET, Jurgen, LMU Munich, KLUG, Stefanie, LMU Munich, Munich, Germany

Squaliform sharks constitute a monophyletic group of predominantly deep-water neoselachians with a fossil record extending back into the Barremian. Their interrelationships were examined using dental features for fossil and extant, and molecular data for extant taxa alone. Both data sets display high potential for reconstruction phylogenetic relationships within squaliforms but more taxon sampling and character definition is necessary to gain a better understanding of their evolutionary patterns. Eleven partial phyletic trees including dental, skeletal, and molecular data of squaliform interrelationships were merged to create a comprehensive phylogenetic hypothesis. The resulting supertree is the most inclusive estimate of squaliform interrelationships that has ever been proposed and contains 17 extant and six exclusively fossil members of all intraordinal clades. The supertree supports the existence of ten monophyletic groups, three of which are exclusively fossil, that may have family rank. Sleeper sharks (Somniosidae), as currently understood, seem to be paraphyletic. According to our and previous results, we exclude Middle and Late Jurassic protospinacid sharks from Squaliformes and propose a post-Jurassic origination for squaliforms. The supertree and the simple completeness metric (SCM) were used to scrutinize the quality of the fossil record of squaliforms. Although slightly different (48% and 54% respectively) both measurements indicate a rather poor fossil record for squaliforms. On average, the fossil record is better for the Cretaceous than for the Cenozoic. Squaliform sharks were heavily affected by the K/T event based on diversity and SCM analyses. Gaps in the fossil record derived from the supertree and statistical parameters range from 5 to 100 million years. The diversity recovered in the late Paleocene and modern squaliform diversity was established in the Pliocene.

Wednesday, Preparator Poster

***CAMPTOSAURUS BROWNI*, GILMORE; THE HOLOTYPE IS NO LONGER MOUNTED**

KROEHLER, Peter A., Smithsonian Institution, Washington, D.C. 20560

Mounted in 1912 by Charles Gilmore (US)NMNH 4282 has been disassembled and removed from public exhibition. A cast will take its place. Certain skeletal elements have been partially buried (and basically inaccessible to scientific scrutiny) in our exhibit here for many years. This poster will illustrate the various processes involved in disassembly, molding, casting, and remounting of *C. browni* at the Smithsonian's Vertebrate Paleontology Prep Lab. Molds have been made of nearly all the bones, save the sacrum, badly deformed by an abcess in life, (which is in progress) and the skull, which was a reconstruction and will be replaced with one of the more recently discovered skulls to be cast. Damage done to numerous parts of the skeleton during the original mounting by Gilmore (sorry Charles) will also be shown to demonstrate why those antiquated methods are no longer acceptable. The commendable use of volunteers, trained here at SI, for some aspects of the tasks associated with this project will be noted.

Wednesday 5:30

THE USE OF CONSERVARE OH-100 FOR THE STABILIZATION OF PARTICULARLY FRAGILE DINOSAUR BONE

KRONTHAL, Lisa, American Museum of Natural History, New York, NY; BISULCA, Christina, Winterthur/Univ. of Delaware, Winterthur, DE; DAVIDSON, Amy, American Museum of Natural History, New York, NY

The American Museum of Natural History in collaboration with the Mongolian Academy of Sciences has been excavating the locality Ukhaa Tolgod, in the Gobi Desert of Mongolia, a site rich in late Cretaceous dinosaur specimens. Much of the fossil bone, although well preserved, is very fragile, and many specimens require a combination of meticulous and challenging preparation techniques and manipulation of consolidants in order to strengthen the bone enough to be completely removed from surrounding sediment. However, results were limited and sometimes unsuccessful, primarily due to the lack of full penetration of the consolidant, and the need to consolidate in stages as matrix is removed. An investigation was undertaken into the potential use of Conservare OH 100 for the consolidation and preparation of these specimens. Conservare OH 100 is a tetra-ethoxy silane (TEOS) based reaction adhesive manufactured for the consolidation of architectural stone. This material was chosen because of its extremely low viscosity, which allows for complete, uniform penetration of the substrate. Additionally, while the bone demonstrated a marked increase in strength after consolidation, the surrounding matrix remains virtually unconsolidated. These properties combined allow the entire block to be consolidated before preparation, targeting the bone within. Using this material, two exceedingly fragile specimens, including the type specimen of Citipati osmolskae, were able to be more safely, easily and quickly prepared. A TEOS based consolidant has not previously been used on bone, and its consolidative effect and bonding to the bone and sediment were investigated utilizing a variety of methods, including microhardness testing, SEM/EDS examination, as well as visual inspection and examination by a fossil preparator.

Student Poster Session

PRELIMINARY REPORT ON NEW VERTEBRATE FOSSILS FROM THE DRANEY LIMESTONE (APTIAN) AND WAYAN FORMATION (ALBIAN) OF EAST IDAHO

KRUMENACKER, Laurel, Idaho Museum of Natural History, Pocatello, ID

Fieldwork undertaken over the past several years in the Draney Limestone (Aptian) and Wayan Formation (Albian) of east Idaho is resulting in a dramatic increase in understanding of the vertebrate faunas of Early Cretaceous Idaho.

The Draney Limestone is a predominantly lacustrine unit consisting of freshwater limestones and mudstones. Vertebrate fossils from the Draney include teeth from the hybodontid shark *Hybodus*, teeth and scales referred to cf. *Lepidotes*, pycnodontid teeth, plastron and carapace fragments from the turtles cf. *Naomichelys* and cf. *Glyptops*, crocodile teeth, a lizard jaw, and a probable dinosaur vertebra fragment. Associated non-vertebrate fossils include freshwater bivalves, gastropods, and petrified wood.

The Wayan Formation was deposited in a semi-arid, meandering stream fluvial system and consists of conglomerates, sandstones, mudstones, and minor tuffs. Vertebrate fossils from the Wayan include a theropod tooth fragment and associated caudal vertebrae tentatively referred to the Dromaeosauridae, and moderately common skeletal remains from probable basal euornithopods similar to *Othnielia*. Basal euornithopods are previously unreported from the Wayan. Cranial remains from a large crocodilian discovered in 2004 are the first known crocodilian skeletal material from the Wayan. Unidentified, unpatterned turtle carapace fragments, button like fish teeth and a ganoid scale, both similar to *Lepidotes*, are also recent discoveries in the Wayan. Associated non-vertebrates include rare freshwater molluscs, petrified wood, angiosperm, conifer, and fern foliage similar to *Gleichenia*.

Vertebrate faunas from the Draney and Wayan are similar to the roughly equivalent in age Cloverly Formation of Wyoming and Montana, and the Cedar Mountain Formation of Utah. Work is continuing in the Wayan and Draney and will add significantly to the poorly known Early Cretaceous vertebrate faunas of Idaho.

Poster Session B

THE MICROVERTEBRATE FAUNA OF THE BLUE HILLS (BLUE MESA MEMBER, PETRIFIED FOREST FORMATION: ADAMANIAN), UPPER TRIASSIC OF EAST-CENTRAL ARIZONA

KRZYZANOWSKI, Stan, Tucson, AZ; HECKERT, Andrew, LUCAS, Spencer, BOYER, Kathleen, New Mexico Museum of Natural History & Science, Albuquerque, NM

Screenwashing a productive Upper Triassic locality in the vicinity of Charles Camp's collecting areas in the Blue Hills, northeast of St. Johns, Arizona, yields a diverse microvertebrate assemblage, including the first selachians reported from the area. The locality (NMMNH locality 4127) is in the Blue Mesa Member of the Petrified Forest Formation, and tetrapods from this unit, especially the aetosaur *Stagonolepis* and the possible ornithischian *"Revueltosaurus" hunti*, indicate an Adamanian (latest Carnian) age. Microvertebrates recovered from this site include rare xenacanth sharks and osteichthyans, metoposaurid amphibians (including a partial skull of a juvenile *Buettneria*), phytosaurs, sphenosuchians, putative ornithischians, and diverse archosauriforms of uncertain affinities. Teeth of *"Xenacanthus" moorei* are the first such teeth recovered from the Blue Hills, although they are a common component of other Adamanian microvertebrate faunas. Osteichthyans are represented principally by fish scales, some of which pertain to palaeoniscoids (aff. *Turseodus*). In addition to the partial *Buettneria* skull, metoposaurids are well represented by small jaw fragments and isolated labyrinthodont teeth. Phytosaur teeth are a relatively common component of the microvertebrate fauna, and sphenosuchians are represented by an isolated osteoderm (scute). Teeth, including both "maxillary/dentary" and "premaxillary" teeth of the putative ornithischian *Crosbysaurus harrisae* are also present, and further validate use of that species as an Adamanian index taxon. Archosauriform teeth represent diverse morphotypes, and presumably taxa, and include morphotypes A-C, E, H-J, M-N of Heckert as well as a new morphotype (morphotype U) that consists of moderately tall, laterally compressed, strongly recurved teeth that probably represent theropods or "rauisuchians." Coprolites ranging in length from a few mm to 5 cm are also a common component of the assemblage. The fauna of L-4127 is considerably more diverse than previously reported for the area, even though Camp's "meal pots" localities yielded comparably small elements.

Friday 1:45

THE PHYLOGENY OF THE LIVING AND FOSSIL PALAEOGNATHAE

KSEPKA, Daniel, BERTELLI, Sara, American Museum of Natural History, New York, NY; DYKE, Gareth, Univ. College Dublin, Belfield Dublin 4, Ireland; CRACRAFT, Joel, American Museum of Natural History, New York, NY

The Palaeognathae, the sister group to all other neornithine birds, comprises the large, flightless Ratitae and the volant Tinamidae and Lithornithidae. Because entire clades (Lithornithidae, Dinornithiformes, Aepyornithidae) and landmasses (Madagascar) are represented only by extinct taxa, inclusion of data from fossils is crucial for an understanding of palaeognath phylogeny and biogeography. We conducted a morphology-based phylogenetic analysis of the Palaeognathae, incorporating all extant genera and the fossil taxa *Aepyornis, Mullerornis, Palaeotis, Lithornis, Pseudocrypturus, Paracathartes* and five dinornithiform (moa) genera. Our matrix of osteological, integumentary and oological characters is the first to sample nearly all palaeognaths at the generic level and more than doubles the number of characters used in previous analyses. In particular, we utilized a suite of 67 cranial characters, the majority never before included in a cladistic analysis of the group.

A heuristic search using TNT recovered 3 most parsimonious trees. Our results confirm the monophyly of the Tinamidae, Lithornithidae, and Ratitae, and support a sister group relationship between the latter two clades. The problem of ratite phylogeny is one of the classic examples of conflict between morphological and molecular data, and our expanded data set highlights areas of conflict by providing new character support for many morphology-based clades. Within Ratitae, our results clash with those of molecular analyses by placing *Struthio* and *Rhea* as sister taxa rather than as basal ratite lineages and by allying *Apteryx* with the Dinornithiformes rather than with the Australian ratites. These groupings were also recovered by analysis of a cranial partition of our data set, indicating they are not the result of convergences in the postcranial skeleton. A novel clade grouping the Aepyornithidae (elephant birds) with *Apteryx* and the Dinornithiformes is one of the more surprising results of our analysis

Poster Session B

TAPHONOMY, TAXONOMY, AND ANATOMY OF SAUROPOD AND THEROPOD DINOSAUR REMAINS FROM THE MORRISON FORMATION, SHELL, WY

KUBAREK, Sara, SWOR, Emily, Univ. of Minnesota Duluth, Duluth, MN

Two quarries near Shell, Wyoming, have produced two partial skeletons of sauropods from separate stratigraphic horizons. We are currently researching to decipher the taxonomy, taphonomy, and anatomy of the dinosaur bones that were excavated. The two quarries differ significantly. The upper quarry sediment is a very fine siltstone in which a femur, ribs, vertebrae, and hip bones were excavated, while another femur and some vertebrae were uncovered but are still in the ground. Bones excavated so far in the upper quarry are roughly articulated in their original skeletal order. When the first femur was excavated out of the ground another femur was found underneath it. This and the fairly original skeletal order suggest that the dinosaur is being uncovered in the original state it was buried. The upper bone surface of the femur is collapsed which suggests possible post-burial compression. The lower quarry sediment is very hard sandstone. Vertebrae, ribs, and teeth have been excavated from this site. The bones in the lower quarry are disordered. Theropod teeth were found in the uppermost layer of sediment yielding bones and in the lower layers of bone-bearing sediment. The deepest layers of sediment with bones have large deposits of plant material. There is no evidence so far that the dinosaur was killed by another animal, therefore the teeth are possible evidence of scavenging. Since the teeth were mainly found in the uppermost layer of sediment yielding bones, this suggests that only a portion of the skeleton was exposed enough for scavenging. The bones in both quarries were examined using microprobe geochemical analyses. The samples from the upper quarry were most likely washed with mineralizing solutions which caused some post-depositional changes. Low temperature minerals such as barite and calcite were found as well as a higher level of sulfur. However, the pores of the lower quarry samples were left empty. The role of gypsum and pyrite on samples from both of the quarries will also be explored as well as the effects of waterlogged environments on bones and the minerals that may or may not develop as a result.

Poster Session B

NEW MATERIAL OF AN IGUANODONTIAN (DINOSAURIA: ORNITHOPODA) FROM THE LOWER CRETACEOUS SHINEKHUDAG FORMATION, CHOIR BASIN, MONGOLIA

KUBOTA, Katsuhiro, Univ. of Tsukuba, Tsukuba, Ibaraki, Japan; KOBAYASHI, Yoshitsugu, Hokkaido Univ. Museum, N-10 W 8 Kita-ku, Sapporo, Japan; BARSBOLD, Rinchen, Geological Institute, Mongolian Academy of Science, Ulaan Baatar-51, Mongolia

During an excavation at Khuren Dukh, Choir Basin, Mongolia, by Mongolian Academy of Sciences between 2000 and 2004, a partial skeleton of a non-hadrosaurid iguanodontian dinosaur, missing most of vertebrae and pelvic girdle elements, was collected from the Shinekhudag Formation (Hauterivian to Barremian). The formation is composed of non-marine limonitic sandstone with coal seams and gypsum-bearing mudstone and has yielded dinosaurs (*Altirhinus kurzanovi*, *Harpimimus okladnikovi*, and *Psittacosaurus mongoliensis*) and other vertebrates (champsosaurs, turtles, and fishes). Two non-hadrosaurid iguanodontian dinosaurs (*Altirhinus kurzanovi* and *Iguanodon bernissartensis*) are known from Mongolia.

A neurocentral suture in a preserved centrum is open, which may indicate that it is subadult. A phylogenetic analysis is performed utilizing 62 characters for twenty taxa with three outgoups and produced six most parsimonious trees. The strict consensus tree suggests that the Khuren Dukh iguanodontian and *Altirhinus kurzanovi* are monophyletic, supported by a single unambiguous synapomorphy (long jugal process of maxilla, projecting posteroventrally). The Khuren Dukh iguanodontian may be a new taxon because it shows some differences from *Altirhinus kurzanovi* in having slight ventral reflection of anterior portion of dentary, absence of dentary diastema, unexpanded end of coronoid process of dentary, anteroposteriorly long surangular, absence of surangular foramen, and dorsal expansion of anterior pubic process. The tree topology in this study shows that the clade of *Altirhinus kurzanovi* and the Khuren Dukh iguanodontion is a sister taxon to the clade of *Equijubus normani*, *Eolambia caroljonesa*, and higher taxa, *Altirhinus kurzanovi* and *Eolambia caroljonesa* are paraphyletic, and *Iguandon* (*I. bernissartensis* and *I. atherfieldensis*) and *Ouranosaurus nigeriensis* are monophyletic.

Poster Session B

ABUNDANT DINOSAUR TRACKSITES FROM THE MID-CRETACEOUS DAKOTA GROUP PROVIDE A REGIONAL ICHNOFACIES DATABASE IN A HIGH-RESOLUTION STRATIGRAPHIC FRAMEWORK

KUKIHARA, Reiji, LOCKLEY, Martin, Univ. of Colorado at Denver, Denver, CO; HOLBROOK, John, Univ. of Texas at Arlington, Arlington, TX; SCHUMACHER, Bruce, USDA Forest Service, La Junta, CO

Dinosaur tracksites continue to be discovered at many sites in the mid Cretaceous Dakota Group of the high plains region of eastern Colorado and eastern New Mexico. For example, during 2004, drought conditions almost emptied John Martin Reservoir in southeastern Colorado revealing 9 new dinosaur tracksites. Most tracks are those of ornithopods, sometimes in multiple, in situ, parallel trackways suggesting gregarious behavior. Other John Martin sites are dominated by abundant swim tracks of crocodilians, mostly consisting of three parallel scratch marks oriented in preferred directions suggesting that animals swam in response to currents in channels. Other sites in southeastern Colorado and northeastern New Mexico yield various samples of theropod and ankylosaur tracks. Thus, a mosaic of more than 50 sites are now known in the upper part of the upper Albian-lower Cenomanian Dakota Group previously designated as 'sequence 3' and popularly known as the Dinosaur Freeway.

High-resolution Dinosaur Freeway stratigraphy allows us to begin to place these tracksites in the context of three landward-stepping sequences associated with the Cenomanian transgression. Thus, the sequence 3 paradigm has been refined allowing us to dissect the track-bearing facies of the dinosaur Freeway more precisely. It is now a three-lane rather than a one-lane highway! Within this framework we can plot the changing relative abundance of theropod, ornithopod, ankylosaurian, crocodilian and rare bird tracks to produce a substantial database that serves as a proxy for census paleoecology. Thus, we can track the changing ichnofaunal composition in space and time, and fine tune our understanding of the relationship between paleoecology and paleoenvironments.

Romer Prize Session, 10:45

METATHERIAN PETROSAL BONES FROM THE PALEOCENE OF ITABORAI (BRAZIL), AND AN ATTEMPT TO ASSIGN ISOLATED PETROSALS TO DENTAL REMAINS

LADEVEZE, Sandrine, Museum national d'Histoire naturelle, Paris, France

Nine metatherian petrosal bones were recovered from the early Late Paleocene Itaborai, Brazil and are attributed to five morphotypes (I to V). A cladistic analysis of the distribution of 56 petrosal and basicranial characters among four outgroup taxa and 20 extant and fossil metatherians, resulted in seven parsimonious trees. Relationships among metatherian ingroup taxa are congruent with current understanding of metatherian phylogeny. A clade including the Paleocene taxa *Mayulestes*, *Pucadelphys*, and *Andinodelphys* from Tiupampa (Bolivia), and Petrosal Type II from Itaborai is the first diverging among Notometatheria (South American and Australian metatherians). These taxa share a deep groove for the internal carotid artery on anterior pole of promontorium; a deep and large fossa on the lateral trough; a medial squamosal process; an enormous jugular foramen (at least three times larger than fenestra cochleae). The South American "monito del monte" *Dromiciops* is nested within the Australasian radiation, and represents the sister taxon of dasyurids. The South American *Caenolestes* appears more closely related to the Australidelphia than to the South American didelphids. The Petrosal Types I, III, IV and V from Itaborai are the stem taxa of the clade Australidelphia plus *Caenolestes*. The significant synapomorphies supporting this relationship are: enlargement of the fossa subarcuata that produces a bulbous ventral aspect of the mastoid; loss of posttemporal canal. An attempt at assigning the petrosal morphotypes to tooth-based taxa from Itaborai was made by combining parsimony and morphometric methods. Although both analyses led to mostly incongruent results, they emphasise the necessity for a broader investigation that would involve basicranial and dental characters in a larger number of metatherian taxa, and particularly in all the Itaboraian genera.

Friday 9:15

A NEW ENANTIORNITHINE PARTIAL SKELETON FROM THE EARLY CRETACEOUS OF NORTHWESTERN CHINA

LAMANNA, Matthew, Carnegie Museum of Natural History, Pittsburgh, PA; YOU, Hai-lu, JI, Shu-an, LÜ, Jun-chang, JI, Qiang, Chinese Academy of Geological Sciences, Beijing,

China; CHIAPPE, Luis, Natural History Museum of Los Angeles County, Los Angeles, CA

Although recent discoveries from Lower Cretaceous sediments in northeastern China have greatly improved our knowledge of the initial stages of avian diversification in eastern Asia, the early evolution of the clade elsewhere in the continent remains poorly understood. In the summer and fall of 2004, a collaborative field effort led by personnel from the Chinese Academy of Geological Sciences and Carnegie Museum of Natural History recovered multiple partial to nearly complete avian skeletons from the Early Cretaceous Xiagou Formation exposed near the village of Changma in Gansu Province of northwestern China. Here we report a new songbird-sized partial skeleton comprised of a fragmentary pelvic girdle and nearly complete hindlimbs. The following synapomorphic characters exhibited by the Changma specimen indicate that it pertains to Enantiornithes: 1) iliac postacetabular process dorsoventrally shallow; 2) distal condyles of metatarsal I reflected caudally; 3) distal condyles of metatarsal I joined along their dorsal margin; 4) distal condyles of metatarsal II and proximal articular surface of phalanx II-1 mediolaterally broad relative to the corresponding regions of metatarsal III and phalanx III-1; and 5) distal condyles of metatarsal IV C-shaped in distal view. Moreover, metatarsal IV is significantly mediolaterally narrower than metatarsals II and III throughout much of its length, suggesting that the Changma specimen may reside within Euenantiornithes. Regrettably, the new partial skeleton is not directly comparable to another enantiornithine specimen recently reported from the Xiagou Formation, as the latter includes only the pectoral girdle and forelimb. Nevertheless, when coupled with additional recent discoveries from Changma, the new specimen will considerably improve our understanding of early avian evolution and diversification in central Asia.

Poster Session A

A REVISED MASS REGRESSION FOR RATITE BIRDS

LAMM, Kristin, Stony Brook Univ., NY; KSEPKA, Daniel, American Museum of Natural History, New York, NY; GEORGI, Justin, SIPLA, Justin, Stony Brook Univ., Stony Brook, NY

We provide new body mass estimates for several species of large-bodied, extinct terrestrial birds, based on observed relationships of long bone cross sectional geometry and body weight in living birds. Data on cortical bone thickness were collected via CT scan. Cross-sectional geometry at least shaft circumference was modeled, and cortical areas obtained from these models were used to generate estimates of body mass.

An animal's body mass may be used to infer many life history variables, including number and size of offspring, growth rate and metabolic rate. The long bones of the limbs transmit weight and forces associated with locomotion, and their morphology reflects their ability to withstand the resulting stresses. In birds, diaphyseal proportions of the femur and tibiotarsus are correlated with body mass.

Prior studies compare live body mass to least shaft circumference of the femur and tibiotarsus in extant birds, and the weights of extinct birds are estimated from this observed relationship. However, estimates based on cross sectional area of the hindlimb bones at their least circumference may provide better body mass estimates than those based on external diaphyseal dimensions. Cross-sectional area accounts for variations in cortical thickness due to the size of the medullary cavity, thereby representing the actual area of bone able to resist bending stress.

Previous mass regression analyses have been used to estimate the body weight of extinct ratites such as *Aepyornis*, *Pachyornis* and *Dinornis*, which were larger than most or all living birds. This study incorporates increased data from extant ratites, which most closely approximate these fossil species in body size and locomotor regime. Because we use more large living birds to calibrate the relationship between mass and other body measurements, estimates of ratite body mass generated by this regression may be more reliable than those from data sets using smaller-bodied birds.

Saturday 9:00

***SATURNALIA TUPINIQUIM* AND THE ORIGIN OF SAUROPODOMORPHS**

LANGER, Max, Univ. Sao Paulo, Ribeirao Preto, SP., Brazil

The South American Late Triassic offers the most comprehensive window to the basal radiation of dinosaurs. It includes some of the earliest members of the sauropodomorph lineage, which first appears in Ischigualastian (Early-Mid Carnian) deposits of southwestern Pangea. The best known of these forms is *Saturnalia tupiniquim*, based on 3 partial skeletons from south Brazil. Its position on the dinosaur phylogenetic tree matches its age, and the taxon has various traits that justify its primitiveness in relation to typical sauropodomorphs: femur with trochanteric shelf and proximally placed fourth trochanter; less robust *pes* with flat medial margin of proximal Metatatarsal II, Metatarsal III more than twice proximally broader than Metatarsal II, Metatarsal II distally narrower than Metatarsal III, and metatarsal V less expanded proximally. Recently, additional material of this dinosaur was recovered, including a partial skull with nearly complete braincase and distal parts of the tail, which provide significant anatomic-phylogenetic data. Its lachrimal has an oblique ventral ramus forming about three-quarters of the preorbital height and a lateral expansion overhanging the dorsocaudal corner of the antorbital fenestra; the squamosal ventral ramus is narrower than a quarter of its length; the paroccipital process projects laterally in caudal view; the basiocipital forms a median crest on the floor of the endocranial cavity; the short basipterygoid process extends rostroventraly in lateral view; the parasphenoid rostrum lies below the occipital condyle; and distal tail vertebrae have short prezygapophyses. These traits mainly agree with the position of *Saturnalia* as the basal most member of the sauropodomorph lineage, and help to define the plesiomorphic condition of that dinosaur group. Further Ischigualastian putative sauropodomorphs are based on partial remains from Africa, India, and North America. These still represent rare faunal components, while Norian sauropodomorphs were the protagonists of the first important event of dinosaur diversification.

Thursday 3:00

ANALYSIS OF FAUNAL REMAINS FROM SPOTTED HYENA (*CROCUTA CROCUTA*) DENS IN AMBOSELI NATIONAL PARK, KENYA

LANSING, Sarah, Michigan State Univ., Haslett, MI; BEHRENSMEYER, Anna, National Museum of Nat. Hist. Smithsonian Inst., Washington, DC

To better understand the fossil record and its potential biases, taphonomists study biotic and abiotic processes that alter the physical characteristics and depositional context of bones. Spotted hyenas (*Crocuta crocuta*) are important modern taphonomic agents that produce identifiable chew marks on bones with their specialized dentition and cranial morphology, transport bones away from the place of death, and accumulate remains at den sites. Studies of bone accumulations at spotted hyena dens indicate that taphonomic features of the assemblage vary with the type and persistence of dens, numbers of hyenas utilizing the site, and length of occupation. Systematic collections of faunal remains were recovered from ten spotted hyena dens in Amboseli National Park, Kenya. These included seven communal and three natal den sites under calcrete hardpans and dug into softer soils (ground dens). All remains at dens, including tiny bone fragments and regurgitated bones, were mapped and collected, using 10m long radial transects oriented N, S, E, and W of the primary den hole. Bones were retrieved from den holes until the entrance tunnels were too deep and narrow. Additionally, radial transects 200m in length were surveyed outward from three dens to document characteristics of the surrounding surface bone assemblages. Bones were identified to skeletal element type and species and weathering stages, breakage patterns, and the number, type, and position of chew marks were also recorded. Results show that greater numbers of bones occur at communal and calcrete dens than natal and ground dens. The majority of bones in the collected samples bear evidence of hyena damage and are not highly weathered. Comparisons with the adjacent surface bones surrounding the dens help to define the unique taphonomic features of den assemblages. Patterns of bone representation and modification in modern *Crocuta*-generated accumulations provide baseline comparative data for reconstructing the history of activity and taphonomic signatures of particular animals at fossil sites.

Friday 8:00

MODULES OF DEVELOPMENTAL EVOLUTION: WHAT REALLY LIES AT THE INTERSECTION OF PALEONTOLOGY AND DEVELOPMENTAL BIOLOGY?

LARSSON, Hans, McGill Univ. Redpath Museum, Montreal, QC, Canada

Evolutionary explanations of information offered by paleontology and phylogenetic systematics are often limited to narrative hypotheses. The incorporation of additional sources of data, such as ecology or developmental biology, offers instances of comparison that may support mechanisms of transformational hypotheses. However, the utility of data comparison and its explanatory powers have not been formalized with respect to evolutionary novelties and phenotypic modules. In fact, universal definitions of evolutionary novelties and modules are themselves lacking.

The topic of phenotypic modules and evolutionary novelties are addressed here with discussions of the scale to feather and fin to limb transitions. Both examples make heavy use of the fossil record and modern developmental biology. Details of the paleontological record offer resolution of the series of evolutionary stages involved with the origin of these complex characters. The developmental record provides a series of developmental transformations and genetic expressions. The two sets of data are found to share equivalent states in some instances. The presence and sequence of these shared states yield a unique insight into the intersection of evolutionary and developmental biology. The shared states offer explanations to the transformations that account for the origin and modification of these complex characters. Discrete stages of transformation are described along the evolutionary and developmental trajectories of the scale to feather and fin to limb transitions. The intersections of the evolutionary and developmental trajectories offer a dynamic definition of evolutionary novelties and modularity. The intersections also result in novel definitions of the complex characters themselves to reflect the evolutionary history and developmental mechanisms underlying the characters. Feathers can be defined by early gene expression reorganizations that result in sets of phenotypic changes also found in the fossil record. Limb development shares a number of discrete stages found deep within tetrapod ancestry and suggests a gradual transformation of the fin along multiple nodes of sarcopterygian fishes.

Thursday 2:00

ONTOGENETIC HISTOLOGY OF *ALLOSAURUS* (DINOSAURIA: THEROPODA): ASSESSING GROWTH TRAJECTORY AND EVOLUTION OF ONTOGENETIC LIMB ALLOMETRY

LEE, Andrew, Berkeley, CA; BYBEE, Paul, Utah Valley State College, Orem, UT; LAMM, Ellen-Therese, Montana State Univ., Bozeman, MT

Allosaurus is one of the most common Mesozoic theropod dinosaurs. The availability of skeletal material through ontogeny presents an excellent opportunity to assess the growth

dynamics of *Allosaurus* in context of other theropods. We present a histological analysis to assess its growth trajectory and ontogenetic limb allometry. Based upon an ontogenetic series of humeral, ulnar, femoral, and tibial sections of fibrolamellar bone, we estimate the ages of the largest individuals in the sample between 13-19 years. Growth curve reconstruction suggests that maximum growth occurred at 14 years, when body mass increased 130 kg/yr. Based on larger bones of *Allosaurus*, we estimate an upper age limit between 22-28 years of age, which is similar to preliminary data for other large theropods. Limb growth in *Allosaurus* is not completely isometric. Although the humerus increases isometrically in length with respect to the femur, the ulna and tibia show negative allometry in length. Phylogenetic optimization suggests that large theropods independently evolved reduced humeral, ulnar, and tibial lengths by a phyletic reduction in longitudinal growth relative to the femur.

Friday 10:30

A NEW PROTOSUCHIAN (ARCHOSAURIA: CROCODYLIFORMES) SKULL FROM THE HASANDONG FORMATION (LOWER CRETACEOUS) OF HADONG COUNTY, SOUTH KOREA

LEE, Hang-Jae, LEE, Yuong-Nam, Korea Institute of Geoscience and Mineral Resource, Daejeon, Republic of Korea

A complete crocodyliform skull was found in the Hasandong Formation (Aptian) of Hadong County, Korea. The skull is 52mm in length with a relatively short snout. It is different from *Shangtungosuchus* from the Lower Cretaceous of China in having a relatively wide rostrum. The second dentary tooth fits to the notch between the premaxilla and maxilla but its tip is not exposed. There are two small antorbital fenestrae. The infratemporal fenestra is strongly reduced as in other protosuchians. The quadratojugal forms a posterolateral shelf. The secondary palate is incomplete. The small leaf shaped palatine is separated from the suborbital fenestra by the maxilla and pterygoid. The external mandibular fenestra is smaller than that of *Shangtungosuchus*. The surangular occupies the upper posterior portion of the outer surface, taking over part of the articular surface primitively.

Hadong protosuchian is characterized by (1) four premaxillary teeth slightly recurved with D-shaped cross section and the largest third caninform, (2) very sharp ventromedial edges of pterygoids and parallel to each other, (3) slender and long anterior jugal process not contact the lacrimal, and (4) the maxilla contributed to the anteroventral margin of the orbit.

Forty-nine characters of 13 taxa with two outgroups are analyzed based on *Shangtungosuchus* by using PAUP. Two most parsimonious trees show that it is belonging to the Protosuchia and closely related to *Zosuchus* from Zos Canyon, Mongolia. It forms a monophyletic group with *Shangtungosuchus*, *Sichuanosuchus*, and *Zosuchus*.

Poster Session A

TURTLE SHELLS AS NUCLEI FOR CADDISFLY-DOMINATED MICROBIAL CARBONATE MOUNDS: WILKINS PEAK MEMBER, EOCENE GREEN RIVER FORMATION

LEGGITT, V. Leroy, BUCHHEIM, H. Paul, CUSHMAN JR., Robert, Loma Linda Univ., Loma Linda, CA

Abundant articulated turtle shells served as nuclei for a bed of caddisfly-dominated microbial carbonate mounds that occur in lake margin sediments associated with the Wilkins Peak Member of the Eocene Green River Formation. This unique occurrence of fossil turtles is located in the northwest corner of the Greater Green River basin near the town of La Barge, Wyoming. The mounds are 30-40 cm thick and in plan view they resemble an expanded turtle carapace (dome shaped). When the microbial carbonate mounds are evaluated in cross-section, the turtle plastron is seen embedded in layered lake bottom calcimicrite at the base of the mound. The upper two thirds of the carapace is covered by a thin zone (1-6 mm) of digitate stromatolites (both internal and external carapace surfaces are coated). The carapace was exposed above the sediment-water interface during the formation of the stromatolitic carbonate, however the carapace did not disarticulate because the carapace was protected from disarticulation by the thin microbial carbonate coating. Each turtle carapace was subsequently covered with a 20-30 cm carbonate accumulation composed of layered, columnar and digitate stromatolites. Two of these microbial carbonate layers are chiefly composed of caddisfly pupal cases. In order to evaluate the paleoenvironment of these fossil turtles, standard stratigraphic sections were measured at five study sites and each lithologic unit was evaluated by thin section, XRD and by analysis of oxygen and carbon stable isotope ratios. Similar methods were used to evaluate the microbial carbonate mound layers. In the measured section (and in the mound layers), oxygen and carbon stable isotopes covary suggesting that the lake was hydrographically closed. Significant variation in carbonate mineralogy and in oxygen and carbon stable isotopes supports this conclusion and indicates frequent lake level fluctuation. The turtles likely lived in freshwater lagoons at the northwest margin of the more saline/alkaline Lake Gosiute. The cause of the synchronized death of the turtles is unknown, however volcanic events associated with the layered tuff may have affected their death.

Poster Session B

THE TUCSON MOUNTAINS DINOSAUR: A LARGE HADROSAUR FROM THE UPPER CRETACEOUS OF SOUTHERN ARIZONA

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The Tucson Mountains dinosaur has been considered an Early Cretaceous dinosaur from a megabreccia block of the Amole Arkose in the Tucson Mountains caldera. But, it is a large hadrosaur represented by an incomplete left hindlimb, including proximal and distal femur, a distal tibia, a possible calcaneum, a proximal metatarsal and unidentifiable bone elements. This specimen is diagnostically hadrosaur because it has distal femoral condyles greatly expanded caudally and a very deep intercondylar groove on the distal femur. The distal femur is ~ 250 mm wide, so it is slightly larger than a hadrosaur femur from the Campanian Fort Crittenden Formation in the Santa Rita Mountains, AZ, but smaller than the largest known hadrosaur. Hadrosaurs are restricted to strata of Late Cretaceous age, and, in the American West, large hadrosaurs typically indicate a Campanian or Maastrichtian age. The collecting locality of the hadrosuar lies ~550 m NNW of Gates Pass in ground exposing lenticular bodies of intracaldera megabreccia that interfinger complexly with Cat Mountain Tuff, the compound cooling unit of welded ash-flow tuff that forms the fill of the Tucson Mountains caldera. Megabreccia bodies were formed by landslides that slid into the caldera from its walls during eruption, and are blocks of extracaldera rocks encased in partially welded intracaldera tuff. Cat Mountain Tuff has yielded multiple K-Ar (feldspar) ages of 68-72 Ma, and a single $^{40}Ar/^{39}Ar$ age (biotite) of 73.1 Ma. Approximately 8 km WNW of the dinosaur locality, Tuff of Confidence Peak (~73 Ma), which was erupted from the Silver Bell caldera 30 km NW of the Tucson Mountains caldera, is interbedded with upper horizons of the Amole Arkose as exposed just outside the Tucson Mountains caldera. The stratigraphic relationship of the Tuff of Confidence Peak to the Amole Arkose is evidence that the latter includes strata at least as young as Campanian in age, even though older parts of the Amole Arkose are evidently correlative with Lower Cretaceous Bisbee Group. The sandstone matrix of the hadrosaur fossil thus is a block derived from an Upper Cretaceous horizon in the upper Amole Arkose.

Poster Session B

DROMAEOSAURID TRACKWAYS FROM SHANDONG PROVINCE, CHINA

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Although dromaoesaurid dinosaurs are well known and have attracted popular attention their trackways have proved elusive. Based on footprint morphology they should have a functionally didactyl footprint with the impression of digit III only slightly longer than IV. Previous reports of possible dromaeosaurid tracks include *Velociraptorichnus* trackways from the Cretaceous Jiangun Formation of Sichuan Province China, and un-named tracks from the Lower Cretaceous Cedar Mountain Formation of Utah. The Sichuan tracks are 11 cm long and associated with a diverse ichnofauna of small dinosaur and bird tracks The Utah tracks are larger (30-35 cm long), but isolated and from the same formation as Utahraptor. The Shandong dromaeosaurid trackways are from the Lower Cretaceous Tianjalou Formation, with an associated ichnofauna of bird tracks (Shandongornipes) tridactyl theropod tracks and other undescribed dinosaur footprints. They are about 28 cm long in the best-preserved examples with steps of about 95 cm, forming a narrow trackway. Digit III made the longest impression, but digit IV is only slightly shorter. Digit II is not impressed but leaves a rounded impression in the same position as the proximal pad of digit II in typical tridactyl theropod footprints. These features are consistent with predicted dromaeosaurid trackway morphology. Recent footprint finds in Shandong and other Chinese provinces indicate a large untapped potential for significant advances in vertebrate ichnology.

Saturday 1:30

A MAMMALIAN BIOSTRATIGRAPHY WITH ADDITIONAL NEW MAMMALS FROM THE TORREJONIAN-TIFFANIAN TRANSITION IN THE NACIMIENTO FORMATION, NORTHWESTERN SAN JUAN BASIN, NEW MEXICO

LIBED, Shirley, Rio Rancho, NM

New data from the Paleocene Nacimiento Formation in the northwestern San Juan Basin establishes a third record of Torrejonian-Tiffanian superpositioned strata, and first recognized Tiffanian fauna from New Mexico. Previously, the youngest Paleocene mammals from New Mexico derived from the type Torrejonian (To3, ~ 61.5Ma) in the south-central San Juan Basin, 60m below the Eocene San Jose Formation. The subsequent fossil horizon was early Eocene, and 30m above the San Jose base or approximate Paleocene-Eocene boundary. Because the type Tiffanian deposits (Ti4-5, ~57.3Ma) of Colorado's northwestern San Juan Basin were never correlated to a regional lithostratigraphy, a minimum 90m stratigraphic, 4.2my temporal, and morphological gap persisted in the basin. This mammalian biostratigraphy fills part of this gap. Seven successive fossiliferous zones and over 165 localities yield over 670 vertebrate fossils, including over 360 mammalian. At least 28 mammalian genera and 43 species are represented, including two new genera and nine new species. I will introduce new species of *Anisonchus*, *Eucosmodon*, *Paromomys*, *Protictis*, *Pentacodon*, *Coriphagus*, and *Litomylus*. The new proto-*Ectocion* and basal tillodont genera were previously here presented. Despite Torrejonian elements, an earliest Tiffanian age is contended on the convergence of five lines of evidence: 1) stratigraphic superposition above the type Torrejonian; 2) stratigraphic lateral equivalence to the paleomagnetically-dated Tiffanian Escavada Member; 3) derived condition of several Torrejonian forms; 4) new taxa transitional or antecedent to previous earliest Tiffanian species; and 5) record of definitive Tiffanian genus, *Plesiadapis*. As the type area and original basis for the Puercan, Torrejonian, and Tiffanian North American land mammal ages,

the San Juan Basin, its Paleocene faunas, and their stratigraphic succession remain pivotal to biochronological correlation of western North American Paleocene strata. The new mammals and zones give further evidence of this faunal succession in a previously unrecognized temporal interval, bridging the former latest Torrejonian and Tiffanian in the San Juan Basin.

Poster Session A

HIGHLY DERIVED TOOTH ENAMEL MICROSTRUCTURE OF PYROTHERES (MAMMALIA) COMPARED TO THAT OF DEINOTHERES (PROBOSCIDEA, MAMMALIA)

LINDENAU, Christa, Institut für Palaeontologie, Universität Bonn, Bonn, Germany

The endemic South American Pyrotheria, which existed from the early Eocene to the late Oligocene, include only a single family with six genera. The animals are of large size (up to 3 m total body length). Their dentition is characterized by bilophodont teeth and elongated hypsodont incisors, except for the earliest member with bunodont teeth. Because of these characteristics, they were originally classified as Proboscidea. The auditory region and derived features of the ankle serve to assign the pyrotheres to the South American ungulates. For the enamel analysis, molars of the two genera *Protypotherium* (middle Eocene from Argentina) and *Pyrotherium* (late Oligocene from Argentina) were examined. The highly derived microstructure consists of very thick bands decussating predominantly in a vertical plane, and superficially resemble vertical Hunter-Schreger bands (HSB, prisms decussating in layers) but differ in details.

The proboscidean *Deinotherium* has similar bilophodont molars and an ancestor with bunodont dentition. Its microstructure consists of variable sized bundles of prisms with irregular patterns of decussation, so called irregular enamel.

An earlier extensive survey of tooth enamel microstructure of South American ungulates had revealed surprising convergences with holarctic mammals. This homoplasy between the South American Pyrotheria and North American and Old World Proboscidea represents an additional example. Specific enamel microstructures characterizes taxa at generic or family level, but they may also occur in phylogenetically unrelated groups.

Wednesday Evolution Symposium Poster

LIGERS AND GRIFFINS AND MULES, OH, MY!: MISUNDERSTANDING / MISPREPRESENTATION OF THE CONCEPT OF "THEORY" AS BEING UNCLEAR AND UNFINISHED IN AN ATTEMPT TO HYBRIDIZE THE STUDY OF BIOLOGY BY MODELING SPIRITUAL BELIEFS WITH SCIENTIFIC PRINCIPLES

LINDSAY, Thomas, SHAW, Barbara, RUEDAS, Luis, CUMMINGS, Michael, Portland State University, Portland, OR, USA

Evolution is the unifying framework of modern biology, and is strongly supported with evidence from the fossil record. Today, the very foundation of biological education is being weakened by proponents of "alternative," non-scientific pseudo explanations which are contrary to fundamental definitions of the concept of science. The scope of science is to understand nature by elucidating natural mechanisms. Alternative explanations, however, state that these are manifestations of supernatural mechanisms at work. Theories are interpreted by the lay public as unsure guesses.

Science embraces Popperian falsification by using testable questions and encouraging falsification. Intelligent Design, in contrast, emphatically rejects the falsification of an "Intelligent Designer," which in and of itself is not testable. Science however, is in constant refinement. Doubt and uncertainty are part and parcel of the scientific process as we engage in trying to better understand our universe and all contained herein. Intelligent Design ineluctably rejects doubt and uncertainty, using that very strength of science 'questioning' as science's Achilles' heel when addressing the uninformed laypeople that this IS how science works.

Novel presentation approaches need to be attempted and evaluated for students who still are undecided about the validity of the theory of evolution. A survey course of the history of life on Earth is usually taught from the origins of life to current diversity of life on Earth. Would students better conceptualize evolution by natural mechanisms if instead it were taught starting from the current diversity of life on earth and proceed backwards through time?

Upper division college students taking Life of the Past were given pre- and post-tests to assess if: 1) if they can accept that evolution can occur; 2) if their understanding of geological time changed, 3) if their understanding that evolution occurs predominately through natural selection punctuated by random events like extinctions, and 4) if they have a better understanding of the finer issues of evolution, such as needing to already possessing the traits that will fend against an extinct event.

Poster Session B

***MINISAURIPUS*—THE TRACK OF A DIMINUTIVE DINOSAUR FROM THE CRETACEOUS OF KOREA: IMPLICATIONS FOR CORRELATION IN EAST ASIA**

LOCKLEY, Martin, Univ.of Colorado Denver, Denver, CO; YANG, Seong-Young, Kyungpook National Univ., Taegu, Republic of Korea; MATSUKAWA, Masaki, Tokyo Gakugei Univ., Tokyo, Japan; LI, Jianjun, Bejing Natural History Museum, Beijing, China

Type *Minisauripus chuanzhuensis*, a diminutive tridactyl dinosaur track (foot length 2.1-2.8 cm excluding claw trace), was described from the purportedly Upper Cretaceous Jianguan Formation of Emei County, Sichuan, China, on the basis of 19 footprints comprising at least seven trackways. The Sichuan tracks, first attributed to tiny ornithopods, have unusual, blunt nearly equidimensional toe impressions (i.e., digit III does not project far beyond II and IV). The step is also relatively long (16.2-24.5 cm) thus averaging 6-10 x foot length. The Sichuan ichnofauna, which includes diminutive theropod tracks (*Grallator emeiensis* < 2.0 cm long), didactyl tracks 11.0 cm long (*Velociraptorichnus sichuanensis*) and bird tracks (*Aquatilavipes sinensis*), is distinctive, well-preserved, and until recently the dinosaurian ichnogenera were unknown outside the type locality.

The discovery, in 2004, of two well-preserved *Minisauripus* tracks from the Lower Cretaceous (?Aptian-Albian) Haman Formation of Namhae Province South Korea, confirms the presence of elements of this ichnofauna more than 2000 km from the type locality. The tracks are 3.3 cm long (including faint heel pad traces), 1.9 cm wide with minimum step estimates of 13.5 and 22. 5 cm. The elongate foot and pad impressions (phalangeal formula 2-3-4 for digits II III and IV) allows a more detailed description of *Minisauripus* and suggests a theropod trackmaker. The age of *Minisauripus* and *Aquatilavipes* in Korea and elsewhere suggests an Early Cretaceous age. Thus, the age of the Jianguan Formation in Sichuan may need to be re-evaluated.

Saturday 10:15

UNUSUAL PRESERVATION OF A NEW SAUROPODOMORPH FROM THE NAVAJO SANDSTONE OF UTAH

LOEWEN, Mark, SERTICH, Joseph J, SAMPSON, Scott, GETTY, Michael, Univ.of Utah Utah Museum of Natural History, Salt Lake City, UT

Recent fieldwork by the Utah Museum of Natural History in the Comb Ridge area of southwestern Utah has resulted in the recovery of the articulated remains of a new sauropodomorph dinosaur. UMNH VP 18040 is preserved in chaotic, fine-grained sand at the base of the Navajo Sandstone. Most missing elements — including the head, neck, and tail — were eroded away prior to discovery. Recovered elements include: dorsal vertebrae and ribs, both forelimbs, both pubes and ischia, and left tibia and pes. In addition to the scapulae and coracoids, the specimen preserves a complete articulated gastral basket, including paired ossified sternal plates.

Taphonomic evidence, including the articulated nature of the distal limbs, and a complete articulated torso region with gastralia preserved in place, suggests a considerable amount of soft tissue still attached prior to burial. Rapid catastrophic burial is indicated by a complex three-dimensional orientation, as well as the chaotic nature of the sand matrix. Taphonomic, sedimentologic, and petrographic data are suggestive of dune collapse preservation.

UMNH VP 18040 — with its short robust metacarpals and metatarsals, long phalanges, and the presence of a pubic boot — differs from both the sauropodomorph *Anchisaurus* and prosauropod material previously reported from the Navajo Sandstone of Arizona. Prosauropod characteristics of UMNH VP 18040 include: a wide pubic apron, an enlarged distal carpal 1 overlapping distal carpal 2, massive metacarpal I, and a calcanium half the width of the astragalas. Morphological and systematic analyses suggest a close affinity to *Massospondylus*.

Friday 11:15

INTERRELATIONSHIPS OF THE HOLODONTID LUNGFISHES (OSTEICHTHYES, DIPNOMORPHA) BASED ON NEW MATERIAL FROM THE UPPER DEVONIAN GOGO FORMATION OF WESTERN AUSTRALIA

LONG, John, Museum Victoria, Melbourne, Australia

New finds of exceptionally well preserved lungfishes from the Late Devonian (Frasnian) Gogo Formation, Kimberley district, Western Australia, made on the 2001 expedition include additional material of previously poorly known forms as well as new taxa. *Holodipterus longi* was originally described by Campbell and Barwick (1991) from a lower jaw, palate and few isolated bones, is now shown to represent juvenile material. A relatively complete new skull shows the species was a large holodontid, whose absence of tooth rows and very short jaw symphysis (30% jaw length) suggests it should be placed into a new genus distinct from typical *Holodipterus* species (H. *kiprijanowe, H. gogoensis, H. elderae*) which have teeth arranged in distinct rows and massive jaw symphyses (43-55% jaw length). *Holodipterus longi* represents an evolutionary stage between typical holodontids and *Griphognathus*, here considered to be an apomorphic end member of the holodontid group which has lost all teeth except for remnant marginal cusps and has an elongated snout with short jaw symphysis (21% jaw length). Another new holodontid lungfish discovered from Gogo shows the most plesiomorphic condition for the group in its well-developed tooth rows, paired dentary bones, non-fused pterygoids and a discrete space for the parasphenoid. It represents a new species of the holodipterid subgenus *Asthenorhynchus* which can now be elevated to its own generic rank and include 2 species. At Gogo holodontids have radiated into many niches and this event may have precluded occupation by other higher osteichthyan groups which are noticeably absent from the Gogo fauna (eg. porolepiforms, actinistians). The origin of holodontid lungfishes is discussed along with the validity of the Rhynchodipteridae.

Poster Session B

REVISED OSTEOLOGY OF *SUPERSAURUS VIVIANAE*

LOVELACE, David, HARTMAN, Scott, WAHL, William, Wyoming Dinosaur Center, Thermopolis, WY

A second, and more complete, associated specimen of *Supersaurus vivianae* (WDC-DMJ021) was discovered in the Morrison Formation of east-central Wyoming in a single sauropod locality. The skeleton provides a more complete picture of the osteology of *S.*

vivianae, including a surprising number of apatosaurine characteristics. The caudals have heart shaped centra that lack a ventral longitudinal hollow, and the rectangular distal neural spines of the anterior caudals are mediolaterally expanded similar to *Apatosaurus excelsus*. The centra of the anterior caudals are procoelous as in other diplodocids, but the posterior ball is very weakly pronounced. The robusticity of the tibiae and fibulae are intermediate between *Apatosaurus* and diplodocines. The cervical vertebrae demonstrate classic diplodocine elongation with an elongation index ranging from 4 to 7.5. All 7 of the new cervicals have a centrum length that exceeds 1 meter. Mid-posterior cervicals are semicamellate at mid-centra near the pneumatic foramina. The dorsal vertebrae exhibit a high degree of elaboration on laminae, and extremely rugose pre and postspinal laminae. Costal elements are robust, with complex pneumatic innervations in the rib head. Although unknown in other diplodocids, early reports described pneumatic ribs in an *A. excelsus*; unfortunately the described specimen is unavailable.

Inclusion of lesser-known North American diplodocids such as *Supersaurus*, *Seismosaurus* and *Suuwassea* in phyolgenetic studies, may provide a framework for better understanding North American diplodocid evolution.

Poster Session B

A NEW AZHDARCHID PTEROSAUR FROM THE EARLY CRETACEOUS OF LIAONING PROVINCE

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A nearly complete skeleton with a lower jaw of a pterosaur from the Early Cretaceous of western Liaoning is described. It is characterized by its relatively small size, with the ratio of the length to width of the middle series cervical vertebrae approximately 3.5 and the ratio of humeral length to femoral length approximately 96%. The humerus of the new specimen shows great resemblance to that of Azhdarchidae in the ratio of the deltopectoral crest length to the humeral shaft length and the shape of the deltopectoral crest. The new specimen especially resembles an azhdarchid humerus from the Lower Cretaceous Glen Rose Formation of Texas, so it is assigned to that family. The small size of the new specimen and other characters may indicate that it is primitive and it represents the earliest azhdarchid pterosaur from China found so far.

Poster Session B

TRIASSIC RECORDS OF THE THEROPOD FOOTPRINT ICHNOGENUS *EUBRONTES*

LUCAS, Spencer, New Mexico Museum of Natural History, Albuquerque, NM; GIERLINSKI, Gerhard, Polish Geological Institute, Warsaw, Poland; HAUBOLD, Hartmut, Geiseltal Museum, Halle, Germany; KLEIN, Hendrik, Geiseltalmuseum, Halle, Germany; LOCKLEY, Martin, Univ. of Colorado, Denver, CO; TANNER, Lawrence, Bloomsburg Univ., Bloomsburg, PA; HUNT, Adrian, HECKERT, Andrew, New Mexico Museum of Natural History, Albuquerque, NM; THULBORN, Tony, University of Queensland, Queensland, Australia

Eubrontes is a large (length pes impression > 25 cm) grallatorid, bipedal, functionally tridactyl track with a relatively short digit III and a broad pes of a theropod dinosaur. Since the 1970s, many workers have considered the lowest occurrence (LO) of *Eubrontes* to mark the base of the Jurassic, largely based on its stratigraphic distribution in the Newark Supergroup of eastern North America. However, theropods large enough (> 5 m body length) to make *Eubrontes* tracks (e.g., *Liliensternus*, *Gojirasaurus*) are known from Upper Triassic body fossils, and there are several well documented Late Triassic records of *Eubrontes* (*Eubrontes*-size grallatorids) in Australia, Africa and Europe: (1) Blackstone Formation, Queensland, Australia; (2) Lower Elliot Formation, Lesotho, South Africa, (3) Keuper, dAnduze, France; (4) ?Upper Keuper Rhaetian Sandstone, Germany; (5) Hoganas Formation, Scania, Sweden; (6) Tomanova Formation of the Polish-Slovak borderland; (7) Diavel Formation, Swiss Alps; (8) Mercia Mudstone Group, Great Britain; (9) Flemingfjord Formation, Greenland. Furthermore, the palynological change equated to the Triassic-Jurassic boundary in the Newark Supergroup does not correlate to the Triassic-Jurassic boundary in marine strata. The latter boundary is above the oldest Newark basalts, so it is above the pollen change and the LO of *Eubrontes*. This means that the LO of *Eubrontes* in the Newark predates the beginning of the Jurassic; it is probably a Rhaetian datum. Indeed, *Eubrontes* may even have older records in the Newark, such as its possible occurrence at the Culpeper Crushed Stone Quarry in Virginia, which is in the Norian Balls Bluff Siltstone. If the LO of *Eubrontes* actually is a biological event (not just a facies artifact), then its large theropod trackmaker has a markedly diachronous Late Triassic first appearance. It appears first in the Carnian of Australia, then in the Norian-Rhaetian of Africa and Europe and finally in the Rhaetian of eastern North America. The stratigraphic distribution of *Eubrontes* thus falsifies the idea of "ecological release" enabling large theropods to diversify following a putative end-Triassic extinction.

Poster Session B

MAGNETIC STRATIGRAPHY AND GEOCHRONOLOGY OF THE BARSTOVIAN-CLARENDONIAN (MIDDLE TO LATE MIOCENE) PART OF THE MOONSTONE FORMATION, CENTRAL WYOMING

LUDTKE, Joshua, San Diego State Univ., San Diego, CA; PROTHERO, Donald, Occidental College, Los Angeles, CA; SCOTT ANDERSON, Jessica, Riverton, WY; CHAMBERLAIN, Kevin, Univ. of Wyoming, Laramie, WY

The Moonstone Formation in central Wyoming consists of about 400 m of fluvial and lacustrine deposits that mantle the Precambrian granites of the Sweetwater Arch and overlie the lower to middle Miocene Split Rock Formation with a slight unconformity. Previous age constraints were very imprecise ('Pliocene' mammals, now considered middle to late Miocene, and Miocene to Pliocene diatoms). Recent new collections show that the fauna is late Barstovian to earliest Hemphillian in age. Magnetic samples were taken through two fossiliferous sections at Castle Basin and Big Blowout. The samples showed a single component of remanence held mainly in magnetite, with only minor overprinting, and passed a reversal test for stability. Based on a U/Pb date of 11.3 ± 0.5 Ma on the base of the Castle Basin section and a geochemically correlated date of 9.8-10.2 Ma near the top of the same section, we correlate this section with Chrons C5r1r-C5r2r (9.9-11.4 Ma), which is latest Barstovian to earliest Clarendonian. The shorter Big Blowout section was entirely reversed in polarity, and probably correlates with Chron C5r2r (11.1-11.4 Ma). These results suggest that the time between the cessation of Split Rock deposition (earliest Barstovian, 15.9 Ma) and the earliest deposition of the Moonstone Formation (at least 11.4 Ma, and possibly earlier) is only about 4.5 million years or less, much shorter than previously thought.

Saturday 8:45

THE MORPHOLOGY OF BEAR GULCH INIOPTERYGIANS WITH COMMENTS ON THEIR RELATIONSHIPS TO OTHER FISHES

LUND, Richard, Carnegie Museum of Natural History, Mount Holly, NJ; GROGAN, Eileen, Saint Joseph's Univ., Philadelphia, PA

The iniopterygian fishes of the Serpukhovian Bear Gulch Limestone are presented. In doing so, the marine Iniopterygii are thereby known from at least five Upper Mississippian species in addition to the Pennsylvanian species previously described. All members of the order share the two critical autapomorphous characters of the Chondrichthyes; pelvic axis-derived claspers in males and calcified cartilage. They also exhibit the more common form of jaw suspension found in Paleozoic chondrichthyans; autodiastyly. Among the Paleozoic Chondrichthyes, iniopterygians are most recognizable by their apomorphous, dorsally situated and extended pectoral fins. This condition is as yet unique in the Chondrichthyes and only shared in common with certain euteleosteans, such as the Exocetoid Flying Gurnards. Neurocrania are extremely stenobasal, as in Actinopterygii. The Bear Gulch Limestone iniopterygians recovered to date present as two distinct morphs. One morph is represented by three species, displaying large broad heads set on short thick bodies and with extensive plates rimming the head, jaws, and abdomens. Dentition in this group is restricted to the parasymphysial area. The second morph, represented by one species, is close to that of the Pennsylvanian forms in being laterally compressed, with complex, strongly toothed upper parasymphysial and lower symphysial plates, external plates limited in extent, and palatal and pharyngeal dental plates formed by fusion of initial isolated denticles. Dentition of the jaws themselves is questionable. Males of both morphs also have conspicuous denticulation of the leading rays of the pectoral fins. Species of the first morph show strong benthic adaptations, analogous to the teleostean Triglidae; the second morph shares propulsive adapations only with the teleostean Exocetidae (flying fish). We note that cladistic analyses of the Iniopterygii can be potentially misleading in that the highly derived characters may be masking a morphological bauplan fundamental to the origin and early diversification of the Chondrichthyes.

Thursday 1:45

CONVERGENT EVOLUTION OF MYRMECOPHAGAN AND FOSSORIAL ADAPTATIONS OF *FRUITAFOSSOR* AND ECOMORPHOLOGICAL DIVERSIFICATION OF MAMMALS OF THE LATE JURASSIC AND EARLY CRETACEOUS

LUO, Zhe-Xi, WIBLE, John, Carnegie Museum of Natural History, Pittsburgh, PA

Fruitafossor from the Upper Jurassic Morrison Formation is very distinctive from other contemporary mammals. Although similar to eutricondontans, multituberculates, and spalacotheriid symmetrodontans in many mandibular features, *Fruitafossor*'s tubular and single-rooted teeth are entirely different from the generalized insectivorous or omnivorous mammals in the same fauna, and are similar to the teeth of Tertiary armadillos and aardvarks specialized for feeding on colonial insects. *Fruitafossor* retains many primitive features of the scapula, humerus, and ulna, as seen in extant monotremes, docodontans, *Morganucodon*, *Sinoconodon*, and mammaliamorphs, and is far more primitive than the condition of those elements in eutriconodontans, multituberculates, and spalacotheriids through the crown Theria. Its lumbar vertebrae have developed xenarthrous articulations that are similar to those of xenarthran placental mammals, but differ from xenarthrans in retaining mobile lumbar ribs, in lacking the synsacral fusion of the ischium and caudal vertebrae, and in having primitive calcaneal features. Parsimony analysis of all preserved features of *Fruitafossor* and all known dental, cranial, and skeletal features across the major mammal groups has unequivocally ruled out that *Fruitafossor* is related to any extant placentals, and that *Fruitafossor* evolved convergently its tubular teeth and its fossorial features of the forelimb and vertebral column.

Fruitafossor is the earliest-known case of convergent development of termite-eating ('myrmecophagy') dental specializations, combined with fossorial skeletal adaptations in mammalian evolutionary history. The unique dentition and skeletal features of *Fruitafossor* are adding to a rapidly growing body of evidence that, even within the relative narrow range of small body size (30 to 60 grams body mass), mammals of the Late Jurassic to Early Cretaceous

developed diverse locomotory adaptations, and explored feeding guilds other than the terrestrial and generalized insectivorous adaptations. The ecomorphological diversification of basal mammalian lineages is far greater than previously recognized.

Poster Session B

SEXUAL DIMORPHISM IN *EUBAENA CEPHALICA* FROM THE LATE CRETACEOUS (HELL CREEK FORMATION) OF SOUTHWESTERN NORTH DAKOTA

LYSON, Tyler, Swarthmore College, Swarthmore, PA; SCHACHNER, Emma, Bristol Univ., Bristol, United Kingdom; TREMAIN, Emily, Univ. of Kansas, Lawrence, KS; HANKS, Harold, Marmarth Research Foundation, Marmarth, ND

The Mosquito Creek Quarry, located in the Hell Creek Formation of southwestern North Dakota has produced over 40 baenid turtle shells and 15 baenid skulls. All of the shells collected have been identified as *Eubaena cephalica*, based off the presence of suprapleurals. The turtles occur on a horizon of ripup clasts overlain by approximately one meter of fine-grained cross-bedded sandstone and laminated clay layers. This depositional environment suggests a mass mortality event that occurred due to a sudden climatic or liminological shift. Preservation of the specimens is remarkable, containing complete skulls, shells, and limb bones.

The number of specimens and variety of ages (based of carapace length) at this site provides an opportunity to analyze ontogenetic variation and sexual dimorphic characters within this particular species. Like other chelonians, the plastron and carapace of *E. cephalica* is sexually dimorphic. Male plastrons are concave and have long gracile epiplastral lobes. The female plastrons are flat and have short robust epiplastral lobes. In general, the female carapaces are larger, higher domed, and more circular compared to the male carapaces. There is a wide range in size of shells: the smallest carapace length is 19 cm while the largest is 33 cm long. The general carapace shape remains the same throughout development. The mesoplastral bones change shape from triangular to trapezoidal.

Wednesday 11:45

COMMUNICATING EVOLUTION THROUGH NATURAL HISTORY MUSEUM EXHIBITS AND RELATED PUBLIC PROGRAMS

MacFADDEN, Bruce, DUNCKEL, Betty, Univ. of Florida, Gainesville, FL

With attendance at natural history museums in the tens of millions annually, these institutions can play a significant role in communicating to their visitors about evolution through exhibits and related public programs. Furthermore, they are the principal venues in which the objective evidence for evolution, i.e., specimens, is displayed. A NSF-funded project (ESI-0138030) investigated visitor understanding of evolution at six natural history museums (USNM, Florida, Kansas, Denver, LACM, and George C. Page) across the United States. The study addressed visitors' knowledge of fossils and fossil evidence, understanding of geological time, understanding of biological change, and personal views about evolution. The results from 624 visitor interviews help elucidate concepts of evolution that are fairly well known (e.g., fossil evidence) versus those that are poorly understood (e.g., magnitude of geological time, microevolution). As a follow-up to the research study, a national conference on visitor understanding of evolution in natural history museums was held in Gainesville, FL in 2004 that included administrators, curators, exhibit designers, educators, psychologists, informal learning consultants, and NSF program directors representing 28 institutions. The research data and conference proceedings are yielding a series of recommendations and 'best-practices' to inform future natural history exhibit content development and communication strategy choices. For example: some concepts (e.g., macroevolution) are well suited for paleontology exhibits, whereas others (e.g., microevolution) are better suited to exhibits with genomic content. Gaps in evolution content of existing natural history exhibits can be augmented with related public programming. In designing new natural history exhibits, a holistic approach that uses a variety of halls and integrates physical, cyber-exhibits, and public programming may well be the optimal strategy for the most effective communication of evolutionary content and learning environment for the natural history museum visitor.

Poster Session B

ON A THEROPOD SCAPULA FROM THE LATE CRETACEOUS (BAURU GROUP) OF BRAZIL

MACHADO, Elaine, KELLNER, Alexander W., Museu Nacional/UFRJ, Rio de Janeiro, Brazil; CAMPOS, Diogenes de, Museu de Ciencias da Terra, Rio de Janeiro, Brazil

The record of theropod dinosaurs in Brazil is very scarce. From the Bauru Group, the largest Cretaceous continental deposit in the country, theropod remains are restricted to the incomplete skeleton of the abelisaurid *Pycnonemosaurus nevesi* (Mato Grosso), an unnamed abelisaurid premaxilla (Sao Paulo), and isolated teeth. Here we report a right scapula (housed at the Earth Science Museum of the DNPM/Rio de Janeiro) that is the first evidence of a Tetanurae from the Bauru Group. The specimen was recovered from the outskirts of the village Peiropolis, Minas Gerais. It consists of a right element that was found isolated in the sandstones of the Marilia Formation (Campanian-Maastrichtian), the uppermost unit of the Bauru Group. The bone surface is extremely well preserved and does not show any sign of distortion. The dorsal tip of scapular blade and part of acromium process are incomplete. The total length of the preserved portion is around 15cm, indicating that it belongs to a small to medium sized animal. It is a long and slender element and the shaft has an oval cross-section close to the glenoid fossa but gets gradually more compressed and blade like closer to the vertebral column. The scapula blade is long and strap-like with sub-parallel margins. The shaft has a significant anterior curvature, similar to *Microraptor zhaoianus*. The glenoid fossa is directed posteroventrally and not laterally as in avialans and closely related taxa (e.g., *Unenlagia comahuensis*). The articulation surface with the coracoid is clearly visible, demonstrating that scapula and coracoid (not preserved) were unfused.

Comparisons with other theropod dinosaurs are limited but the overall morphology of this new specimen indicates that it is not a member of the Aviale nor a member of the Abelisauria. It also differs from more basal members of the Theropoda, but the shape (particular the glenoid region) is consistent with several members of the Tetanurae, particularly the Dromaeosauridae. Despite the lack of precision in the phylogenetical position, this new specimen clearly demonstrates the presence of two distinct theropod clades in the Bauru Group.

Student Poster Session

MORPHOLOGY, HISTOLOGY, AND DISTRIBUTION OF TEETH IN EARLY GNATHOSTOMES FROM THE MACKENZIE MOUNTAINS, NORTHWEST TERRITORIES

MacKENZIE, Lindsay, Univ.of Alberta, Edmonton, AB, Canada

The origin of teeth is a heavily debated topic that is not easily answered. There are two main hypotheses about how teeth evolved. The first is that they evolved from denticles lining the oro-pharyngeal cavity of fishes. The second is that they evolved from body scales that migrated into the oral region and became specialized.

There is also a great deal of debate about what constitutes a tooth versus a denticle. We will initially use the definitions suggested by W. E. Rief and possibly make future modifications. A tooth is defined as an element of dentition produced in a deep epidermal invagination, called a dental lamina. A denticle is formed superficially and does not originate in an invagination, but rather directly at the epithelium.

The specimens being studied constitute putative chondrichthyans and acanthodians from the M.O.T.H. locality in the Northwest Territories, Canada. These are Devonian fishes that show much diversity in teeth and tooth-like structures. The structures range from none at all to specialized lip scales, crushing tooth plates, whorls, and specialized shearing structures. I plan to describe the morphology, histology, and distribution, both on the body of the fish as well as among the taxa, of the scales, teeth, and tooth-like structures. I hope to clarify which are teeth and will possibly modify the definition of a tooth as well as give definitions for certain tooth specifications. The observed characteristics will then be placed in a phylogenetic framework based on the work of G. Hanke. Some of the specimens have preserved stomach content, which I hope to examine for possible diet (i.e., look for bone or shell fragments).

The observations should lead to a better phylogenetic and functional understanding of the tooth-like structures. Some of the new characters noted about the teeth or denticles may slightly change the most accepted phylogeny to date. This, in turn, may have an impact on the interpretation of the evolution and development of teeth in early fishes.

Saturday 9:30

NEW HOMINOID DENTAL SPECIMENS FROM MOROTO II, EARLY MIOCENE, UGANDA

MacLATCHY, Laura, Univ. of Michigan, Ann Arbor, MI; ROSSIE, James, State Univ. of New York, Stony Brook, NY

The Moroto II locality from northeast Uganda is radiometrically dated to >20.6 Ma. The type specimen of the large hominoid Morotopithecus bishopi is from this locality, and consists of part of the face and maxilla of a single individual. Other published hominoid dental remains from Moroto II include three isolated upper teeth (2 canines and 1 molar) and a fragmentary, edentulous mandible. All dental specimens but one isolated canine have been interpreted to be male, with male size similar to that found in *Proconsul major* and *Afropithecus turkanensis*. The differences in size among the known upper canines, should they all come from the same taxon, suggests a high level (i.e. Gorilla-like) of sexual dimorphism. Here we report on a new right mandible and the first hominoid lower tooth crowns from Moroto II. The central incisor crown is broken off, but the lateral incisor is labiolingually long and narrow, as in *Proconsul* and *Afropithecus*. The canine has a distinct distal heel with radiating striations lateral to the junction of the distal ridge and lingual cingulum. The canine also has a flat mesiolingual face, rather than the rounded outline seen in male and female *Proconsul*, and male *Afropithecus*. In terms of the size of the base, the canine falls within the distribution of those of female *P. major* or *P. nyanza*e, but the tip is missing. The crowns of the premolars are also absent but judging from the roots, P4 was as long as P3, which distinguishes the specimen from both *Proconsul* and *Afropithecus* because the latter have relatively shorter P4s. The molars are narrow and long, and relatively large compared to canine size. Overall, the new mandible confirms the presence of a morph with much smaller canines than represented by the type specimen of *Morotopithecus* or the large, edentulous mandible. On the basis of the lower dental traits, this morph can be distinguished from both *P. major* and *A. turkanensis*. If all the large and small specimens are from a single species, the degree of dimorphism is high, but it is also possible that more than one hominoid taxon is present at Moroto II.

Friday 11:45

THE DECLINE AND FALL OF THE NON-AVIAN DINOSAURS

MacLEOD, Norman, Natural History Museum (London), London, United Kingdom; ARCHIBALD, J. David, San Diego State Univ., San Diego, CA

Despite claims to the contrary, the cause or causes of the non-avian dinosaur extinction at the end of the Cretaceous remain as controversial as ever. The reason little progress has been, and perhaps will never be made, has to do with (1) the nature of the end-Cretaceous dinosaur record and (2) the nature of cause-effect tests involving historical data. Two proposals have appeared recently that purport to account for this extinction. Both assume a bolide impact was the sole cause. The first suggests that following collision, impact ejecta re-entering the atmosphere would create a "thermal pulse" that would kill any land-dwelling organism that could not find shelter quickly. While this scenario may account for the general pattern of dinosaur extinction, it falters when its predictions are referenced to other terrestrial (e.g., birds, evidence for wildfires, evidence from terrestrial invertebrates) and marine groups. The second proposal addresses the data used to support the long-standing observation that non-avian dinosaur species richness values declined from a late Campanian high through the Maastrichtian. This proposal uses a questionable interpretation of rarefaction results to suggest that late Maastrichtian values were the equal of—if not greater than—late Campanian values. A reanalysis of the data on which these conclusions are based not only fails to reproduce these results, it confirms the magnitude of the Maastrichtian dinosaur richness decline and offers further detail into that decline's taxonomic structure. Other proposals involving combined analyses of turtles, mammals, and plants and another analysis of plants do offer sufficient temporal resolution to rule out a long-term richness decline in these groups, but not to the point where differences between extinction patterns played out over 50-500,000 years could be recognized. Given the certain knowledge that several potential extinction mechanisms were active in the Earth's environment over this interval, the singling out of any one as the only cause of non-avian dinosaur extinction is more a matter of speculation than science.

Friday 9:00

SIGNIFICANCE OF ASYNCHRONOUS SLOTH EXTINCTIONS ON CONTINENTS AND ISLANDS DURING THE LATE QUATERNARY

MacPHEE, Ross, American Museum of Natural History, New York, NY; STEADMAN, David, Florida Museum of Natural History, Gainesville, FL; MARTIN, Paul, Univ. of Arizona, Tucson, AZ

Dozens of genera of large mammals became extinct during the late Quaternary throughout the western hemisphere. Sloths (Xenarthra, Phyllophaga) lost approximately 90% of their diversity at the generic level; only the small continental tree sloths *Choloepus* and *Bradypus* have survived. The 19 genera of nothrotheriid, mylodontid, megatheriid, and megalonychid sloths that lived in the continental Americas during the late Pleistocene are comparatively well known and figure prominently in debates concerning the cause of late Quaternary extinctions. The five genera of megalonychid sloths that lived in the West Indies during the same interval have garnered much less attention. These taxa ranged in size from the Cuban graviportal species *Megalocnus rodens* (at ~200 kg, the largest Antillean land mammal) to the smallest known sloth, the tree-dwelling *Neocnus toupiti* (~4 kg) from Hispaniola.

Radiocarbon dates on dung, bones, or other tissue of extinct continental sloths place their last appearance datum at ~11,000 yr BP in North America and ~10,500 yr BP in South America, apparently in concert with the simultaneous loss of proboscideans and many other large continental mammals. By contrast, a new series of AMS dates on various West Indian sloths places the last appearances of these megalonychids much later in time, ca. ~4400 yr BP. How should this apparent mismatch be interpreted?

The role of anthropogenic vs. climatic factors continues to be a source of debate in regard to continental losses, in part because end-glacial conditions overlapped with the arrival of the first humans in the New World, thus muddying any basis for distinguishing their roles. In the West Indies. however, sloth extinctions are decoupled from the period of continental losses by thousands of years. Asynchronous losses of this magnitude are not compatible with glacial-interglacial climate change forcing both sets of sloth extinctions. Instead, the last appearance chronology for extinct sloths, whether on continents or islands, more closely tracks the first arrival of people as established by the archeological record (~13,000 yr BP in the continental Americas, ~5500 BP in the Greater Antilles).

Thursday 2:15

A DIGITAL CRANIAL ENDOCAST OF *VINCELESTES* AND A DISCUSSION OF THE EVOLUTION OF ENDOCRANIAL SPACE IN MAMMALS

MACRINI, Thomas, Univ.of Texas Austin Dept of Geosciences, Austin, TX; ROUGIER, Guillermo, Univ. of Louisville, Louisville, KY; ROWE, Timothy, Univ. of Texas, Austin, TX

The study of endocranial space in fossil mammals was historically limited by the availability of natural endocast material or specimens from which artificial endocasts could be easily extracted. High-resolution X-ray computed tomography (HRXCT) is a proven and relatively recent technique for increasing taxonomic sampling by allowing extraction of digital endocasts from virtually any skull. Using HRXCT, a digital endocast was extracted from *Vincelestes neuquenianus*, an early Cretaceous theriiform mammal from Argentina. This represents the first endocast from a close relative of crown Theria and therefore it is important for understanding the evolution of endocranial space in therians. This endocast is compared with other endocasts extracted from a number of extant taxa from the three major clades of living mammals.

Similar to its skull and previous reconstructions of its cranial vascular systems, the endocast of *Vincelestes* possesses a combination of ancestral and derived features. *Vincelestes* possesses relatively large olfactory bulb casts and smooth (= lissencephalic) cerebral hemisphere casts, both conditions being plesiomorphic for Theria and Mammalia. The medulla oblongata and pons of the hindbrain do not leave distinctive impressions on the *Vincelestes* endocast, which is most likely the ancestral condition for Mammalia. However, *Vincelestes* possesses reduced parafloccular casts of the cerebellum (confirming previous studies), and a large bulge on the dorsal surface of the endocast that covers the midbrain, both potentially derived characters. Presence of enlarged parafloccular casts are plesiomorphic for Mammalia but reduction of these casts has occurred in several other mammalian taxa besides *Vincelestes*. The large bulge covering the midbrain most likely represents a cast of an anteriorly expanded vermis of the cerebellum.

Wednesday 11:00

A LARGE VARANODONTINE VARANOPID (SYNAPSIDA: EUPELYCOSAURIA) FROM RICHARDS SPUR, OKLAHOMA

MADDIN, Hillary, EVAND, David, REISZ, Robert, Univ.of Toronto at Mississauga, Mississauga, ON, Canada

The karst deposits at Richards Spur, Oklahoma, provide a unique insight into the upland vertebrate communities of the Early Permian. Varanopid synapsids are represented in this assemblage by *Mycterosaurus*. Here we report on a new varanopid that is significantly larger than any known mycterosaurine and similar to *Varanops*. The skeletal remains consist of a partial maxilla, two parabasisphenoids, partial humeri, a proximal ulna, tibiae and several dorsal vertebrae from at least two individuals collected from a single block. We also attribute a well preserved but incomplete maxilla from a different area within the sediment to this taxon. The maxilla has an expanded, triangular dorsal process. The lateral surface of the maxillary process has a vertical ridge at the confluence of two depressions. This morphology is also seen in *Varanops* and *Varanodon*, and is diagnostic of varanodontines. Maxillary teeth are characteristically varanopid with sharply recurved and finely serrated crowns. The parabasisphenoid is particularly distinctive. Teeth extend from the base of the cultriform process to the posterior margin of the parasphenoid plate. It shares with other varanodontines the presence of a posteromedial dental field, but differs from known taxa in having relatively large basipterygoid processes, raised marginal dental fields, and deep vidian sulci. The appendicular bones are distinctly varanopid and closely resemble *Varanops* in size and morphology. Similarly, the dorsal vertebrae and the lateral excavations of their neural arches are comparable to *Varanops*. The ventral keel of the centrum is less prominent than in sphenacodontids.

This new varanodontine varanopid is the largest carnivore known from Richards Spur, and may have been a top predator in the ecosystem represented by this assemblage. Varanopids are generally rare components of Paleozoic continental communities. At Richards Spur varanopids are the most commonly found synapsids, and the presence of a second taxon suggests that these agile predators may have been more common in upland communities than in the widely sampled fluviodeltaic assemblages of Laurasia.

Poster Session A

WHERE TO LOOK FOR MORE FOSSILS: A GIS APPROACH

MAGA, Murat, Univ.of Texas at Austin, Austin, TX

Remote sensing is a powerful technique for geological exploration of unknown regions of interest. For vertebrate paleontologists, this means that remote sensing can help them to isolate potentially fossiliferous areas more readily. The primary drawback of remote sensing approach is that it requires detailed knowledge of spectral image processing and depends on special software packages. However, if the region is not completely unexplored, meaning that at least some geologic mapping is done, a typical GIS raster analysis perhaps can be helpful. In addition to the geology map, the imagery required is readily available on the Internet: Thematic satellite imagery to model the land cover, and digital elevation models (DEM).

The proposed conceptual model is rather simple. A survey for fossils should take place where the fossils can be seen, and in geologic units appropriate for the hypotheses being tested. Using the thematic imagery, vegetation can be classified as covered, partially covered, and open. The open areas can be used in conjunction with the geologic map to determine the locations most likely to produce good survey results. The topography of the region can be modeled using the DEMs. If the lithologies and structural arrangements are known to a further extent, then the slope information can be reclassified into regions of high erosion versus low erosion. Finally, based on the conceptual weighting (e.g., if the vegetation covers everything densely, it doesn't matter what the underlying rock is) of each of these factors, a composite overlay can be produced from the raster analysis.

If any fossil collection is done in this region, then the spatial density distribution of the fossils can be utilized as a reality check of the conceptual survey model. If the model predicts the fossil producing areas, then it can be assumed successful. If not, then the parameters can be adjusted in subsequent iterations until there is a significant overlap between where the fossils occur and the results of the model.

Student Poster Session

CHINA'S STEGOSAURS: A REVIEW OF UPPER JURASSIC ARMOURED DINOSAURS FROM CHINA

MAIDMENT, Susannah, Univ.of Cambridge, Cambridge, United Kingdom

Nine species of stegosaurian dinosaur have been named on the basis of material from the Upper Jurassic of China, suggesting that in Asia there was a stegosaur fauna far more diverse than that of the rest of the world during the Upper Jurassic. However, many of the original specimens used to diagnose and describe these species are currently lost or unavailable. Moreover, the Chinese stegosaurs have proved to be unstable in cladistic analyses of the clade, and the original descriptions and figures are often inadequate. A robust alpha-level taxonomy is a necessity to ongoing studies of stegosaur evolution, phylogeny and palaeobiology. Supplementary information on previously described specimens is presented here and new taxonomic revisions are carried out to assess the validity of these nine species. Only *Tuojiangosaurus multispinus*, *Chungkingosaurus jiangbeiensis* and *Wuerhosaurus homheni* are found to be valid taxa, with autapomorphies pertaining to features of the sacra in all cases. The holotype specimen of *"Chialingosaurus kuani"* is juvenile and putative diagnostic characters are all related to ontogeny, whilst other taxa, including *"Monkonosaurus lawulacus", "Wuerhosaurus ordosensis"* and *"Gigantspinosaurus sichuanensis"* are based on fragmentary, undiagnostic or as yet undescribed material.

Poster Session B

CRETACEOUS PALEOGEOGRAPHY AND THE PALEOBIOGEOGRAPHIC DISPERSAL OF THE HADROSAURS

MAIN, Derek, SCOTESE, Christopher, Univ. of Texas at Arlington, Arlington, TX

The post-Pangean world of the Cretaceous was a time of continued paleogeographic evolution. Accelerated rifting of the Atlantic Ocean basin separated N. America from Eurasia and Gondwanaland, pushing N. America towards the Arctic. Concurrently, a land bridge formed between Asia and N. America. The land bridge formed from the counterclockwise rotation of the North Slope Block due to Arctic rifting associated with the opening of the Canada basin. The collision of the North Slope Block with Proto-Alaska formed an accreted land mass; Berengia. The Berengian land bridge was established in the Albian, permitting a biogeographic pathway between eastern Eurasia and N. America. During the Cenomanian both western and eastern N. America was available for colonization from Eurasia. This situation changed with the Turonian transgressive cycle. The Late Cretaceous sea level high stand united the N. American interior seas, closing off biogeographic pathways and forming two separate paleogeographic regions; Laramidia and Appalachia. As the Berengian land bridge provided a dispersal route from eastern Eurasia to Laramidia, the continued rifting of the Atlantic presented a significant dispersal barrier to faunas migrating from western Eurasia to Appalachia. A paleobiogeographic model for the dispersal of hadrosaurs is proposed with a Mid-Cretaceous Asiatic origins and a subsequent eastern migration to N. America via the Berengian land bridge. The Turonian transgressive cycle closed biogeographic pathways between Laramidia and Appalachia, establishing separate faunal realms. Laramidian hadrosaur faunas varied with latitude, showing distinct biotic provincialism and a higher overall diversity than those of Appalachia. This pattern is possibly a biogeographic phenomenon, or a reflection of sampling bias and gaps in the fossil record. Paleobiogeographic patterns of hadrosaur distributions are presented with a time slice series of paleobiogeographic maps. These maps demonstrate dispersal paths and the global distribution of hadrosaurs. The new maps provide a framework for understanding hadrosaur paleobiogeography in response to Cretaceous paleogeographic evolution.

Friday 9:30

THE DEVONIAN VERTEBRATES OF SOUTH AMERICA AND THEIR PALEOBIOGEOGRAPHICAL RELATIONSHIPS

MAISEY, John, American Museum of Natural History Dept of Paleontology, New York, NY; JANVIER, Philippe, Museum national d'Histoire Naturelle, 8 rue Buffo, Paris, France

In South America, Devonian vertebrates occur in Colombia, Venezuela, Brazil, Bolivia, and the Falklands. The Middle-Upper Devonian assemblages of Colombia and Venezuela include placoderms, acanthodians, actinopterygians, and sarcopterygianswhich are found also in Euramerica, North Africa and Australia; that is, along the Devonian tropical belt. By contrast, the contemporary faunas of Bolivia are dominated by acanthodians and chondrichthyans, with a single rhenanid placoderm, rare Frasnian actinopterygian remains, and a dunkleosteid arthrodire in Famennian diamictites. The only diverse Devonian vertebrate assemblage from Brazil is Early Devonian (Lochkovian), and is reminiscent of contemporary Bolivian faunas in having only acanthodians and chondrichthyans. It has been suggested that the Bolivian and Brazilian faunas are bound to colder waters of the Malvinokaffric Realm, a view supported by the occurrence of the chondrichthyan *Pucapampella* in the early Middle Devonian of Bolivia and late Lower Devonian of South Africa. However, this explanation is challenged by the occasional Middle Devonian occurrence of placoderm- and osteichthyan-bearing faunas in South Africa and a placoderm in the Falklands. It is thus possible that the Malvinokaffric faunas of Bolivia and South Africa were in fact bound to particular environmental conditions, rather than simply to cold waters. The Late Devonian (Frasnian) vertebrate fauna of Colombia (and to some extent Venezuela) is a mix of taxa that, before the Famennian, are either exclusively Gondwanan (groenlandaspidids, antarctilamnids, megalichthyids) or typically Euramerican (holoptychiid porolepiforms and the antiarch *Asterolepis*). This suggest that Late Devonian contact between Gondwana and Euramerica allowed faunal interchange, rather than a single northward range expansion of certain taxa. South America is unique in displaying widely different Devonian vertebrate faunas, unlike for example in Euramerica, Siberia, China, or Australia.

Saturday 2:30

WALKING WITH SAUROPODS: MODELING DINOSAUR LOCOMOTION IN MSC.VISUALNASTRAN 4D

MALLISON, Heinrich, PFRETZSCHNER, Hans-Ulrich, Tübingen Univ., Tübingen, Germany

In recent years computer animation and modeling has been extensively applied in vertebrate paleontology. New and improved methods of data acquisition, e.g. laser or CT scanning and mechanical digitizing, have provided simple solutions for transferring information from bones into digital formats. CAD programs allow easy creation of 3D models and faster computers make more and more complex models with a wide range of variables manageable.

We employ a commercial, off-the-shelf physics modeling program to study sauropod locomotion in depth. For a simplified model, a walking cycle is developed and ground reaction forces, rotational moments, as well as contraction forces and rates for major muscle groups are determined at various walking speeds to establish a bracket of probable and feasible locomotory modes. The influences of neck and tail movements are assessed.

We find that in addition to a slow walk, where three feet are on the ground at all times, sauropods were probably capable of a fast pace, similar to elephants, in which only two feet must be in contact with the ground at all times.

We also trace the center of gravity and find that at higher speeds it lies significantly forward of the supporting feet, contrary to assumptions by other researchers and similar to all recent large animals with parasagittal legs. As no shoulder mobility is incorporated in our model the results are conservative and represent absolute minimums as far as walking speeds are concerned. These modes of locomotion are compared to prosauropods.

Results are checked against detailed digital models of major joints based on digitized bones and by comparison with recent animals.

Poster Session A

VERTEBRATE REMAINS FROM THE EOCENE OF THE BUGTI HILLS (BALOCHISTAN, PAKISTAN)

MARIVAUX, Laurent, Institut des Sciences de l'Evolution, UMR 5554-CNRS, Montpellier, France; METAIS, Gregoire, Carnegie Museum of Natural History, Pittsburgh, PA; ANTOINE, Pierre-Olivier, Universite Toulouse III, Toulouse, France; BAQRI, Syed Rafiqul Hassan, Pakistan Museum of Natural History, Islamabad, Pakistan; CROCHET, Jean-Yves, WELCOMME, Jean-Loup, Institut des Sciences de l'Evolution, UMR 5554, Montpellier, France

For some years, prospecting for vertebrate fossils in the Bugti Hills (Bugti Agency, Northeast Balochistan) has mainly focused on land mammals from the Oligocene Chitarwata Formation. However, recent investigation in the Eocene formations of the same area has yielded some fragmentary remains of Tethyan marine mammals (including archaeocete Cetartiodactyla and Sirenia). These fossils were collected in the middle Eocene Domanda Formation and in the middle-upper Eocene Drazinda Formation. These formations are particularly important as they already produced numerous remains of archaeocete cetartiodactyls, especially but not exclusively in the Zinda Pir region. In the Bugti Hills, most of the collection was made from two stratigraphic intervals: the lower and middle part of the Domanda Formation has produced some very fragmentary and unidentifiable remains of archaeocete whereas the lower part of the upper Drazinda Formation has yielded fossils of marine mammals including ribs of protosirenid sea cow, large thoracic vertebrae and mandible remains suggestive of Basilosauridae. These formations are broadly exposed in the Bugti territory, and the contact between the Drazinda shale and the Oligocene Chitarwata Formation is a major unconformity in the Tertiary sequence, suggesting that the upper part of the Drazinda Formation is lacking in the Bugti region. On the other hand, attractive outcrops situated in the north part of the Bugti territory, hitherto inaccessible, were preliminarily surveyed in winter 2004. This exploration revealed excellent exposures of the lower Eocene Baska, Drug, and Ghazij formations, but vertebrate remains have yet to be found. Further investigations are needed to complete the Tertiary stratigraphic sequence observable in the Bugti-Mari Agency. In the Sulaiman Lobe area, both the Eocene formations of the Kirthar Group and the Oligocene Chitarwata Formation are widely exposed, and apparently less affected by tectonics than in the Zinda Pir area, about 150 km Northeast of Dera Bugti.

Saturday 8:30

***IN VIVO* CRANIAL SUTURE FUNCTION AND SUTURE MORPHOLOGY IN EXTANT FISH: IMPLICATIONS FOR INFERRING SKULL FUNCTION IN FOSSIL TAXA**

MARKEY, Molly, MAIN, Russell, MARSHALL, Charles, Harvard Univ., Cambridge, MA

This study describes the mechanical role cranial sutures play in fish during feeding. The long-term goal of our work is establishing relationships between suture form and function, so that functional inferences can be made from suture morphology in fossil taxa. We are particu-

larly interested in using this approach to help understand changes in function associated with the shift from aquatic to terrestrial environments during the fish-amphibian transition. To this end, strain gauges were surgically implanted across selected sutures in the skull roof of four individuals of *Polypterus endlicheri*, and two *Amia calva* individuals. After surgery, strains resulting from feeding were recorded along with high-speed videos of the feeding events. In each trial, suction feeding versus biting on prey was established, and head lifting, hyoid position, and gape were quantified to aid in interpreting the strain data.

The strains due to suction feeding are different from those observed during biting. Suction feeding is characterized by tension across the interfrontal and frontoparietal sutures, while the interparietal suture is loaded in compression. In contrast, biting results in tension across the interfrontal, and a tension-to-compression shift across the frontoparietal. In addition, biting loads the interparietal suture in compression followed by tension. Muscle activity patterns measured during feeding available in the literature provide the basis for explaining these differences.

MicroCT scans of the experimental specimens indicate that the interfrontal and frontoparietal sutures, typically loaded in tension, are less interdigitated in cross section than the interparietal suture, which experiences compression. This is consistent with published correlations of suture form and function, where interdigitated sutures indicate compression and lack of interdigitation is associated with tension. Cross-sectional sutural morphology is preserved in fossils and is accessible via CT scanning, and therefore the results of this study should help discern feeding differences in extinct taxa based on their cranial sutures.

Poster Session B

THE "DEAD BIRD" POSTURE IN DINOSAURS: NOT *RIGOR MORTIS*, BUT DEATH THROES

MARSHALL FAUX, Cynthia, Museum of the Rockies and Yale Univ., Bozeman, MT; PADIAN, Kevin, Univ. of California, Berkeley, Berkeley, CA

An extreme, dorsally hyper-extended posture of the spine (opisthotonus) is observed in many well-preserved, articulated tetrapod skeletons (birds and other dinosaurs, pterosaurs, and mammals). Post-mortem water transport may explain many cases of spinal curvature in fossil tetrapods, but these can usually be distinguished from biotic causes, including disease. Traditional biotic explanations nearly all involve post-mortem causes, and have included *rigor mortis*, desiccation, and contraction of tendons. Examination of the process of *rigor mortis* and observations of drying in carcasses show that most traditional interpretations and explanations of the "dead bird" posture explain few or no cases. Neither *rigor mortis* nor desiccation of muscles and tendons produces opisthotonus. It is not post-mortem contraction but peri-mortem muscle spasms resulting from various afflictions of the central nervous system that cause these extreme postures. Such individuals probably died from oxygen deprivation, lack of nourishment or essential nutrients, or environmental toxins, among other causes. It seems important that opisthotonus has only been observed in animals that are known or thought to have high basal metabolic rates. Recognizing opisthotonus in fossil specimens can provide insights not only into possible causes of death, but into paleoenvironmental conditions.

Poster Session A

FIRST BURROW CASTS OF TETRAPOD ORIGIN FROM THE LOWER PERMIAN (TAMBACH FORMATION) IN GERMANY

MARTENS, Thomas, Grossrettbach, Germany

This abstract reports the recent discovery of large burrow casts at the important Lower Permian tetrapod locality 'Bromacker' near Tambach-Dietharz, (Thuringian Forest, Germany). The locality belongs to the uppermost level of the Tambach Sandstone in the middle part of the Tambach Formation (Upper Rotliegend, Lower Permian). The 'Bromacker' is known because of most excellent preserved fauna of terrestrial adapted tetrapods of Lower Permian.

Most of burrow casts are filled with little mixed siltstone/clay stone pebbles in siltstone layers. The pebbles are small sediment casts. Normally the fine-grained siltstone is more or less laminated. 5 to 90% of the sediment can be changed through the bioturbation by some invertebrates and tetrapods shown as borrow casts with different diameters.

Megatambichnus sp. is the newly proposed name for the large burrow cast and trace fossil system (burrow diameter: 10-30 cm) and may be made by digging diadectids (*Diadectes absitus* or *Orobates pabsti*) or associated with the tetrapod footprint *Ichniotherium cottae* from the same locality. *Tambia spiralis* was the name created for the smallest burrow cast (burrow diameter: 2-3 cm) and may be made by crustaceans or by a digging small protorothyridid tetrapod (*Thruringothyris mahlendorffae*). *Scoyenia gracilis* is the smallest burrow cast (burrow diameter: 0.5-1.0 cm) with typical biogenic compressed structure and is made by an invertebrate (maybe by a sediment feeding worm?) *Megatambichnus* is a type of trace fossil with a system of straight and arch-shaped impressions, in groups of 3 to 5 parallel scratch marks externally and especially on the bottom of the large burrow casts. In the deepest part of the beginning helical burrow I found a terminal chamber with frequent impressions on the underside with the same scratch made system.

Megatambichnus sp. and *Tambia spiralis* are the oldest fossil burrow casts of proposed tetrapod origin. Thus, to dig and live in more or less dry and soft sediments (soil) is a very ancient way of life for tetrapods, beginning with the development of the first terrestrially adapted Amniotes in the upper most Carboniferous and Lower Permian of Pangaea.

Friday 9:00

AVIAN TRACKS AS INITIATORS OF MUDCRACKS: MODELS FOR SIMILAR EFFECTS OF NON-AVIAN THEROPODS?

MARTIN, Anthony, Emory Univ., Atlanta, GA

When given certain substrate conditions, behaviors, and pes anatomy, avian tracks can initiate and advance the formation of mudcracks on sedimentary surfaces more so than surfaces lacking tracks. Previously documented examples of these effects are primarily from substrates with algal films, such as in some marine or lacustrine shorelines. In this study, abundant avian tracks and associated mudcracks were observed during subaerial exposure of inland saline lakeshores of San Salvador, Bahamas. Lake sediments were composed largely of carbonate mud and lesser amounts of wind-blown silt and clay bound by thin algal films. Tracks were made by primarily two species, the ardeid *Nyctanassa violacea* and recurvirostridid *Himantopus mexicanus*, which were hunting land crabs and fiddler crabs, respectively. Avian feet that pierced algal films compromised moisture retention of underlying muds; accordingly, mudcracks began on distal ends of digit impressions and spread laterally with further drying. Pes anatomy also apparently influenced the development of mudcracks; both avian species have relatively thin, long digits, digital divarication, proximal webbing, and small metatarsal pads. Closely spaced and abundant tracks caused by foraging facilitated interconnections between cracks and encouraged further mudcrack development. For example, the relatively shorter pace of *H. mexicanus* was a greater factor in causing mudcracks than the larger pes of *N. violacea*. Mudcrack development was also enhanced in areas between saturated and unsaturated sediments along lake peripheries, which were more frequently transected by *H. mexicanus* during its foraging. *H. mexicanus* also tends to forage diurnally, which causes more rapid development of mudcracks from its tracks than those of the more nocturnal *N. violacea*. These observations argue for more careful scrutiny of ancient mudcracks in similar facies for evidence of avian or non-avian theropod influence. Mudcracks and other deformation structures directly associated with a theropod resting trace (Hitchcock's specimen AC 1/7) provide for an Early Jurassic application of this model.

Poster Session A

A JUVENILE PLESIOSAUR AND ASSOCIATED VERTEBRATES FROM THE LATE CRETACEOUS OF ANTARCTICA

MARTIN, James, South Dakota School of Mines & Technology Museum of Geology, Rapid City, SD; CASE, Judd, St. Mary's College, Moraga, CA; REGUERO, Marcelo, Museo de La Plata, La Plata, Argentina; SAWYER, J. Foster, SD Geological Survey, Rapid City, SD; SANTILLANA, Sergio, Instituto Antarctico Argentino, Buenos Aires, Argentina; MOLY, Juan, Museo de La Plata, La Plata, Argentina

A cooperative field expedition between the US National Science Foundation and the Instituto Antarctico Argentino during January and February 2005 produced exceptional fossil vertebrates from the Late Cretaceous deposits of the Antarctic Peninsula. From the Maastrichtian rocks exposed on Vega Island, specimens were found in the Cape Lamb and Sandwich Bluff members. Most specimens represent marine reptiles, but some fossils include terrestrial creatures washed into the shallow marine environment. Of the latter, avian and fragmentary dinosaur remains were secured. The birds are diverse and represent extant orders of birds, supporting the hypothesis that Antarctica was an important area for bird evolution before the terminal Cretaceous extinction. Of the marine creatures, a hexanchid shark and gastroliths were found associated with large plesiosaur trunk material. Perhaps one of the most spectacular discoveries was that of a baby plesiosaur skeleton, which is approximately 90% complete and representative of an elasmosaurid. Overall, the expedition was successful adding to our knowledge of the life and environment of the southernmost continent during the end of the Mesozoic.

Wednesday 5:45

PRELIMINARY REPORT OF RODENT COMMUNITY CHANGE AND MORPHOLOGICAL EVOLUTION THROUGH THE LAST FIVE MILLION YEARS IN SOUTHWESTERN KANSAS

MARTIN, Robert, Murray State Univ., Murray, KY; PELAEZ-CAMPOMANES, Pablo, National Museum of Natural History, Madrid, Spain; HONEY, James, Univ. of Colorado, Boulder, CO; FOX, David, Univ. of Minnesota, Minneapolis, MN; MARCOLINI, Federica, Univ. of Pisa, Pisa, Italy; CROCKETT, Christopher, Murray State Univ., Murray, KY

Information derived from many new local faunas in the Meade Basin of southwestern Kansas reveals a complex pattern of community change. Corrected for sampling bias, an equilibrium number of 16 species is maintained from about 5.0-2.1 Ma, when the number drops to 12 in the Nash 72 local fauna (l.f.). This locality, stratigraphically only 2.5 m above the Borchers l.f. (2.10 Ma) with 17 species, lies very near the Plio-Pleistocene boundary at 1.8 Ma. Both the low number of species at Nash 72 and turnover of species between Borchers and Nash 72 likely represent a faunal reordering consistent with more temperate seasonality at the beginning of the Pleistocene. Oxygen isotope compositions of paleosol carbonates just below the level of Borchers suggest cooling and/or increased aridity relative to the long-term Blancan average conditions; above Borchers, paleosol carbonates suggest continued cooling, and possibly no change in aridity, associated with the onset of Northern Hemisphere glaciation.

Preliminary results on size change and dental evolution within well-represented, long-lived rodent clades (*Geomys*, *Ogmodontomys*, *Sigmodon*) show that morphological evolution pro-

gresses in most lineages throughout the Pliocene. One lineage of *Geomys* dwarfs while another increases in size. *Ogmodontomys* increases in size and the quality of tangential enamel increases, though enamel differentiation remains in stasis. The anteroconid of m1 also undergoes significant shape change. The dentition of *Sigmodon minor* changes in numerous ways through the Pliocene, and a dwarfing event characterizes its last appearance in the Borchers l.f. These data allow the following tentative conclusions: 1) an endogenous but stochastic rate of community restructuring (turnover) establishes an equilibrium number of species in a relatively stable set of ecosystems, 2) the rate of community change increases during periods of rapid climatic perturbation, 3) morphological evolution is not restricted to major periods of rapid climatic change.

Thursday 1:30

THE POSTCRANIAL SKELETON OF THE DOCODONT MAMMAL *HALDANODON*

MARTIN, Thomas, Forschungsinstitut Senckenberg, Frankfurt am Main, Germany

The postcranium of the Late Jurassic docodont *Haldanodon exspectatus* is represented by a partial skeleton comprising ribs, scapulo-coracoids, humeri, radius, ulna, femur, tibia, and phalanges as well as isolated bones of several other individuals from the Late Jurassic (Kimmeridgian) of the Guimarota coal mine in Portugal. The dorso-ventrally elongated, triangular scapula has a convex transverse profile with strongly laterally reflected anterior and posterior scapula margins, enclosing a deep trough-like "infraspinous fossa". A supraspinous fossa is not developed. The saddle shaped glenoid facet is mainly formed by the coracoid and oriented antero-ventrally indicating a sprawling gait. At the humerus no trochlea is present and radial and ulnar condyle are bulbous and well separated; an olecranon fossa is not developed. Width of the distal joint is 61.5 % of the humeral length. No epiphyses were detected and the wide size range observed in humerus and femur probably indicates a lifelong growth.

Haldanodon exhibits adaptations for a fossorial and possibly semiaquatic lifestyle like the platypus (*Ornithorhynchus*) and desman (*Desmana*). These are stout and short limbbones, humeri with greatly expanded distal joints and strong deltopectoral crests, as well as short first and second phalanges. The moderately curved terminal phalanges are laterally compressed and differ from the spatulate claws of the moles (e. g., *Talpa*) and the platypus.

Haldanodon is more derived than *Morganucodon* by complete reduction of the procoracoid, absence of the procoracoid foramen, and a peglike coracoid. It shares with monotremes a postscapular fossa that is absent in *Morganucodon*. The humerus is more derived than that of morganucodontids in that the greater and lesser tubercle are not confluent with the humeral head but represent distinct features. A PAUP-analysis based on 280 cranio-dental and postcranial characters corroborated the position of *Haldanodon* above the node of morganucodontids as sister group of *Hadrocodium* plus *Kuehneotherium* and crown group Mammalia.

Wednesday 3:45

A PLAQUE-MOUNTED TYPE SPECIMEN RESTORED: *HYDROTHEROSAURUS* REVEALED

MASON, Jane, Univ. of California Museum of Paleontology, Berkeley, CA

The Maastrichtian plesiosaur *Hydrotherosaurus alexandrae* was discovered in Fresno County, CA in 1937 by Frank Paiva, who then assisted Samuel P. Welles, of U C Berkeley, in its collection. It was prepared with WPA assistance, described as a type, and then summarily plaque-mounted in a wall. Subsequently, the skeleton was removed from the wall but left in plaster blocks that obscured one side. While restoring this fossil to its multi-dimensional form, an array of materials was encountered. Some were surprising, some were unrecognizable, and some are no longer considered mechanically acceptable, or archival for a museum collection. A serendipitous encounter with an old library volume containing museum correspondence helped identify Bakelite as one of the varnishes or cementing mediums. Zip Strip, a more aggressive solvent, was required to remove old shellac. After the re-preparation was complete, the bones were excessively consolidated and then coated with latex to protect the blocks from scratches when flipped for making collections jackets. Once in their final ethafoam-lined jackets, the latex and excess consolidant were removed. *Hydrotherosaurus* is ready for research, on both sides.

Wednesday 5:15

A NEW SILICA BONDING TREATMENT PROVIDING LONG-TERM WEATHERING PROTECTION FOR FOSSIL TRACKWAYS IN A WIDE VARIETY OF ROCK SUBSTRATES

MASON III, William, Paleo-Bond, St. Paul, MN

The material is clear, penetrating, breathable water-repellant consolidant for use on exterior above-grade rock of all types. It penetrates the surface and bonds chemically to the substrate, resulting in permanent attachment of the water repellent molecule. This is not a coating; as a result it will not change the surface appearance of the substrate. Test data is extensive including ASTM C and Federal Specifications SSW-110C. The treatment chemical is applied with a low-pressure tank pumping equipment with a wet fan type nozzle in a hand-held wand.

Poster Session B

A GEOSPATIAL LOOK AT THE MORPHOLOGICAL VARIATION OF TRACKS AT THE TWENTYMILE WASH DINOSAUR TRACKSITE, GRAND STAIRCASE-ESCALANTE NATIONAL MONUMENT, UTAH

MATTHEWS, Neffra, USDOI Bureau of Land Management, Denver, CO; BREITHAUPT, Brent, Univ. of Wyoming, Laramie, WY; NOBLE, Tommy , Bureau of Land Management, Denver, CO; TITUS, Alan, Bureau of Land Management, Kanab, UT; SMITH, Joshua, Univ. of Utah, Salt Lake City, UT

Utah's Grand Staircase-Escalante National Monument is home to a wealth of geological and paleontological resources. One such resource, located approximately 25 km southeast of the town of Escalante, is the Twentymile Wash Dinosaur Tracksite (also know as Collett Wash Dinosaur Tracksite). Here hundreds of dinosaur tracks are preserved in the upper part of the Middle Jurassic Entrada Sandstone. These tracks, preserved as darker sediment infillings and as alternating light and dark underprinted sand laminations, are exposed at multiple horizons along the upper portion of a sloping sandstone bench. At least two separate dinosaurian ichnogenera are present. Tridactyl tracks (15 to 45 cm long) are preserved in dozens of trackways ranging from 2 to 30 steps. The number, extent, and complexity of tracks and trackways make this a unique and paleontologically significant site.

Past work conducted at the Twentymile Wash Dinosaur Tracksite has focused on mapping the spatial distribution of the tracks exposed along the bench. The great majority of the tracks exhibit significant morphologic variation. This variation may be, in part, the result of exposure of underprints at depth. Within a single trackway, morphology can vary in as few as three steps from distinct tridactyl footprints (with evidence of digital pads and claw impressions) to oval concentric circles representing deep underprints. In addition, some morphological variations may be the result of slope gradients that existed at the time of track formation and through soft sediment deformation of the substrate. GIS analysis of trackway geometery (including foot length and width ratios, pace angulations, stride lengths, and straddle widths) were conducted. These calculations provide further insight into the ichnites of the track maker. By examining the spatial context of these footprints, both to each other and within the chronology and spatial context of the site, insight may be gained into the expression of deep underprints and their usefulness in tracksite analysis, as well as the true taxonomic diversity of the site.

Friday 2:00

TESTING THE RELATIONSHIP BETWEEN ONTOGENY AND PHYLOGENY USING AVIAN SKELETAL DEVELOPMENT

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The concept of the ontogenetic recapitulation of phylogeny is a very old one. It states that changes observed during embryological development should parallel those seen over evolutionary time within a lineage. It has led to the practice of polarizing features in phylogenetic analyses based on their relative time of appearance in the development of individuals; it has also led to the widespread view that the final stages of embryonic development are those that are the most flexible and prone to change, leading to the addition of novel features only late in development. In spite of its history and frequent application recapitulation has never been tested over an appropriate time frame: most examinations of the concept to date have compared ontogenies between phyla, which have been evolving independently for so long that recapitulatory signatures may have been lost from the developmental trajectory. Crown group Aves is ideal for testing these ideas, as it is only approximately 75 million years old and is morphologically relatively conservative. Preliminary results indicate that there is no relationship between ontogeny and phylogeny in the skeletal development of the basal lineages of extant birds (Galliformes, Anseriformes and ratites). Lineage-specific features are acquired throughout the developmental period, indicating that no constraints exist to modifying early and mid development. Determining character polarity using the ontogenetic criterion is strongly discouraged for this group.

Friday 9:15

GETTING PC(A) WITH MYLODONTID SLOTHS: SEPARATING *PARAMYLODON* FROM *GLOSSOTHERIUM*

McAFEE, Robert, Northern Illinois Univ., De Kalb, IL

For nearly a century, there has been a lack of consensus in North America regarding the assignment of sloth specimens to the genera *Paramylodon* and *Glossotherium*. Origins of this problem can be traced back to the days of Owen and the first descriptions of South American mylodontids, specifically *Glossotherium* and *Mylodon*. The confusing nomenclatural history of these genera and a lack of previous morphometric studies have enabled this taxonomic issue to continue without question or resolution, until now.

An earlier pilot study demonstrated the ability of PCA to successfully separate *Glossotherium* and *Paramylodon* into distinct generic clusters within morphospace, and corroborated results from recent phylogenetic studies of the sloths. These preliminary results were hampered by small sample sizes and only focused on data from cranial measurements. The expanded results presented here utilize cranial, mandibular and some post-cranial elements from many more specimens, and continue to support a separation of the North American *"Paramylodon"* from the South American *"Glossotherium."* The genera are separated not only by size along the first axis but also by shape differences along the second and third axes, reflecting differences in the evolutionary history and functional lifestyles of these sloths.

Student Poster Session

TAPHONOMY OF CHONDRICHTHYAN TEETH FROM THE PENNSYLVANIAN OF ILLINOIS

McCORMICK, Kaitlin, Northern Arizona Univ., Flagstaff, AZ

The Pennsylvanian (Desmoinesian-Missourian) Livingston Limestone Member of the Bond Formation in Illinois represents a diverse normal marine environment. The taxa are well preserved and the presence of immature and juvenile forms and the lack of surface abrasion suggests that there was little post-mortem transport. The invertebrate fossils, particularly articulated crinoids, undamaged brachiopod spines, and large *Fenestrella* fronds, indicate a lack of strong wave action. Most of the invertebrate taxa are suspension feeders, suggesting little turbulence. The fauna also includes teeth of the chondrichthyan *Petalodus*.

Petalodus is a ubiquitous Pennsylvanian chondrichthyan genus with a small number of large triangular teeth. There are two species present in the location sampled, *P. destructor* and *P. linguifer*. Unusually specimens in the Livingston Limestone Member are overwhelming preserved as bases minus the crowns. A small sample of thirty specimens of *Petalodus* sp., not identifiable to species due to the lack of crowns, shows that in all cases the broken surface is an abrupt one without any indication of erosion, abrasion, or dissolution. Sectioning of two specimens shows that the break is a clean one and that it is associated with minor parallel microfractures. This suggests that breakage occurred prior to preservation by incorporation into the sediment.

One possible explanation of this mode of preservation is that the teeth were broken during sediment compaction. However, this hypothesis seems to be negated by the fact that the crowns were missing when the bases were found. A more likely hypothesis is that the breakage indicates separation of the crown of the tooth prior to loss of the base and that this might have occurred due to mechanical trauma during feeding. Little is known of the feeding habits of *Petalodus*. Its teeth appear to be adapted to slicing and cutting soft tissue although it has been implicated in damage to a cephalopod. Breakage of teeth of this size may suggest predation on hard-shelled invertebrates.

Saturday 2:15

CANADA`S LARGEST DINOSAURS: ICHNOLOGICAL EVIDENCE OF THE NORTHERNMOST RECORD OF SAUROPODS IN NORTH AMERICA

McCREA, Richard, Peace Region Palaeontology Research Centre, Tumbler Ridge, British Columbia, Canada; CURRIE, Philip, PEMBERTON, S. George, Univ. of Alberta, Edmonton, AB, CANADA

Until recently, the skeletal and ichnological records of sauropod dinosaurs in North America have been limited to areas south of the Canada-U.S. border. Paleogeographic barriers and paleoenvironmental preferences have previously been cited to explain the absence of sauropods in Canada. However, recent discoveries of footprints and a trackway from southeastern British Columbia represent the first record of sauropods in Canada, and the northernmost record of sauropods in North America.

The first discovery of Canadian sauropod footprints comes from open pit coal mines in the Mist Mountain Formation (Tithonian/Berriasian). This was an important time in the evolution of sauropod faunas in North America, as camarasaurids and brachiosaurids declined in numbers and diversity and the first possible titanosaurids appeared. Isolated sauropod footprints (primarily pes prints less than one meter in length) in the form of natural casts were found amongst talus debris below active surface mining pits. A solitary *in situ*, wide-gauge sauropod trackway was exposed on a footwall. Based on the morphology of the isolated pes prints and the width of the solitary trackway the ichnites are referable to *Brontopodus* ichnosp.

In addition to sauropods, the vertebrate ichnofauna of the Mist Mountain Formation includes several ichnotaxa of theropod, ornithopod, reptilian and pterosaur prints. The ichnofauna of the Mist Mountain Formation is the oldest record of terrestrial vertebrates in western Canada. The sauropod tracks occur in coal-bearing sediments deposited in deltaic and/or distal fluvial-alluvial floodplain environments. The depositional environment of the Mist Mountain Formation is different than the low latitude evaporitic or alkaline-saline-carbonate lake deposits that sauropod tracks (*Brontopodus* Ichnofacies) usually occur in.

Thursday 2:15

ENVIRONMENTAL RECONSTRUCTION OF THE RED SHIRT TABLE FOSSIL LOCALITY IN BADLANDS NATIONAL PARK, SOUTHWESTERN SOUTH DAKOTA

McCULLOUGH, Gavin, Mesa Southwest Museum, Mesa, AZ

The Paleogene Red Shirt Table fossil locality was discovered by National Park Service research scientist Michael Greenwald during the mitigation phase of the Mni Wiconi water pipeline project in Badlands National Park in southwestern South Dakota in the late 1990s. The locality is divided into two faces of a 38-meter wide roadcut that possibly contains the contact between the Chadron and overlying Brule formations. Although near to one another, the roadcut faces contain fine-grained bedding that is for the most part laterally untraceable, and fossils that are varied in degree of completeness, size range, and type of preservation. The deposits have been interpreted as cyclical lacustrine. Because of the differences between them, the two roadcut faces were separated into two sites, named Black Cows and Body Parts. The fossils collected were eroded out of the outcrops, and were therefore not stratigraphically identified. Common to both sides are fossil animals well established in the White River Group, such as *Mesohippus*, *Palaeolagus*, and *Merycoidodon*. In contrast to the Black Cows side, The Body Parts side contains microvertebrates such as *Leptictis* and a rhineurid cf. *Ototriton*, several mammal endocranial casts, and an identifiable carnivore component that includes *Hesperocyon*. These differences were investigated in detail using taphonomic observations, biodiversity statistics, and cenogram analyis in order to identify the paleoenvironemnt and whether the lateral variation was more likely due to contemporaneous ecofacies processes, taphonomic biases, temporally spaced paleocommunities, or a combination of processes. Results are equivocal between the Red Shirt Table locality representing separate populations and the possibility that it records only the proximal, medial, and distal environments of a dilating lake system with unknown resolution with respect to time.

Poster Session B

ARRIVAL OF *BISON* AND THE RANCHOLABREAN IN A NEOTROPICAL SETTING, NORTHERN SONORA, MEXICO

MEAD, Jim, Northern Arizona Univ., Flagstaff, AZ; BAEZ, Arturo, Univ. of Arizona, Tucson, AZ; SWIFT, Sandra, HOLLENSHEAD, Marci, Northern Arizona Univ., Flagstaff, AZ; CARPENTER, Mary, National Park Service, Hagerman, ID

The beginning of the Rancholabrean Land Mammal Age (RLB) is currently defined by the first appearance of *Bison* in North America south of 55 deg N latitude. The conservative best estimate for the arrival of *Bison* is between 210 ± 60 ka and 160 ka; estimate avoids unclear stratigraphic positions, unsatisfactory chronologic controls, or possibly erroneous identifications. A Mexican Faunal Province has been alluded to for the RLB, yet is not adequately characterized or established. We recovered Pleistocene fossils from a basin deposit created by a lava flow at Terapa, semi-arid northeastern Sonora, Mexico. The impoundment produced short-lived marsh, river, and savanna habitats. The fauna includes ostracodes, mollusks, fish, amphibians, turtles, crocodylian, squamates, birds, and mammals. An $^{40}Ar/^{39}Ar$ analysis produced an age of 0.44 ± 0.13 (2SD) Ma for the lava flow. Abutting stratigraphic layers on the lava imply that the sediments and fossils began deposition immediately following emplacement. Molars unequivocally identified to *Bison* are in situ in the lowest units and throughout the 11m-sequence. Marsh and fluvial units at Terapa contain tropical taxa: *Hydrochaeris*, crocodylian, birds, and a stenocyprid ostracode. Aquatic snails, clams, ostracodes, fish, turtles, anurans, crocodylian, and additional bird remains attest to a freshwater environment. *Glyptotherium*, *Pampatherium*, *Mammuthus*, camels, pronghorns, *Bison*, and *Equus* indicate an adjacent grassland/savanna habitat. The recovery of a crocodylian and *Pampatherium* is unique in this northern interior Sonora setting. A well-developed riparian corridor from the Gulf of California to Terapa during a tropical climate can account for the animals with tropical affinities to extend 350 km inland at 29°N. The faunistic data emerging from Terapa permit a unique opportunity to unequivocally establish the beginning of the RLB based on the arrival of *Bison* at approximately 0.44 Ma and to begin the characterization of a Mexican Faunal Province as a mosaic-community of what are today northern and southeastern taxa integrating with those with a present pervasive Neotropical affinity.

Wednesday 8:45

NEW FROG MATERIAL FROM THE OLIGO-MIOCENE ETADUNNA FORMATION OF SOUTH AUSTRALIA

MEREDITH, Robert, Riverside, CA; CASE, Judd, St. Marys College of California, Moraga, CA; MARTIN, James, SD School of Mines and Technology, Rapid City, SD

The early Tertiary fossil frog record of South Australia, despite intensive collecting, is still poorly known. Four frog species have been described based on ilia from the Miocene Namba Formation (one specimen) at Lake Yanda and the Oligo-Miocene Etadunna Formation at Lake Palankarinna. Of the reported material the extant families Hylidae and Leptodactylidae have been recognized. Hylids dominate the fauna with the majority of the specimens being referred to the extinct genus *Australobatrachus* (approximately twenty specimens) and the living genus *Litoria* (two specimens representing two species). The only described leptodactylid is the living genus *Limnodynastes* (five specimens).

Recent efforts to sort screen-washed concentrate from the Tedford Locality, at Lake Palankarinna, have yielded almost 200 frog ilia and the first reported vertebrae and humeri from the Etadunna Formation making this one of the richest frog deposits anywhere in South Australia. Several species were recovered including *Australobatrachus ilius*, *Lymnodynastes archeri*, and an undescribed species. The majority of the specimens were referred to *Australobatrachus* based on the presence of a large lateral groove on the ilial shaft and the poor development of both the dorsal prominence and acetabular expansion. However, the morphology of this species is variable but the lateral groove is always present. Specimens were referred to *Lymnodynastes* based on the presence of a high dorsal crest on the ilial shaft and a very large dorsal protuberance. The new species is distinct from the previously described early Tertiary forms in having the following characters: a short lateral groove on the ilial shaft, a small and high acetabulum bisected by the ventral border of the ilial shaft, a prominent blade-like dorsal protuberance anterior to the acetabular rim, a moderately developed and pointed dorsal acetabular expansion, and a poorly developed ventral acetabular expansion. Other species may also be present and possibly represent *Litoria* species but these ilia are poorly preserved and their description should await the recovery of better preserved specimens.

Saturday 4:15

EARLY SELENODONTIA (ARTIODACTYLA) FROM THE MIDDLE EOCENE OF CHINA

METAIS, Gregoire, Carnegie Museum of Natural History, Pittsburgh, PA; QI, Tao, GUO, Jianwei, IVPP, Beijing, China; BEARD, Christopher, Carnegie Museum of Natural History, Pittsburgh, PA

The Shanghuang fissure-fillings (Jiangsu Province) and the Heti Formation (Shanxi Province) have yielded unique middle Eocene mammal assemblages including dichobunoid and ruminant artiodactyls. Most of the dental and post-cranial material from the Shanghuang fissure filling D are referable to the dichobunid *Elaschitotherium qii*, and to three new forms of Selenodontia more poorly documented. *Elaschitotherium qii* shows greatest affinities with two other poorly known Asian genera (*Lantianius*, from the middle Eocene of China, and *Eolantianius* from the early Eocene of Kyrgyzstan), which are united within a new subfamily of Asian dichobunids, the Lantianiinae. Lantianiine artiodactyls may be related to *Diacodexis pakistanensis*, but they do not seem to be closely related to other dichobunids known from the early-middle Eocene of the Indo-Pakistani region. Relationships with North American homacodonts and the earliest hyperdichobunine dichobunids (MP 13) from Europe are still unclear. The middle Eocene dichobunoid assemblage of Shanghuang is particularly critical as it represents one of the rare windows into the Eocene evolution of artiodactyls in Asia. The complete analysis of this key fossil material suggests that bunoselenodont artiodactyls radiated synchronously in Asia, Europe, and North America. The diversity of early ruminants from both the lower member of the Heti Formation and the Shanghuang fissure filling D confirms the early diversification of the suborder as early as middle middle Eocene. Preliminary phylogenetic analysis suggests that the selenodont grade was probably acquired independently in several lineages of dichobunids inhabiting the three northern landmasses during the middle Eocene. For the first time in Asia, early ruminants and dichobunids have been recovered in direct association at a single locus Shanghuang fissure D (Irdinmanhan ALMA). Further investigation on artiodactyl assemblages from both Shanghuang and the Heti Formation should significantly improve our knowledge of the early evolution of Selenodontia in Asia, hitherto particularly poorly documented.

Friday Fishes Symposium poster

THREE NEW PALEONISCOID FISHES FROM THE BEAR GULCH LIMESTONE (SERPUKHOVIAN, MISSISSIPPIAN) OF MONTANA AND THE RELATIONSHIPS OF LOWER ACTINOPTERYGIANS

MICKLE, Kathryn, Saint Joseph's Univ., Philadelphia, PA; LUND, Richard, Carnegie Museum of Natural History, Pittsburgh, PA; GROGAN, Eileen, Saint Joseph's Univ., Philadelphia, PA

Previous studies of the interrelationships of the lower actinopterygians (ray-finned, bony fishes) from the Paleozoic have been limited by few and poorly preserved specimens. However, the Bear Gulch Limestone preserves a diverse assemblage of well-preserved actinopterygians. Three new paleoniscoid fishes (Osteichthyes, Actinopterygii), representing two new genera, are now described from this 318 million year old lagerstatte. Morphological, morphometric, and meristic data were analyzed and compared to information available for other paleoniscoid fishes. These fishes, previously identified by the codenames Mesobeck and LoJo, represent two new genera and three new species. In order to examine the interrelationships between these newly described species and other lower actinopterygians, a matrix of 110 characters and 40 taxa was constructed. The matrix represents an expansion of previously published studies, and includes relatively complete taxa ranging from the Devonian to the Recent. Cladistic analysis using Hennig86 and Winclada resulted in two trees (mh*=l 688, ci 38, ri 61). One of these trees supported a monophyletic Paleoniscimorpha, while the paleoniscoids were paraphyletic in the other tree. After branch and bound treatment, one tree resulted (bb8 =l 1272, ci 54, ri 74), in which the paleoniscoids were paraphyletic. Analyses of this and previous matrixes have generated highly robust clades for the diverse taxa included in the study and, so, we are confident in the general relationships shown in this analysis. By nature, however, this analysis must be viewed as a work in progress. We expect further clarification of the relationships of the paleoniscoid fishes to unfold as more Bear Gulch and non-Bear Gulch forms are described and incorporated into a matrix.

Wednesday 2:45

MESOWEAR AND THE DIETARY HISTORY OF NORTH AMERICAN HORSES FROM *HYRACOTHERIUM* TO *EQUUS* AND ITS RELATIONSHIP WITH CLIMATIC AND MORPHOLOGICAL EVOLUTION

MIHLBACHLER, Matthew, SOLOUNIAS, Nikos, New York College of Osteopathic Medicine, New York, NY

Evolutionary trends in the dentitions of horses and other ungulates seem to reflect adaptations to new diets necessitated by increasingly cooler and more open habitats that appeared during the Cenozoic. The overall trends observed in the dentitions of North American ungulates suggest a two-phase dietary trend involving, (1) a reduction of frugivory following the loss of tropical-like Eocene habitats, and (2) an increase in dietary abrasion associated with the spread of grasslands in the Oligocene and Miocene. To test this hypothesis is was necessary to develop a comprehensive picture of horse dietary history that does not rely exclusively on morphology. We reconstructed paleodietary trends for North American horses, starting with early Eocene *Hyracotherium*, and ending with late Pleistocene *Equus*, using an improved version of the mesowear method. Upper molar paracone wear facets of 6390 specimens from 64 species and 206 fossil localities were assigned to eight standardized categories of molar facet development. Mesowear patterns of fossil Equids strongly reflect the predicted two-phase trend. The early Oligocene is an important transitional period marked by a browsing optimum where frugivory has been phased out but mixed feeding and grazing diets are not yet present. There is a sharp increase in dietary abrasion among brachydont Anchitheriine horses during the earliest Miocene (23-18.8 Ma), thus the trend toward increased dietary abrasion preceded hypsodonty. An additional leap in dietary abrasion is concomitant with the appearance of *Merychippus*, the first hypsodont equine horse, at about 18.8 Ma. At the same time, the trend in dietary abrasion among brachydont horses reverses and they appear to resume low-abrasion browsing diets until their extinction at about 8.8 Ma. Hypsodont horses maintain diets with higher levels of abrasion. A steady trend of increasing abrasion occurs among hypsodont horses from their early Miocene appearance to the end of the Pleistocene. After 4.5 Ma (early Pliocene) all horse mesowear patterns suggest abrasion levels consistent with extreme grazing or grass dominated mixed feeding and other dietary categories are phased out.

Thursday 2:45

SKELETAL DISTRIBUTIONS ACROSS TIME; A MULTIVARIATE APPROACH TO THE CHANGING TAPHONOMY OF AMBOSELI PARK, KENYA

MILLER, Joshua, Univ. of Chicago, Chicago, IL; BEHRENSMEYER, Anna, Smithsonian Institute, Washington D.C.

The surface bone assemblage of Amboseli National Park, Kenya has been extensively studied, providing insight into the taphonomic patterns and processes of bone accumulation and destruction on an African savannah. Over the last thirty years, the Amboseli ecosystem has experienced significant ecological and climatological changes. In conjunction with these changes, the bone assemblage has undergone major transformations including a reorganization of skeletal element taphonomy across the landscape.

Multivariate analyses of the 1975-76 and 2002-04 samples reveal a complex set of changes over time in the spatial distribution of skeletal elements. Compared to samples from 1975-76, the 2002-04 data show a significantly more heterogeneous distribution of bones such that habitat-specific patterns of skeletal element representation are more readily observed. The more recent samples also show greater similarity within major habitat types such as "woodland-bush" and "grass-dominant" than samples from the mid 1970s. The distinctive structures of the 1975-76 and 2002-04 bone assemblages likely result from both the mode of skeletal accumulation (the mass mortality-causing draught of the mid 1970s) and recent changes in predator community.

The variability of bone accumulation patterns seen in Amboseli over thirty years demonstrates the sensitivity of landscape-scale bone assemblages to ecological and climatological variations over decadal timescales. This sensitivity indicates the importance of examining a diversity of modern and ancient environments to understand taphonomic variability in skeletal part representation. Preliminary observations of Yellowstone National Park, WY, indicate that temperate ecosystems with predator:prey ratios and weathering rates that differ from those in Amboseli show characteristics in bone survival and distribution patterns dissimilar to the African savannah. Increased understanding of the influence of climate and ecology on the variable appearance of skeletal distributions is vital for paleoecological interpretations of fossil remains.

Poster Session A

PHYLOGENETIC TESTS FOR THE IDENTIFICATION OF ISOLATED POSTCRANIAL REMAINS: AN EXAMPLE USING NORTH AMERICAN MULTITUBERCULATES

MINJIN, Bolortsetseg, American Museum of Natural History, New York, NY; GEISLER, Jonathan, Georgia Southern Univ., Statesboro, GA

Although the value of articulated fossil skeletons cannot be overstated, most of the fossil record consists of isolated skeletal elements. Among mammals, the identification of isolated postcranial bones to species and even genus is often problematic because most holotypes are restricted to craniodental remains. In the absence of articulated or associated skeletons, factors such as overall morphology, size, and relative abundance are used to identify isolated postcranial bones, but these criteria have their limitations. We have developed two phylogenetic tests to evaluate identifications of isolated postcranial bones. For the first measure, the known craniodental remains of a taxon and its suspected postcranial elements are coded as two OTU's (operational taxonomic units). The length of the shortest trees that have these OTU's as sister-groups is then subtracted from the length of the unconstrained most parsimonious trees. If the lengths from both analyses are the same, then the identification is supported, while the more negative the difference, the more the identification is contradicted.

The second phylogenetic test is a modified incongruence length difference (MILD). Unlike the standard incongruence length difference, the partitions in MILD are delimited by characters and taxa. In our pilot study using multituberculates, one partition consists of data from craniodental specimens and associated/articulated skeletons, while the second partition includes all postcranial specimens that were tentatively using relative size. The contribution of each tentative identification to the MILD was determined by removing its postcranial codings from the second partition, one taxon at a time, and then noting the change, if any, to the MILD.

If the removal of data from a single taxon caused the MILD to decrease, then the identification of isolated bones to that taxon was rejected, but if its removal caused the MILD to stay the same or increase, then it was accepted. While we will describe application of these methods to North American multituberculates, these phylogenetic tests have broad application to other fossil groups represented by fragmentary remains.

Poster Session A

DENTAL CHARACTERS OF A NEW CORYPHODONTID PANTODONT FROM THE EOCENE AKASAKI FORMATION, KUMAMOTO PREFECTURE, WESTERN JAPAN

MIYATA, Kazunori, Fukui Prefectural Dinosaur Museum, Fukui, Japan; TOMIDA, Yukimitsu, National Science Museum, Tokyo, Japan

A coryphodontid specimen with skull (GCM-VP 101) from the Akasaki Formation, Goshoura, Amakusa area, Kumamoto Prefecture, was considered as a questionable species of *Asiocoryphodon* in 1998. Coryphodontid pantodonts are significant elements of Eocene land mammal biostratigraphy in Asia. However, the specimen was not well enough prepared to allow definitive taxonomic study. Our preparation project recently revealed detailed dental characters, providing new ontogenetic information of the Coryphodontidae and suggesting further diversity of the family in Asia.

The skull specimen is of a young individual with well-preserved deciduous incisors and premolars (dI1-2, di1-2, dP1-4, dp1-4), although the posterior half is compressed and partially disintegrated. The 13/i3 and M1/m1 were erupted but unworn, the crowns of M2/m2 and canines were formed but not fully erupted, and the crowns of p3-4 and possible i1 were being formed in the dentary. These conditions show a similar sequence of dental eruption with that in *Coryphodon*, but the canine replacement might be more progressive. The permanent m1-2 are bilophodont with distinct metalophids and hypolophids, and bear massive metaconids. The M1-2 are more bilophodont with stronger protolophs and premetacristae than in *Heterocoryphodon* from the Bumbanian age, and there is no metaconule and no distinct lingual cingula in the M2 unlike in *Asiocoryphodon*. These derived molar structures suggest a close affinity with Arshantan *Eudinoceras* rather than other primitive coryphodontids, although it was previously believed to belong to *Asiocoryphodon* in having large I3/i3 and a narrow skull roof. The upper molars are narrow lingually and have stout protocones separated from paraconules by apparent notches, and labial styles, especially the mesostyle in M1, are markedly rounded. These unique features are previously unknown in other Asian coryphodontids. Presence of the relatively derived coryphodontid from the Akasaki Formation supports a correlation with the Arshantan age in mainland Asia.

Wednesday 2:30

THE CRANIAL SKELETON OF THE CAPTORHINID REPTILE *LABIDOSAURUS HAMATUS* FROM THE LOWER PERMIAN OF TEXAS

MODESTO, Sean, Cape Breton Univ., Sydney, NS, Canada; BERMAN, David, Carnegie Museum of Natural History, Pittsburgh, PA; SCOTT, Diane, MULLER, Johannes, REISZ, Robert, Univ. of Toronto at Mississauga, Mississauga, ON, Canada

The skull and the mandible of the Early Permian captorhinid reptile *Labidosaurus hamatus*, known only from the lowermost Clear Fork Group of Texas, are described on the basis of new specimens. *Labidosaurus* is distinguished from other captorhinids by its conspicuously hamate snout, low dorsum sellae, narrow stapes, and relatively small foramen intermandibularis medius. Despite the presence of a single row of teeth in each jaw, the skull of *Labidosaurus* resembles most closely those of moradisaurines, the large, herbivorous, multiple-tooth-rowed captorhinids of the latest Early and Middle Permian. A phylogenetic analysis confirms that the large, single-tooth-rowed *Labidosaurus* is related most closely to moradisaurines within Captorhinidae, a relationship that supports the hypothesis of a diphyletic origin for multiple rows of marginal teeth in captorhinids. *Labidosaurus* shares several features with moradisaurines that are trademarks of herbivorous adaptation, which suggest that *Labidosaurus* was probably omnivorous. This large, single-tooth-rowed captorhinid accordingly represents a taxon that is transitional between faunivorous basal reptiles and the herbivorous moradisaurines.

Saturday 2:30

REASSESSMENT OF THE VALIDITY OF THE GLENOACETABULAR DISTANCE IN TETRAPOD TRACKWAYS

MONKS, Joe, Purdue Univ., West Lafayette, IN

Recent studies in tetrapod ichnology are giving insight into the validity of using the glenoacetabular measurement of fossil trackways for determining body size. The glenoacetabular distance is the distance from the glenoid to the acetabular fossa (shoulder to hip girdle). This measurement is used to describe the trunk length of a quadruped track maker and estimate overall body size. The method of using the glanoacetabular distance should give a true body size measurement and be considered valid for a quadruped whose spinal column does not bend laterally while moving. However, for an animal whose body undulates in a sinusoidal manner while walking, the glenoacetabular distance will yield an incorrect measurement. The measurement for this type of animal will be too short due to apparent shortening of the spine while it is curved. This phenomenon is observed in quadrupeds with a short to medium coupling value (less than about 1.2), but not those with a long to very long coupling value (above about 1.2). The coupling value is a ratio of trunk length to limb length and describes an apparent 'longness' or 'shortness' of an animals' trunk. Several authors have mentioned this problem while describing amphibian and reptilian trackways, but have neglected to pursue the problem in detail. Still photos and video footage are being used to analyze numerous species of short to medium coupled salamanders and lizards in motion, in addition to studying their trackways. It is expected that this will enable us to better understand this phenomenon and should produce a useful analytical tool such as a valid proportionality constant to more accurately asses glenoacetabular distances from fossil trackways.

Poster Session B

NEW MATERIAL OF *POLYGLYPHANODON BAJAENSIS* FROM EL ROSARIO, BAJA CALIFORNIA, MEXICO

MONTELLANO, Marisol, Instituto de Geologia Universidad Nacional Autonoma de Mexico, Mexico City, DF., Mexico; WILSON, Gregory, Institute of Biotechnology, Univ. of Helsinki, Helsinki, Finland; ALVAREZ-REYES, Gerardo, HERNANDEZ-RIVERA, Rene, Instituto de Geologia, UNAM, Mexico, Mexico; QUINTERO, Enrique, ARANDA-MANTECA, Francisco, Universidad Autonoma de Baja California, Ensenada, Mexico

During the late 1960s and early 1970s, crews from Los Angeles County Museum and Occidental College carried out a series of paleontological expeditions in the area of El Rosario in Baja California. Prospecting and collecting in the Upper Cretaceous rocks resulted in a collection of dinosaurs and other fossil vertebrates, such as lizards, amphibians, birds, turtles, crocodiles, and mammals. Although these localities included the first locality from Mexico with Mesozoic mammals, only secondary emphasis was placed on the recovery of the microvertebrate fauna. Since these expeditions, intensive paleontological fieldwork in the area has been limited. Teams from the Universidad Autonoma de Baja California (UABC) have primarily prospected for dinosaurs and only performed maintenance excavations.

In 2004, a collaborative research project between Museum of Paleontology of the Univ. of California, UABC, and Universidad Nacional Autonoma de Mexico was initiated to explore the stratigraphy and vertebrate faunas of Upper Cretaceous non-marine deposits (La Bocana Roja and "El Gallo" Formations) in El Rosario, Baja California. The primary aims of the ongoing project are to (1) re-discover the old vertebrate fossil localities, (2) undertake systematic study of the vertebrate faunas, and (3) better understand their paleoenvironmental and biogeographic relationships to terrestrial faunas from the Late Cretaceous and Paleogene of Asia, South America, and the remainder of North America.

During the preliminary field season, several of the old localities were re-discovered and new ones were discovered. From one of the new localities, well-preserved remains of a teiid polyglyphanodontine were collected. The specimen includes cranial fragments, right dentary with ten teeth, and left maxilla with nine teeth. Associated articulated and disarticulated postcranial elements were also recovered, including vertebrae, a pectoral girdle, and limb elements. This material along with other isolated dentary specimens contribute significantly to the original description of *Polyglyphanodon bajaensis*, which was based on isolated teeth and a dentary fragment with two teeth.

Poster Session A

PRELIMINARY REPORT ON A NEW SPECIES OF *PAROTOSUCHUS* (TEMNOSPONDYLI: CAPITOSAUROIDEA) FROM THE EARLY TRIASSIC OF UTAH

MORALES, Michael, Emporia State Univ., Emporia, KS

In 1945, a Univ. of California Museum of Paleontology field team collected an isolated skull with mandibles from what is now known as the Torrey Member (Lower Triassic: Spathian) of the Moenkopi Formation in Indian Creek, southeastern Utah. This material is the only specimen of a new species of *Parotosuchus*, which is the oldest reported occurrence of capitosauroids in North America.

The taxonomically important postglenoid area of both mandibles is missing, but the well preserved skull is nearly complete, although somewhat flattened and distorted. Both frontals and both jugals enter the orbital rims. Compared to other capitosauroids, the skull is of moderate size (midline length 362 mm), but the snout is relatively long (preorbital length is 71% of skull length), narrow (half way between snout tip and front of orbits the snout width is 52% of snout length), and has very straight sides that converge at the snout tip. Overall skull shape is similar to *Parotosuchus helgolandicus*. Orbits are of average size, but the external nares are relatively large, being almost as long as the orbits. Otic notches are very wide, and their tabular and squamosal sides are roughly parallel to each other. This is similar to the otic notches of *Parotosuchus nasutus* and *P. orenburgensis*, although in these taxa the posteromedial edge of the squamosal does not extend as far back as in the new form. Dorsal sculpture is mostly pits and their raised borders, with only rare areas of elongated troughs and ridges. Lateral line canals are also rare. The choanae are long and narrow, as are the interpterygoid vacuities. The single anterior palatal vacuity is reniform and bordered posteriorly by only a few small transvomerine teeth, which follow the curve of the vacuity. The pterygoid-parasphenoid suture is relatively short.

The combination of these features in one skull indicates that the Utah specimen is a new and rather primitive species of *Parotosuchus*. A detailed description and phylogenetic analysis of the specimen is being prepared.

Romer Prize Session, 11:00

PEDAL MORPHOLOGY AND BIOMECHANICS FROM DIGITIGRADY TO SUBUNGULIGRADY

MORENO, Karen, Univ. of Bristol, Bristol, United Kingdom

The evolution of a subunguligrade posture from a digitigrade one has occurred several times in parallel within quadrupedal terrestrial tetrapods. Both mammals (e.g. rhinocerotids, proboscideans) and dinosaurs (e.g. stegosaurs, ceratopsians and sauropods) followed similar patterns of modification in the anatomy of the pes and phalanges: flattening of the phalanges, attenuation of tendinous processes, reduction of the sagittal ridge, and development of hoof-like unguals. These changes constrained pedal motion to a predominantly parasagittal plane, reducing the force required to counteract mediolateral moments about the joints. However, underlying mechanical changes associated with foot use, particularly in dinosaurs, remain poorly known. To assess different loadings of forces during the acquisition of subunguligrady, I focused on its evolution within the dinosaur clade Ornithopoda. I modeled diverse phalangeal and pedal morphologies in 2D and 3D, each for different foot stances, and used finite element analysis to examine potential stress distributions. Phalangeal shape was also modified digitally to test theoretical predictions of shape-stress relations. These experiments were compared against the general trabecular orientation and density obtained from CT scanned images of feet from different dinosaur taxa, which is known to correlate with principal compressive or tensile stresses, as well as the magnitude of shear stresses. The results showed that stress distribution and internal structure (i.e. arrangement of the compact and cancellous bone, and presence of a medullary cavity) are directly related to external anatomy, suggesting at a potential predictive relationship. Moreover, the physics behind several anatomical features of the subunguligrade pes indicates a remarkable capability for supporting high compressive loads in comparison with the digitigrade condition. Consequently, these mechanical and anatomical characteristics are highly advantageous for the evolution of large body size, as observed in Ornithopoda. This appears to be a common evolutionary characteristic of all subunguligrade vertebrates.

Thursday 2:00

COMPARISON OF CARNIVORE GUILD STRUCTURE ACROSS THE PALEOCENE-EOCENE BOUNDARY IN NORTH AMERICA

MORLO, Michael, Forschungsinstitut Senckenberg, Frankfurt, Germany; GUNNELL, Gregg, Museum of Paleontology, Univ. of Michigan, Ann Arbor, MI

The Paleocene-Eocene boundary is marked globally by a dramatic increase in mean annual temperature as indicated by carbon isotope geochemistry. In conjunction with this isotope event, there is a major reorganization of mammalian faunas across the northern continents, including a striking change in carnivore guild structure. At the beginning of the Eocene, the most important new carnivorous group to appear is hyaenodontid creodonts which is added to carnivorans, oxyaenids, mesonychians, pantolestids, and omnivorous arctocyonids. To clarify the ecological relationships of hyaenodontids in North American we compared the guild structure of earliest Eocene (Wasatchian Biochron Wa-0) carnivores with that of the latest Paleocene (Clarkforkian Biochron Cf-3). Our results suggest that hyaenodontids did not replace previously existing taxa, but instead occupied ecological niches not present before. All hyaenodontids from Wa-0 are small (<3 kg), scansorial to terrestrial, and insectivorous to hypercarnivorous. It appears that all six known species of Wa-0 hyaenodontids simply were added to the guild present in Cf-3 instead of replacing existing taxa, resulting in an increased diversification of the overall carnivore guild, especially in terms of locomotor pattern. Another result is an overall decrease in mean body mass of the guild. This is congruent with general mammalian faunal turnover patterns which followed the rapid warming at the Paleocene-Eocene boundary. Today, tropical carnivore guilds are more diverse than are those from temperate regions because of the presence of more small species (and thus a smaller mean body mass). The increase in carnivore diversity at the Paleocene-Eocene boundary is therefore not unexpected given the expansion of more tropical climatic zones into northern latitudes. This result also suggests that, wherever hyaenodontids ultimately originated, it was likely from a tropical region.

Poster Session A

RARE EARTH ELEMENT (REE) AND TRACE ELEMENT ANALYSIS OF LATE JURASSIC MORRISON FORMATION FOSSIL LOCALITIES IN THE NORTHERN BLACK HILLS: STRATIGRAPHIC AND PALEOENVIRONMENTAL IMPLICATIONS

MOSES, Randolph, South Dakota School of Mines and Technology, Rapid City, SD; PATRICK, Doreena, Univ. of Pennsylvania, Philadelphia, PA

Rare earth and trace element analysis of vertebrate fossil bone in four sites from the Morrison Formation of the northern Black Hills proves the utility of REE and trace element analysis as a tool for stratigraphic and paleoenvironment interpretation within terrestrial systems. REE signatures of the Morrison Formation are shown to have a high degree of similarity over a wide geographic area. REE and trace element signatures show that other fossil-bearing formations in the same area are significantly different, indicating a possible new tool for determining fossil provenience. Furthermore, fossil bones from each site display similar patterns, but statistically distinctive REE signatures. Therefore, it may be possible to correlate Morrison Formation fossil sites over short distances, yet discriminate among differing paleoenvironments within the same overall depositional system.

REE signatures at the four Morrison Formation sites are the result of influence from fluvial and circum-neutral ground waters, a result consistent with current interpretations of depositional environment. REE signatures also reveal evidence of reworking and slightly elevated sedimentation rates. Uranium concentrations are systematically different at each site, a result of either slight stratigraphic or local depositional environment influences at those sites. Because uranium reactions are heavily influenced by redox conditions in aqueous chemistry, uranium concentrations may be used to infer paleoenvironmental conditions. High uranium values indicate relatively oxic environments, whereas low uranium concentrations indicate anoxic environments.

Wednesday 11:15

THE PHYLOGENY OF THE EARLY EUREPTILIA (AMNIOTA, REPTILIA)

MUELLER, Johannes, REISZ, Robert, Univ.of Toronto Mississauga, Mississauga, ON, Canada

Eureptilia is one of the three major clades of the Amniota and includes not only the Paleozoic Captorhinidae, the paraphyletic 'Protorothyrididae', and the basal diapsid clade Araeoscelidia, but also numerous other groups, like dinosaurs, birds, crocodiles, lizards and snakes. The early evolutionary history of this clade is poorly understood, and their interrelationships are somewhat problematic because previous cladistic analyses included only a few eureptilian representatives. Thus, we are poorly informed about the more detailed relationships among basal eureptiles, and we currently do not know if 'protorothyridids' are indeed closer to diapsids than to captorhinids, or if all the taxa designated as eureptiles even belong in this clade.

Recent research on the early Eureptilia include the description of the oldest-known captorhinid from the Upper Carboniferous of Kansas, the anatomical and phylogenetic revision of the enigmatic eureptile *Thuringothyris* from the Lower Permian of Germany, and the reinvestigation of the Early Permian taxon *Protorothyris* from Texas. These examinations have led to a revision and expansion of the morphological data sets that have been previously used to decipher the relationships of the early Eureptilia, and a new phylogenetic analysis of Permo-Carboniferous eureptiles. In light of these new results, the relationship between the earliest diapsids and the remaining basal eureptiles will be discussed, the early evolution of captorhinids will be reevaluated, and eureptilian anatomy will be compared with the morphology of parareptiles.

Wednesday, Preparator Poster

APPLYING A PVC FILM FOR MOLDING MEDIUM-SIZE FOSSIL VERTEBRATES: VARIATION OF A TRADITIONAL TECHNIQUE

MUGNAI, Riccardo, SILVA, Helder de Paula, KELLNER, Alexander Wilhelm, Museu Nacional, Rio de Janeiro, Brazil

The basic technique for molding three-dimensional fossils, where the mold is made of two or more parts, consists in dividing and separating each part on the surface of the specimen. The simplest method is to make this separation through the application of clay (or plasticine) around the fossil according to a previously established molding plan. After each part of the mold is made, the applied clay has to be removed. In some cases this procedure can damage the fossil, considering that the clay can strongly stick to the external surface of the bone. At the end of the procedure, it is necessary to remove all residues of clay, and this phase can take a long time especially if the specimen has uneven and rough surfaces, even if substances like Acryloid or Butvar had been applied. In October 2004 the laboratory of the Paleovertebrate Section of the Museu Nacional/UFRJ (Rio de Janeiro) made a cast of the holotype of *Staurikosaurus pricei* (Theropoda, Dinosauria; MCZ 1669). The elements of this unique specimen had a particularly rough external bone surface (broken in several small uneven bony fragments) due to the expansive nature of the minerals developed during the fossilization processes. A thick base of clay was made for each part of this specimen and further excavated in the shape and size of each element. All bones were covered with a thin film of PVC and placed inside the excavated opening of the clay. The clay was mold to attach the surface of each element and the PVC film was cut to about 0,5 mm underneath the horizontal surface. In other to avoid the silicon rubber to infiltrate between the PVC film and the specimen, the clay is mold again to touch the bone at a very thin surface. The next phases follow the classic technique. This simple procedure: 1) avoids the direct contact between clay and specimen except for a thin line of 0,5 mm that can be easily removed; 2) reduces the mechanical stress on the specimen during the removal of the clay since the contact area between fossil and clay is small; and 3) notably reduces the working time of the whole process, since the PVC film avoids the "dirtying" of the specimens with clay, a constant worry of the preparator.

Wednesday 9:45

NEW LATE HOLOCENE MICROMAMMALS FROM ANKILITELO CAVE, SW MADAGASCAR

MULDOON, Kathleen, Washington Univ., St Louis, MO; SIMONS, Elwyn, Duke Univ. Primate Center, Durham, NC

Subfossil microvertebrates in Madagascar are scarce but important for the reconstruction of paleoenvironments, especially as they relate to recent megafaunal extinctions. We report on a uniquely rich subfossil assemblage from Ankilitelo, southwestern Madagascar, dated to the late Holocene (~500 yrs BP). Ankilitelo is a vertical shaft, or "gouffre" cave, that documents the

latest appearances of the giant lemur taxa *Palaeopropithecus*, *Megaladapis*, and *Archaeolemur*, in association with abundant remains of small vertebrates, including other primates, rodents, tenrecs, carnivores, bats, birds and reptiles. Deep gouffre caves, such as Ankilitelo, provide an exceptional source of paleoenvironmental data because the deposits are not influenced by postdepositional disturbances such as fluvial processes or trampling by large mammals.

Since 1994, more than 5000 mammalian subfossils have been collected from Ankilitelo, documenting at least 18 species of micromammals. Skeletal remains in the microfaunal assemblage demonstrate a high quality of preservation and include largely complete crania, jaws, isolated teeth, and postcranial elements. Primates are the most abundant order represented, with *Lemur*, *Eulemur*, *Lepilemur*, *Cheirogaleus*, *Microcebus* and *Propithecus* represented by both craniodental and postcranial remains. Rodents are represented by at least 4 taxa: *Macrotarsomys*, *Eliurus*, *Hypogeomys*, and *Rattus*; as are insectivores: *Tenrec*, *Echinops*, *Setifer* and *Geogale*. Other orders represented include Carnivora (*Cryptoprocta*, *Galidia*) and Chiroptera (*Pteropus* and an unidentified microbat).

In Madagascar, small vertebrates provide the only direct comparison between subfossil and modern vertebrate assemblages. Analyzing the micromammals from Ankilitelo in relation to modern communities will illustrate the ways in which species are affected by dramatic changes to their ecosystem and will inform conservation efforts in Madagascar.

Saturday 12:00

ECOLOGICAL DIVERSITY ANALYSIS APPLIED TO FACIES FAUNAS IN THE TWIN BUTTES MEMBER, MIDDLE EOCENE BRIDGER FORMATION, SOUTHWESTERN WYOMING

MURPHEY, Paul, San Diego Natural History Museum, San Diego, CA; TOWNSEND, K., Case Western Reserve Univ. School of Medicine, Cleveland, OH

The Bridger Formation is well known for its middle Eocene vertebrate fossil fauna, and has produced the holotypes of most presently recognized Bridgerian mammalian taxa. In the Twin Buttes Member, vertebrate fossils are numerically most abundant and taxonomically most diverse in lake-margin deposits. However, the dominant facies within the Twin Buttes Member are volcaniclastic floodplain deposits, which represent up to 85% of depositional time, and contain few fossils. Ecological Diversity Analysis (EDA) is a method in which particular mammalian adaptations (diet, locomotor behavior, and body mass) are correlated with certain vegetation types. EDA has been used in paleobiology to predict vegetation, or habitats, for mammalian fossil assemblages. It has been very successful in predicting habitats for Neogene mammalian assemblages, but has only rarely been used for interpreting Paleogene assemblages.

Using a discriminant model developed by evaluating the ecological diversity of 20 Neotropical mammalian faunas representing four macrohabitats in Central and South America, 9 Bridger Formation facies faunas represented by over 3,000 specimens from over 500 localities were analyzed. The purpose was to infer probable habitat types for each depositional facies independent of existing taphonomic and sedimentologic information. The facies faunas include fossil samples from 7 stratigraphically distinct lake margin deposits, 1 combined sample representing all fossils collected from stream channel deposits, and 1 combined sample representing all fossils collected from floodplain deposits. The lake-margin and stream channel samples were all classified as forest habitats, and the floodplain sample was the only sample that classified as an open country habitat with few to no trees. Taphonomic and sedimentologic data support the hypothesis that these volcaniclastic floodplains were less favorable habitats for mammals, with sparse vegetation and high sedimentation rates. Furthermore, the results suggest that the stratigraphic and geographic pattern of fossil distribution in the Twin Buttes Member reflects paleohabitat types rather than differential fossil preservation attributable to taphonomic factors and/or rates of sedimentation.

Saturday 4:30

DEVELOPMENT OF STRATIGRAPHIC PLACEMENT AND DATING PROTOCOLS FOR FOSSIL LOCALITIES IN THE VALLECITO CREEK-FISH CREEK BASIN, ANZA-BORREGO DESERT STATE PARK, CALIFORNIA

MURRAY, Lyndon, Austin, TX

The Vallecito Creek-Fish Creek section consists generally of a single, undeformed, tilted block of marine and terrestrial sediments, in excess of 5 km thick, showing only localized and seasonal hiatuses throughout. Most individual bedding horizons are laterally uniform in thickness, traceable along strike up to several kilometers at ground level, and appear in aerial photographs and satellite imagery as parallel bands.

From the mid-1950s through late 1970s dating of localities was by geologic mapping and biochronology. Stratigraphic position of localities was correlated to a series of lines drawn mechanically on aerial photographs, roughly paralleling visible bedding surfaces, with intervals between lines arbitrarily correlated to an engineer's (40) scale, measured normal to strike, then plotted on a stratigraphic (y-axis)-geographic (x-axis) grid. In the late 1970s and early 1980s the strata and encompassed fossil localities were correlated to the Geomagnetic Polarity Time Scale (GPTS), and anchored by a dated ash layer. The protocol and supporting data changed little prior to new paleomag and ash sampling within the last three years.

GIS technology provides new methods for displaying recently acquired data and updating and refining previous data. Paleomag sample points, fossil localities, geologic maps, and topographic quad sheets can be digitized to satellite images. Image colors can be adjusted to enhance the natural banding effect of differential lithologies of bedding horizons. Overlays of the georeferenced data produce directly both the stratigraphic position (constrained by stratigraphic bands) and relative age of fossil localities, without the necessity of measuring, calculating, or plotting points on an idealized strat column or grid. The GPTS chron boundaries can be extended laterally along bedding surfaces, bracketing localities within known time spans. The nearly continuous nature of the depositional regime allows for fine-tuning of sedimentation rates within chrons, with fewer sources of error and narrower ranges of error than was previously possible. This allows for reasonable assignment of absolute dates to sub-segments within chrons.

Wednesday 3:30

PNEUMATIC PREP TOOLS, THEN AND NOW

MURRAY, William, PaleoTools, Brigham City, UT

Ten years ago, there were two pneumatic engraving type tools on the market which were widely used in preparing fossils. This was the Chicago Pneumatic CP9361 and the ARO. Today we have some 28 different tool combinations allowing a tool to be matched to a specific preparation task. Speciality tools are becoming more prevalant allowing work to be done which previously either couldn't be done or couldn't be done as effectively.

This presentation will show examples of the equipment now available along with information on how to get the best performance from it. It will also show examples of tools now being manufactured in Germany and to some degree, available in the U.S.

Poster Session A

FUNCTIONAL CORRELATES BETWEEN ZYGOMATIC ARCH STRUCTURE AND MASTICATORY STROKE ORIENTATION IN SLOTHS

NAPLES, Virginia, McAFEE, Robert, Northern Illinois Univ., DeKalb, IL

Sloth heads vary greatly in size, from small, as in the tree sloths *Bradypus* and *Choloepus*, to large as in the ground sloth, *Eremotherium*. Sloth skull proportions also vary, from extremely long and low, as in the scelidotheres and nothrotheres, to short and deep, as in some megalonychids, with most skull proportion types represented by animals belonging to a range of body sizes from small to large. Sloths also show a variety of zygomatic arch morphologies, from anteroposteriorly incomplete with slender zygomatic and temporal processes and delicate ascending and descending processes, as in *Choloepus*, to those with large, complete arches with robust vertical ascending and descending zygomatic processes, as in *Eremotherium*. This study demonstrates that sloth zygomatic arch morphology does not relate exclusively to the absolute size of the animal, as it would if it resulted exclusively from the dependence upon generation of larger forces for mastication in larger animals, but it also relates to the orientation of the masticatory stroke and the shape and relative amount of dental masticatory surface area across all genera examined. Masticatory strokes that are more anteroposteriorly oriented correlate with an increase in size and concommitant surface area for origin of masticatory muscles on the vertical components of the zygomatic arch, as is reflected in possible elaborations of one or both of the zygomatic bone ascending or descending processes. In contrast, a more oblique angulation of ascending, descending or both processes, when each is present, of the zygomatic bone reflect masticatory strokes that are oriented in a more mediolateral direction. Masticatory muscle lines of action and relative proportions also correlate with the morphology of the skeletal elements of the zygomatic arch regardless of the orientation of the masticatory stroke.

Saturday 4:45

REFLECTORLESS VERSUS RETRO-REFLECTOR EDM FOR DATA COLLECTION AT THE GRAY FOSSIL SITE: A STATISTICAL ANALYSIS FOR PRECISION

NAVE, Jerry, MATNEY, Sarah, East Tennessee State Univ., Johnson City, TN

The recent advancements in Electronic Distance The recent advancements in Electronic Distance Measurement (EDM) technology through the use of reflectorless total stations, also known as EDMs, has allowed for the collection of data through non-intrusive methods at the Gray Fossil Site. Traditionally, a retro-reflector prism and Total station has been employed for the collection of three-dimensional mapping of fossil specimens at the site. This method required that a small mini-prism be placed in direct contact with the fossil for measurement of the location. While the mini-prism weighs only 370 grams, it can damage some fragile specimens. However, the new reflectorless technology does not require a prism, operating instead by means of reflecting infrared light from the surface of an object back to the instrument for measurements of three dimensional locations. In addition, the reflectorless total stations still allow the user to operate the instrument in traditional mode, thus, allowing the researcher two methods for mapping specimens. The research question for this study was to determine the precision of data collected by a reflectorless EDM and compare it against the traditional based retro-reflector technology. By establishing a controlled set of points set at various distances, typically found in the field at Gray, a statistical analysis of the data was possible to compare the precision of the equipment. Variables introduced into the study included temperature and barometric pressure as well as various field conditions. Multiple measurements to the same control points were collected under a variety of conditions to create a reliable sampling of data. The results of the study indicated that the reflectorless technology use at the Gray Fossil Site met the established criteria of ± 5 millimeters horizontally and vertically.

Friday 2:30

CRITICAL REVIEW OF THE LATE TRIASSIC DINOSAUR RECORD, PART 3: SAURISCHIANS OF NORTH AMERICA

NESBITT, Sterling, American Museum of Natural History, New York, NY; IRMIS, Randall, Univ.of California Museum of Paleontology, Berkeley, CA; PARKER, William, Petrified Forest National Park, AZ

Dinosaurs were relatively rare in the Late Triassic of North America and were not as diverse as previously thought. The recent discovery of the basal dinosauromorph *Silesaurus* allows a critical examination of the Late Triassic saurischian record of North American. These taxa include *Caseosaurus*, *Chindesaurus*, *Camposaurus*, *Gojirasaurus*, *Protoavis*, *Shuvosaurus*, *Eucoelophysis*, *Coelophysis*, and fragmentary specimens assigned to the Sauropodomorpha.

Coelophysis bauri, from Ghost Ranch, New Mexico, is a coelophysoid theropod and because it is so well known it provides a reference for other purported Late Triassic saurischians. *Camposaurus* may represent the oldest currently known coelophysoid in North America, but it cannot be diagnosed from *Coelophysis*. The holotype of *Gojirasaurus* is a chimaera and is only diagnositic to Saurischia indet. The femur, astragalus, and calcaneum of the *Protoavis* chimera pertain to a coelophysoid. A new, well-preserved and articulated specimen indicates that the skull of *Shuvosaurus* belongs to the suchian postcrania known as '*Chatterjeea*.' *Shuvosaurus* is an aberrant suchian archosaur convergent with some saurischians but is not a dinosaur. Likewise, *Eucoelophysis* is not a dinosaur, but possesses basal several ornithodiran synapomorphies. None of the proposed North American 'prosauropod' fossil material is diagnostic. The holotypes of *Caseosaurus* and *Chindesaurus* may belong to the same or closely related taxon of a basal saurischian. Other purported herrerasaurids from western North America lack diagnostic characters of Saurschia.

We conclude that 1) some elements represent unrecognized basal saurischians (parts of the holotypes of *Protoavis*, *Camposaurus*, and *Gojirasaurus*), 2) that Triassic sauropodomorphs are currently unknown from North America, and 3) all known Triassic North American theropods are coelophysoids. Out of the nine proposed Late Triassic saurischians from North America, only *Coelophysis* can confidently be placed within Theropoda.

Saturday 8:15

GROWTH CHARACTERISTICS OF NORTH AMERICAN HIODONTIDAE (TELEOSTEI) FROM THE LATE CRETACEOUS TO RECENT

NEWBREY, Michael, North Dakota State Univ., Fargo, ND; WILSON, Mark V.H., Univ. of Alberta, Edmonton, AB, Canada; ASHWORTH, Allan, North Dakota State Univ., Fargo, ND

Age/length characteristics for Late Cretaceous and Eocene Hiodontidae were compared to those of extant *Hiodon* in North America. Several relationships show extinct and extant forms differ by characteristics of age, total length (TL), longevity, and sexual size dimorphism (SSD). The centra and TL of contemporary *H. alosoides* and *H. tergisus* were compared to hiodontids in the fossil record, including: centra from the Cretaceous Dinosaur Park Formation; scales, centra, and TL of middle Eocene *Eohiodon rosei* and *E. woodruffi*; centra and TL from the late Eocene *H. consteniorum*; and unidentified hiodontid scales from the middle Eocene Clarno Formation. The results suggest an evolutionary trend toward larger, longer-lived individuals that mature at older ages. Cretaceous hiodontids lived up to at least age five but only attained 86% of the centrum radial distance of Eocene *Eohiodon*. These data suggest that Cretaceous hiodontids were smaller than *Eohiodon*. *Eohiodon* species lived up to at least age 11 but only attained 46% of the TL of extant *Hiodon*, which live up to 16 years of age. *Eohiodon rosei* and *E. woodruffi* have overlapping growth patterns as seen in the scales, centra, and TL. *Eohiodon woodruffi* (=*E. falcatus*) from the Green River Formation grew faster and had shorter life spans than those in more northerly localities; however they attained the same TL as *E. woodruffi* from British Columbia, as might be expected from a population living in a warmer climate. Sexual size dimorphism is apparent in the centra of the Cretaceous hiodontids after age two but is also apparent in the scales of *E. woodruffi* and *E. rosei* after age three. Anal fin dimorphism is apparent in *Eohiodon* as early as age one. Modern *Hiodon* reach sexual maturity as early as age four, at about 300 mm TL, but show SSD in TL after age five. Extant *Hiodon* inhabiting cooler environments tend to live longer and mature more slowly than those in warmer latitudes; these observations suggest the hypothesis that longer-lived hiodontids with delayed sexual maturity may have been better adapted for the cooler climatic conditions since the Cretaceous.

Poster Session B

THE PALEOBATHYMETRY AND PALEOGEOGRAPHICAL DISTRIBUTION OF THE UPPER CRETACEOUS SELACHIANS FROM THE MIDDLE EUROPE (SW POLAND) AND THEIR RELATIONSHIP WITH NORTH AMERICAN ASSEMBLAGES

NIEDZWIEDZKI, Robert, Wroclaw Univ., Institute of Geological Sciences, Wroclaw, Poland

Marine sedimentation in the Opole, North Sudetic and Intrasudetic Basins (SW Poland) ranges in age from middle Cenomanian to early Santonian. Shark teeth are present in these sediments, the greatest diversity and abundance occurring in the Cenomanian and Turonian marls. The most common species include *Cretoxyrhina mantelli, Cretolamna appendiculata, Squalicorax falcatus, Scapanorhynchus raphiodon, Paranomotodon angustidens, Odontaspis subulata*, and the nekto-benthonic ptychodontid shark *Ptychodus mammillaris*, which was found associated with single teeth of *Hexanchus microdon, Synechodus major* and *Hybodus dentalus*. The Turonian levels also contain numerous teeth of *P. latissimus, P. polygyrus* and *P. rugosus*. The similar assemblages and also *P. decurrens, Cretodus crassidens, C. semiplicatus* occur in the Bohemian Basin (Czech Republic). The zones of abundance of *Ptychodus* and *C. mantelli* are restricted to sediments deposited during periods of peak transgression (latest Cenomanian in the North-Sudetic Basin and middle Turonian in the Opole Basin), and trace fossils at these levels are indicative of deposition near the storm wave base. The other Lamniformes are common throughout the sequence. The assemblage of *C. mantelli* and *Ptychodus* from the Upper Cretaceous in USA is also restricted to relatively deep-water environments. It is suggested that this assemblage is a good indicator of the middleshore or offshore shelf.

Exclusively cosmopolitan taxa occur in the mentioned basins. In spite of older data which suggested distinct differences between the ptychodontid faunas of Eurasia and North America, new evidence shows that a large number of cosmopolitan taxa are common to both provinces. It is now known that all of the species that were once thought restricted to Eurasia (e.g., *P. decurrens, P. polygyrus*) also occur in the USA and Mexico. The rare endemic species are restricted to North America. Such endemism might be a result of limited communication between the restricted Western Interior Sea and the Northern European Province. The cosmopolitan lamniform assemblages from North America are very similar to temporally equivalent assemblages from Eurasia.

Saturday 3:00

BONE MODIFICATION BY CROCODILIANS IN PLIO-PLEISTOCENE FOSSIL ASSEMBLAGES, OLDUVAI GORGE, TANZANIA

NJAU, Jackson, BLUMENSCHINE, Robert, Rutgers, The State Univ. of New Jersey, New Brunswick, NJ

Most paleoecological interpretations of bone modification in the fossil record are based on recent bone assemblages with known traces produced by feeding carnivores or other post depositional processes such as subaerial weathering, breakage, trampling, rodent gnawing, insect burrowing, and root etching. Mammalian carnivore bone modification is well documented through taphonomic studies of modern hyenids, felids and canids, and their feeding traces have been extensively recorded in many fossil localities in Africa, including the Plio-Pleistocene Olduvai Lake Basin. Although most tooth-marked bones at Olduvai come from wetland landscapes, primarily dominated by the extinct large carnivorous *Crocodylus lloidi*, damage has been attributed to the gnawing mammalian carnivores.

We present results of an experimental study of bone modification by extant *Crocodylus niloticus*, a direct descendant of *Crocodylus lloidi*. The study, which was conducted under controlled conditions includes observation of captive crocodile feeding behavior on cow and goat carcasses in nineteen different feeding episodes involving small, medium and large-sized crocodiles. Our results indicate that crocodiles produce a pattern of bone modification distinctive from mammalian carnivores. These include bisected pits, punctures, and scores, and hookscores, which have distinctive morphology. Crocodiles can produce large punctures on cortical bone without fragmenting the bone, and dense concentrations of marks on limbs during carcass reduction. Since crocodiles tend to swallow bones whole, their food refuse is composed of complete bones, lacking gross gnawing or fragmentation even on low density elements. Our recent analysis of Olduvai material reveals direct evidence of bone modification by fossil crocodiles. The evidence is not only useful for paleoecological reconstruction of Olduvai Basin, but also provides a valuable model for identifying crocodilian feeding traces in the fossil record elsewhere. The model can potentially be applied to the study of bone modification by their closely related archosaurian groups such as the large-meat eating tyrannosaurs.

Poster Session B

ANKYLOSAURS AND MORE: RECENT DINOSAUR DISCOVERIES IN BIG BEND NATIONAL PARK, TEXAS

NONA, Ezaria, MACINNES, Steve, GASAWAY, Stephen, JAMISON, Mark, MAUTERER, John, SANKEY, Julia, California State Univ., Stanislaus, Turlock, CA

Less is known about the Late Cretaceous vertebrate fauna from Big Bend National Park, Texas compared to the better studied and more fossil rich Judith River, Two Medicine, and Fruitland-Kirkland Formations. Intensive collection of microsites from inland floodplain deposits of the upper Aguja Formation (latest Campanian-early Maastrichtian) have yielded a diverse vertebrate fauna. This distinctive fauna provides important information on dinosaur diversity in Big Bend. Fossils include teeth of juvenile hadrosaurs, ceratopsians, and theropods (tyrannosaurids, cf. *Saurornitholestes*, and other small theropods). Additionally, two juvenile theropod claws, 15 coprolites, and 72 dinosaur eggshell fragments were found. One of the most significant finds was a juvenile ankylosaur tooth. This is a significant fossil because it demonstrates that ankylosaurs, which are rare in Big Bend, nested in the area. The large number of eggshell fragments collected demonstrates that a nesting site may have been near this locality. The diversity of species, presence of juvenile dinosaurs, and number of eggshell fragments from the site support the hypothesis of a large nesting site or multiple nesting sites nearby.

Friday 3:00

DINOSAUR FUNCTIONAL MORPHOLOGY AND LATE JURASSIC ECOLOGICAL DIVERSITY

NOTO, Christopher, GROSSMAN, Ari, Stony Brook Univ., Stony Brook, NY

Many morphological traits correlate strongly with behavior and ecology, thus providing a means for quantifying ecological diversity in a fossil assemblage. Studies of functional morphology in dinosaurs typically focus on the behavior of a single individual or species. Recently, functional morphology has been introduced into paleoecological reconstructions, but such reconstructions have been limited to a single site or formation. Because communities in similar environments are also recognized to have similar patterns of ecological diversity, here we evaluate regional and global patterns of dinosaur ecological diversity using functional morphology.

In this study, we constructed ecological diversity profiles for nine composite Late Jurassic dinosaur assemblages from four continents. Morphological data for teeth, limbs and body size provided information about diet and locomotion, which was used to construct the ecological categories. Community profiles were then plotted onto paleoclimate reconstructions, and the spatial distribution of assemblage patterns was assessed.

Communities with similar ecological profiles are found to occupy similar biozones. In addition, comparison of ecological diversity between assemblages combined with paleoclimate data suggests a relationship between ecological diversity and climate regime that is independent of the taxonomic composition of the assemblage. This method is able to distinguish between communities based on ecological structure, but this study only utilized data from the literature. We suggest that even finer-scale resolution may be achieved by direct observations on fossils. Our method of comparative functional morphology allows the use of taxon-free categories, reducing reliance on taxonomically-identifiable material, thus increasing the potential sample size of ecologically diagnostic material from a fossil site.

Poster Session B

OSTEOHISTOLOGICAL TAXONOMY OF EXTANT AND EXTINCT TETRAPODS USING THE MICROSTRUCTURE OF CORTICAL BONE

NOVAK, Stephanie, SMITH, Joshua, Washington Univ.in St Louis, St. Louis, MO

Historically, the osteohistology of extinct taxa has been investigated with the hope to gain insight into phylogeny, physiology, and ontogeny. However, attention focused towards distinctive taxonomic features that may be imprinted within the microstructure of cortical bone has not been addressed. Initial study suggests that differentiation of taxa may be achieved through quantification of the microstructure, arrangement, and distribution of secondary osteons in the cortex of long bones. With the eventual goal of dinosaurian taxonomy, this investigation has begun with analysis of extant, skeletally adult mammals from the Perissodactyla, Artiodactyla, and Carnivora as the osteohistological characteristics of the Dinosauria generally resemble more closely those of the Mammalia than any other extant group. Several dinosaurian taxa also underwent analysis. All measurements in this preliminary investigation were taken from transverse sections of the diaphyses of long bones. Statistical comparison was made only between the same skeletal elements. Measurements considered were osteon external radius, osteon internal radius, Haversian canal radius, number of lacunae, minimum radial distance between lacunae, minimum circumferential distance between lacunae, maximum canulicular length, and width of circumferential lamellae. As a result of biomechanical loading throughout life, the arrangement of the Haversian canal is rarely parallel with respect to the longitudinal diaphyseal axis of the long bone and differs greatly between taxa. In transverse view, the canal and surrounding lamellae are often oval and indicate that the osteon is arranged at an angle to the longitudinal axis. Germane to differentiation between taxa, the angle of the canal is accounted for by measuring the minimum and maximum radii of the Haversian canal in the transverse view and applying the Pythagorean Theorem. At present, the osteonal angular shift is assumed to be linear. As the study continues, the method is expected to evolve and lead to definitive and quantitative differentiation of taxa.

Wednesday 11:45

LACERTILIA FROM THE TURONIAN OF SOUTHERN UTAH

NYDAM, Randall, FITZPATRICK, Brandon, Midwestern Univ., Glendale, AZ

The Smoky Hollow Member of the Straight Cliffs Formation is exposed in and around the Kaiparowits Plateau region of southern Utah with most of the microvertebrate-producing localities within the borders of the Grand Staircase-Escalante National Monument. Numerous lizard jaws, osteoderms, and vertebrae representing an array of scincomorphan and anguimorphan taxa have been collected from this horizon. Most of the scincomorphan specimens can be grouped into distinctive morphotypes based on tooth and jaw morphology, but few specimens have been recovered that complete enough for formal taxonomic treatment. Even so, many specimens have teeth characteristic of paramacellodid lizards, but many aspects of this tooth morphology are also found in various modern scincomorphans. One of the scincomorphan taxa has a unique dentition with truncated crowns, well-developed lingual and labial striae and a distinct apical groove. The presence of basal replacement pits, a well-developed subdental shelf and gutter, and a slit-like Meckel's groove indicates that this may be a scincid. Indeed, this taxon bears striking similarity in tooth and jaw structure to *Contogenys* and may indicate that this lineage was present in North America as early at the Turonian.

Anguimorphan lizards are represented by jaw fragments and osteoderms. Ornamentation patterns of the osteoderms are vermiculate, indicative of Anguidae, or tuberculate, indicative of Varanoidea. Although the vermiculate-patterned osteoderms are referable to *Odaxosaurus*, no jaws have yet been found that can be referred to this taxon and they may belong to the same taxon as the non-*Odaxosaurus* anguid jaw fragments. Jaws with plicidentine tooth bases are unquestionably varanoid, but of indeterminate family. Results of a reexamination of specimens previously identified as *Dorsetisaurus* suggests that they may represent an anguid or early xenosaurid. The apparent absence of *Chamops*-grade teiids and definitive *Odaxosaurus* in the fauna indicates that these "classic" lizards of the Late Cretaceous of North America were not widely established until after the Turonian.

Friday 8:45

A NEW FOSSIL BIRD FROM THE LOWER CRETACEOUS JIUFOTANG FORMATION, LIAONING PROVINCE, NORTHEASTERN CHINA

O'CONNOR, Jingmai, CHIAPPE, Luis, Natural History Museum of Los Angeles County, Los Angeles, CA; GAO, Qeqin, Peking Univ., Beijing, China

We report on the discovery of an early Cretaceous bird from northeastern China. The new bird is slightly larger than a sparrow, represented by a nearly complete skeleton with feather impressions preserved in a slab and counter slab. The new specimen was quarried from the famous lacustrine deposits of the Jiufotang Formation (Jehol Group; ca. 120 Ma) near Chaoyang, in Liaoning Province. These deposits have previously yielded numerous fossils ranging from avian taxa such as *Cathayornis*, *Confuciusornis* and *Jeholornis* to a variety of nonavian dinosaurs, from *Microraptor* to *Psittacosaurus*. The new fossil bird shares many similarities with *Yanornis* and *Yixiaornis*, also collected from the Jiufotang, including a curved scapula, the broad and robust nature of the first phalanx of the second manual digit, and a slender U-shaped furcula lacking a hypocleideum, which support its allocation within Ornithuromorpha. While the new fossil shares similarities with these other Liaoning ornithuromorphs, several characters suggest that it belongs to a new taxon. The hindlimb in the new fossil is extremely elongate with the tibiotarsus exceeding the humerus in length, compared to *Yixiaornis* and *Yanornis* in which the two bones are comparable in length. The forelimb to hindlimb ratio is 0.79 as opposed to 1 or more than 1 in *Yixianornis* and *Yanornis*, respectively. The new occurrence adds further to the avian diversity of the Jehol biota as well as increases the meager fossil record of early Cretaceous ornithuromorph birds.

Poster Session B

NEW DINOSAURS AND OTHER VERTEBRATE FOSSILS FROM THE CRETACEOUS RED SANDSTONE GROUP, RUKWA RIFT BASIN, SOUTHWESTERN TANZANIA

O'CONNOR, Patrick, Ohio Univ., Athens, OH; GOTTFRIED, Michael, Michigan State Univ., East Lansing, MI; ROBERTS, Eric, Idaho State Univ., Pocatello, ID; STEVENS, Nancy, Ohio Univ., Athens, OH; NGASALA, Sifael, Univ. of Dar es Salaam, Dar es Salaam, United Republic of Tanzania

Recent field efforts in Cretaceous strata on former Gondwanan landmasses, particularly South America and Madagascar, have dramatically enhanced our understanding of vertebrate evolution in the southern Hemisphere at the close of the Mesozoic. Yet much of the Cretaceous Gondwanan record remains so poorly sampled that supercontinent-level biogeographic hypotheses are often based on only a few data points. Particularly problematic for Gondwanan-wide paleobiogeography is the extremely limited record of Cretaceous-age deposits in subequatorial Africa.

The Rukwa Rift Basin Project (RRBP) was initiated to conduct paleontological field exploration in undersampled terrestrial strata in western Tanzania. Here we report the discovery of a series of new fossiliferous localities from Red Sandstone Group deposits in the Rukwa Rift Basin (RRB). Previously recovered vertebrate materials were known from only a single area within the RRB. Reconnaissance efforts in 2004 expanded not only the geographic extent of fossiliferous deposits along the rift axis, but also added significantly to a growing list of vertebrate clades recovered from Red Sandstone Group strata.

New localities preserve a diverse fauna representing members of several major terrestrial vertebrate clades, including fishes (osteoglossomorph teleosts, ceratodontids), turtles, crocodyliforms, dinosaurs and mammals. Among sauropod dinosaurs, distinctive dental, axial and appendicular morphologies suggest the presence of at least three taxa, two that can be assigned to lithostrotian titanosaurians. Preliminary faunal analysis suggests some overlap with taxa recovered from the Early Cretaceous (~ Aptian) Dinosaur Beds of Malawi. Yet the presence of numerous small vertebrate remains and dinosaur eggshell contrasts substantially with the Malawi fauna. As in Malawi, both nonavian theropod and sauropod dinosaurs have thus far been identified, yet ornithischian taxa (e.g., ornithopods) so characteristic of Early Cretaceous deposits in other parts of Africa have yet to be recovered. Whether this reflects inadequate sampling or a regional-level biogeographic signal awaits future work.

Saturday 5:00

FINDING FOSSILS: A GIS-BASED SUITABILITY ANALYSIS OF THE TWO MEDICINE FORMATION OF NORTH-CENTRAL, MONTANA

OHEIM, Kathryn, HALL, Justin, Washington Univ. in St. Louis, St. Louis, MO

Suitability analysis using GIS can be used to predict vertebrate fossil spatial distribution to ease the process of fossil prospecting in the field of paleontology. To test this method, the Two

Medicine Formation of north-central Montana was analyzed with regard to the factors most likely to characterize fossil existence and viability for finding fossils in this formation. The Two Medicine Fm. is a Cretaceous terrestrial formation possessing abundant dinosaur fossils and minor amounts of other fossils. The factors most influential in finding fossils in this formation include geology, land coverage, elevation, and distance from roads. Digital data of these variables were obtained from the Montana State Library GIS Resources website and the United States Geological Survey. Data layers were converted to a common coordinate system and changed to raster data where applicable. The variables of each layer were scored from 1 to 4, with 4 being the most desirable. The layers were added together using a weighted score determined by data reliability and correlation of existing fossil localities to the data. This calculation created a layer which predicted highest suitability for finding fossils. Field testing the model yielded high success of the preliminary model. Fossil density was significant in high scoring areas of the model versus low scoring areas visited during field testing. Model adjustments that arose from increased data during field testing included minor rescoring of data within 2 layers and the consideration of slope of elevation to the model to increase accuracy.

Wednesday 2:00

EVOLUTIONARY DEVELOPMENT OF THE AMNIOTE ASTRAGALUS: NEW FOSSILS, NEW PERSPECTIVES

O'KEEFE, Frank, SIDOR, Christian, NYCOM, Old Westbury, NY; LARSSON, Hans, McGill Univ., Montreal, QB, Canada

The homologies between the amniote astragalus and the various ossifications of the anamniote tarsus have been debated for decades. Here we report on fossil evidence from the Upper Permian of Niger that sheds new light on this debate. Field work in the Moradi Formation has yielded new material of the large captorhinid *Moradisaurus grandis* Taquet 1969, including a complete juvenile pes. This poorly ossified specimen possesses a well-preserved tarsus in which none of the ossification centers contributing to the astragalus and centrale are coossified. Analysis of this specimen has established that the centrale in stem reptiles arose through the cossification of two distal centralia, as previously hypothesized. The poorly ossified astragalus of *Moradisaurus* apparently contains four ossification centers, rather than three centers as hypothesized in the currently accepted model of astragalus homology. An immature astragalus of the captorhinid *Captorhinikos chozaensis* Olson 1954 also shows clear evidence of four ossification centers. The realization that the captorhinid astragalus arose through the coossification of four centers begs the question of the homologies of these elements. In the three-center model, the reptilian astragalus comprises three centers homologous to the intermedium, tibiale, and 'proximal centrale' of anamniote tetrapods. However, there are two proximal centralia in the tarsus of anamniote tetrapods, so the identity of the 'proximal centrale' in the three-center model is debatable. Drawing on knowledge of the development of the tetrapod tarsus, we propose a four-center model of astragalus homology in which four ossifications homologous to the anamniote intermedium, tibiale, and two proximal centralia contribute to the amniote astragalus. The four-center model requires less reorganization of the tarsus than the three-center model. The possession of multiple-center ossification of the astragalus is unequivocally reconstructed for all stem reptiles, and the ossification pattern seen in all modern reptiles— including turtles— probably arose within Diapsida.

Saturday 4:45

***LISTRIODON*, *BUNOLISTRIODON* OR *EUROLISTRIODON*? IMPLICATIONS OF THE REEXAMINATION OF THE LISTRIODONT MATERIAL FROM MONTREAL-DU-GERS (FRANCE, GERS) ON THE SYSTEMATICS OF THE SUBFAMILY LISTRIODONTINAE (MAMMALIA, SUIDAE)**

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The early middle Miocene site of Montreal-du-Gers (Gers, France; Mammalian age MN4a, circa 17 Ma) has yielded a large sample of suid remains, including a Listriodontinae. A reexamination of this listriodont material, so far attributed to *Bunolistriodon lockharti*, provides evidence that it actually consists in a new species close to the controversial genus *Eurolistriodon*, recently considered as a junior synonym of *Bunolistriodon*. Indeed, the systematics of the subfamily Listriodontinae suffered from instability during the last decades, and successive revisions of the group led to conflicting results. The basic problems that induced the current instability are related to the extent of the genus *Bunolistriodon* and even of its type species *B. lockharti*. A better definition of *B. lockharti* is the key to understand the relationships among Listriodontinae.

The first analysis of the European listriodonts using parsimony is performed, based on 27 dental characters controled for 16 taxa. Among these, seven operational units correspond to assemblages yielded by seven French localities and previously assigned to *B. lockharti*. Only dental characters are considered since cranial and postcranial features are poorly known. Special attention has been paid to the groove pattern of the molars that turns out to be a discriminant feature to define taxa and to describe intermediate states between bunodonty and lophodonty (both cheek tooth structures exist in the subfamily). The results of this preliminary phylogenetic analysis do not support the monophyly of *B. lockharti* and part of the material attributed to this species is in fact closely related to *Listriodon splendens*, suggesting that the two genera could be synonyms. The listriodont from Montreal-du-Gers and *Eurolistriodon adelli* from Spain exhibit a combination of plesiomorphic characters and occupy a basal position in the clade Listriodontinae. An hypothesis about the evolution of dental structure toward lophodonty, resulting from modifications of the groove pattern, is presented.

Poster Session B

DEFINING THE LIMITS OF MOLECULAR PHYLOGENY: THE FIRST COMPLETE PROTEIN SEQUENCE OF A 42 KA *EQUUS* FROM WYOMING

OSTROM, Peggy, HUMPULA, James, Michigan State Univ., East Lansing, MI; STRAHLER, John, WALKER, Angela, Univ. of Michigan, Ann Arbor, MI; LEYKAM, Joseph, GANDHI, Hasand, Michigan State Univ., East Lansing, MI

Although proteins are genetically and ecologically informative molecules, long-standing questions remain regarding their limit of survival. Complete sequence data obtained by MALDI-mass spectrometry (peptide mass fingerprinting: PMF, and MS/MS) demonstrate intact osteocalcin in a 41,770 ka bone from a stout-legged Equid from Juniper Cave, WY. These data are used for phylogenetic comparisons to extant horse (*Equus callabus*), zebra (*Equus grevyi*) and donkey (*Equus asinus*). Osteocalcin sequences determined by PMF and MS/MS are identical for the modern taxa. The monoisotopic mass of the molecular ion for putative osteocalcin from the fossil (5721) was the same as that for modern taxa, suggesting similar sequences. Edman sequence data for residues 2-21, the intact mass of the molecular ion, PMF of tryptic peptides and MS/MS for two peptides, residues 1-19 and 20-43, are consistent with the sequence of modern horse. We are currently obtaining DNA data to further describe phylogenetic relationships among these species. Further, these data suggest that sequences from a variety of bone proteins can be used to derive phylogeny for organisms with obscure lineages and they provide unequivocal evidence for protein surviving at least 42,000 years.

Saturday 5:00

***ARCHAEOHIPPUS MANNULUS* AND THE UTILITY OF PHALANGEAL INDICES**

O'SULLIVAN, Jay, Univ. of Tampa, Tampa, FL

The tiny late Arikareean equid *Archaeohippus mannulus* from Pinellas County, Florida is the smallest and least derived member of its genus. Its small body size and low crowned dentition seem to place it phylogenetically close to *Mesohippus*. However, the derived nature of its manus, supported by certain dental characters, places it within a clade that includes *Archaeohippus*, *Desmatippus*, and *Parahippus* (the ADP clade). The manual and pedal adaptations of these taxa include a suite of derived characters. However, a single phalangeal index (proximal phalanx III length/midshaft width) serves as a diagnostic of this derived condition. The utility of this index is immediately apparent. Phalanges are nearly as common equid fossils as teeth. Dental indices pertaining to crown height evolution are not reliable for late Oligocene-early Miocene taxa. The dietary trends these indices pertain to were not yet established among equids. Except for the Anchitheriinae *sensu stricto*, most equids were probably mixed feeders. In contrast, the pedal adaptations found in the ADP clade were already evident by the late Oligocene. Variation in this index in other Oligocene-Miocene equid taxa from the Florida Gulf Coast suggests the possibility that multiple small equid taxa inhabited Florida. Thus, a single index, viewed as a proxy measure for a suite of pedal adaptations, provides improved resolution of phylogenetic relationships within the Equidae.

Thursday 3:00

SEXUAL DIMORPHISM IN DINOSAURS?: A REVIEW OF THE EVIDENCE

PADIAN, Kevin, Univ.of California Berkeley, Berkeley, CA; HORNER, John, Museum of the Rockies, Bozeman, MT; LEE, Andrew, Univ. of California, Berkeley, CA

Sexual dimorphism has been inferred for nearly every group of dinosaurs at one time or another. But how robust are these inferences in the published literature to date? In many cases, sample sizes are too small to permit statistical separation (e.g., pachycephalosaurs, lambeosaurs, most ceratopsians, most theropods). Frequently, elements suspected of dimorphism are not sufficiently associated with other skeletal parts to provide independent evidence of taxon or ontogenetic age (e.g., pachycephalosaurs, chasmosaurs). Ontogenetic variation may account for many cases in which sexual dimorphism has been invoked. Most of these cases involve "bizarre structures" such as horns, frills, and crests, but in several saurischians "robust" and "gracile" morphs have been identified and sexual dimorphism has been implicated. We show that in these cases statistical samples are not sufficient, or it is equally possible that the "robust" morphs are merely more mature individuals. This does not eliminate sexual dimorphism as a possibility in dinosaurs, although it weakens it as a general pattern; Dodson's study of *Protoceratops* may remain statistically valid, although as he recognized, the dimorphic signal is weak. However, true sexual dimorphism is required for the Darwinian theory of sexual selection. Such dimorphism could have existed in soft parts or behaviors not preserved in the fossil record, but on the basis of what is currently preserved, there is no strong evidence either for sexual dimorphism or sexual selection.

Poster Session B

TAXONOMIC DIVERSITY OF A MAASTRICHTIAN AGE MICROFAUNAL LOCALITY IN THE LITTLE COTTONWOOD DRAW, CARBON COUNTY, MONTANA

PAPPAS, John, New Jersey State Museum, North Brunswick, NJ; MOSES, Randolph, South

Dakota School of Mines and Technology, Rapid City, SD; O'GRADY, Bevin, New Jersey State Museum, Trenton , NJ

The Little Cottonwood Draw section is a nearly continuous sequence of Upper Cretaceous to Upper Paleocene (Judithian-Tiffanian) exposures including the Judith River, Lance and Fort Union Formations. Shield Wolf Quarry (SWQ), in the uppermost Lance Formation, has produced *Lepisosteus*, Theropoda, Hadrosaurinae, Ceratopsia, Crocodylia, and Chelonia and also teeth of marsupial, eutherian and multituberculate mammals. Identifiable mammal specimens include a lower premolar referable to *Alphadon* sp., a *Meniscoessus robustus* M1, and the anterior portion of a p4 of *Gypsonictops* sp. Additional mammal specimens are as yet unidentified and include several tooth fragments and isolated incisors.

Lithology of SWQ is a basal sandstone overlying a clayball conglomerate in a sequence of interbedded sandstones and claystones typical of a late Cretaceous fluvial depositional environment. Most of the specimens were recovered from the conglomerate layer with additional specimens coming from the overlying sandstone. Several specimens of gastropods have also been recovered.

Continued research in this area will provide an opportunity to sample the vertebrate fauna of the Cretaceous Lance Formation and the overlying Paleocene Fort Union Formation with additional information on changes in faunal composition.

Friday 2:00

CRITICAL REVIEW OF THE LATE TRIASSIC DINOSAUR RECORD, PART 1: *REVUELTOSAURUS CALLENDERI*

PARKER, William, Petrified Forest National Park, AZ; NESBITT, Sterling, Columbia Univ., New York, NY; IRMIS, Randall, Univ. of California Museum of Paleontology, Berkeley, CA

Revueltosaurus callenderi was named on the basis of teeth and assigned to the basal ornithischian dinosaurs, even though several features diagnostic of well-known ornithischian teeth were absent. The recent discovery of the skull and postcrania of *Revueltosaurus callenderi* from the Chinle Formation of Petrified Forest National Park, Arizona shows that this taxon represents a suchian archosaur and not an ornithischian. The most complete specimen consists of an articulated carapace and vertebral column and includes much of the skull and associated postcrania.

The skull has a postfrontal and lacks a mandibular fenestra, both non-dinosaurian features; in other respects it is highly autapomorphic. The humerus bears a broad, proximally restricted deltopectoral crest. The ilium is plesiomorphic; it has only a short robust anterior process and two sacral rib articulations. The femur is also plesiomorphic; having a large fourth trochanter and a poorly defined rounded femoral head. The ankle is crocodile-normal. Several types of osteoderms are present with presumed dorsal paramedian osteoderms that are rectangular and have an anterior bar as in many suchians.

The presence of a postfrontal, paramedian osteoderms with an anterior bar, and a crocodile-normal ankle precludes assignment of *Revueltosaurus* to the Dinosauria. Instead these characters allow referral to the Suchia. Based mainly on the presence and morphology of the paramedian osteoderms a preliminary phylogenetic analysis suggests that *Revueltosaurus* is a sister taxon to the Stagonolepididae. Material from the holotype locality in the Dockum Group of New Mexico, plus recently identified elements of *Revueltosaurus*-like forms from the Blue Mesa Member of the Chinle Formation of Arizona and the Pekin Formation of North Carolina demonstrate that this previously unrecognized group of presumably herbivorous archosaurs was widely distributed.

As the teeth of *Revueltosaurus* show numerous supposed ornithischian synapomorphies, it is clear that these characters alone do not diagnose Ornithischia, and that all ornithischian taxa based on dental remains require reevaluation.

Saturday 11:30

EVOLUTIONARY AND PALEOECOLOGICAL ASPECTS OF THE TRIASSIC-EARLY JURASSIC SAUROPODOMORPH RADIATION

PARRISH, J. Michael, Northern Illinois Univ., DeKalb, IL

When the Sauropodomorpha first appeared in the Triassic, they represented the first radiation of large, herbivorous archosaurs. The earliest apparent sauropodomorph is *Saturnalia*, from the Santa Maria Formation of Brazil, but otherwise undisputed members of the group are not known until the Norian, when they appear as two distinct lineages: Prosauropoda and Sauropoda.

Between the Norian and the end of the early Jurassic, Sauropodomorpha were represented by animals ranging in adult size from small (<1 m) to very large (ca. 15 m), and included animals that were principally bipedal as well as those that were exclusively quadrupedal. Within Sauropodomorpha, the disparity between forelimb and hindlimb lengths generally decreases with body size. By the middle Jurassic, the prosauropods had gone extinct, and Sauropoda was represented exclusively by large to giant quadrupeds.

In the Triassic, known taxa of Prosauropoda and Sauropoda had dental batteries suitable for coarsely cutting vegetation and, in some of the smaller taxa, possibly for puncturing the carapaces of invertebrates. During the later Mesozoic, sauropods either retained this type of dentition or reduced oral processing capabilities further by restricting the dental battery to the anterior part of the snout, simplifying the dentition, and increasing the degree of tooth-to-tooth contact. Osteological constraints on cervical column mobility were relatively minimal within basal Sauropodomorpha, but became much more pronounced within the middle Jurassic to Cretaceous sauropods.

As the early record of Sauropodomorpha, and our understanding of their phylogeny, have both continued to improve, it is now clear that, rather than representing a typical example of Cope's rule, this successful dinosaurian clade was one that exhibited a large size range early within its evolutionary history, and emerged later as a lineage of giants principally by atrition of smaller, more generalized taxa.

Poster Session B

A COMPARISON OF POSTCRANIAL FEATURES FOUND WITHIN THE ONTOGENIES OF THE MANIRAPTORAN THEROPOD DINOSAURS *DEINONYCHUS ANTIRRHOPUS* (SAURISCHIA, THEROPODA) AND *VELOCIRAPTOR MONGOLIENSIS* (SAURISCHIA, THEROPODA)

PARSONS, William, PARSONS, Kristen, Museum of the Rockies, South Wales, NY

Expanding upon the preliminary analysis of ontogenetic characters originally observed within the examination of the two sub-adult specimens of *Deinonychus antirrhopus* (MOR 1178 and MCZ 8791), a study of the juvenile dromaeosaurid specimen of *Velociraptor mongoliensis* (IGM 100/985) and a comparison of this specimen with more mature specimens of *V. mongoliensis* have revealed some interesting morphological differences as well as similarities to characters found on the *D. antirrhopus* sub-adults. In regard to limb development, there are distinctions which may relate to behavioral differences between these two genera. The analysis of these adult and juvenile specimens has brought to light some juvenile vertebral characters observed on MCZ 8791 that may be diagnostic of the juvenile status of other individual specimens within the Dromaeosauridae. Some of these vertebral characters indicate a gradual ossification within regions that originally possessed juvenile cartilaginous tissues. On the vertebrae of the sub-adult *D. antirrhopus* MOR 1178 as well as on IGM 100/985, the ossification appears more complete than on MCZ 8791. If the stages of this ossification process are diagnostic of the growth stages within the Dromaeosauridae, it would appear that the juvenile *V. mongoliensis* IGM 100/985 was closer to an adult growth stage than the growth stages represented by the two sub-adult *D. antirrhopus*. These more detailed examinations have focused upon certain skeletal features such as the laterally compressed unguals, the curvature of the third metacarpals, the appearance of or the absence of the posterolateral flanges on the proximal end of the manus II-1 phalanx and similarities in the morphology of the semilunate carpals. This study should help to define both the affinities and the phylogenetic distance between these two closely related genera. The application of this new information to the analysis of dromaeosaurid specimens of undetermined age will help to resolve our understanding of their developmental status.

Poster Session B

***RHYNCHOTHERIUM FALCONERI* (PROBOSCIDEA: GOMPHOTHERIIDAE) FROM THE 111 RANCH, SOUTHEASTERN ARIZONA**

PASENKO, Michael, Northern Arizona Univ., Flagstaff, AZ

A previously undescribed specimen of *Rhynchotherium falconeri* from the 111 Ranch includes rare postcranial elements and a partial mandible. This specimen possesses progressive traits such as a moderately developed pentalophid, modest anacoidy, posttrite conules, lower incisors with roots extending past the symphysis border, and a greatly deflected symphysis. These characteristics separate it from other, more primitive species such as *R. blicki* and *R. euhypodon*, and compares to the more derived *R. falconeri*. A morphometric comparison of the 111 Ranch specimen with the mandibles and teeth for several holotypes, and other specimens suggest the genus is oversplit, and a number of junior synonyms are represented. This specimen provides only the second description of postcranial material for *Rhynchotherium*. Preliminary analysis of the postcranial elements shows they are typical for gomphotheriids with some characters intermediate between *Mammuthus* and *Mammut*. A comparison of the 111 Ranch specimen with that of the only other description of postcranial material for this taxon (F:AM 18225) shows sexual dimorphism may be an attribute of this genus.

The 111 Ranch is a fossil-rich locality in southeastern Arizona that includes paleomagnetic and fission-track dating placing the rhynchothere at no later than 2.47 Ma, or Late Pliocene. A review of previous studies at the 111 Ranch reveals that a savanna-type environment was present with standing bodies of water, which supports other studies of sites with rhynchotheres. In addition, the reports of several other specimens assigned to *Rhynchotherium* in the region of the 111 Ranch indicate this was the preferred environment.

Saturday 12:00

EQUID $\delta^{18}O$ IN THE NEOGENE OF NEBRASKA: RELATIONSHIP WITH UNGULATE DIVERSITY, AND DISCUSSION OF MAMMALIAN $\delta^{18}O$ AS A PALEOENVIRONMENTAL PROXY

PASSEY, Benjamin, CERLING, Thure, Univ. of Utah, Salt Lake City, UT

Good paleoenvironmental records are a prerequisite for examining the interplay between climate and evolution, and oxygen isotopes in mammalian bioapatite can provide such records. We present an oxygen isotope record from Nebraska fossil horses, and use this record to develop a discussion, useful for non-specialists, of important issues to consider when interpreting oxygen isotope data. The 18 Ma $\delta^{18}O$ record from Nebraska spans the apogee and demise of the Clarendonian chronofauna, and continues through to the late Pleistocene. The emerging picture from this survey-type record (159 individuals, 16 genera, 48 localities) is a remarkable

positive correlation between measures of ungulate diversity and equid $\delta^{18}O$. For example, regressions between $\delta^{18}O$ and species richness of Great Plains ungulates have highly significant slopes and r^2 values ranging between 0.79 and 0.90 for different richness estimates. Inasmuch as mammalian $\delta^{18}O$ is a climate-related proxy, this record suggests an important connection between mammalian evolution and environmental change in the Great Plains. Alternatively, changes in equid $\delta^{18}O$ may simply reflect changes in equid behavior and physiology, changes in the proportion of moisture derived from Gulf and Pacific sources, or changes in other factors unrelated to the effective climate of the region. Continued development of the record using a multiple-taxon approach will allow the important forcing factors to be identified. Combined with information from other proxies, a detailed mammalian $\delta^{18}O$ record will enhance our understanding of Great Plains paleoenvironments, and will shed light on the relationship between climate change and evolution.

Poster Session B

AN EXACT RANDOMIZATION STUDY OF DENTAL SHAPE VARIABILITY IN MIOCENE HOMINOIDS

PATEL, Biren, GROSSMAN, Ari, SU, Anne, Stony Brook Univ., Stony Brook, NY

Afropithecus turkanensis and *Morotopithecus bishopi* are two large-bodied hominoid primates from lower Miocene deposits of East Africa. While some authors distinguish both species, others argue that these taxa lack substantial craniodental and postcranial differences and should be congeneric if not conspecific. Of the material shared by both taxa, only the maxilla and upper dentition preserve well enough (although highly worn in both) for possible metric comparisons. We examined five dental shape characters used to distinguish these fossil hominoids in order to test if the differences between these extinct hominoids exceed the variability seen in extant large-bodied hominoids. Our null hypothesis was that *Afropithecus* and *Morotopithecus* are not different enough from each other to support generic or specific distinction.

In this study, exact randomization methods were applied to ask two questions. First, is it possible to find the degree of difference observed between *Afropithecus* and *Morotopithecus* within extant hominoid samples (single species, same-sex comparisons)? Second, what is the probability of observing the fossil differences among pairs of extant individuals? Exact randomization (i.e., complete enumeration) is an appropriate statistical method because of the small comparative sample size which allows metric differences to be calculated between all possible pairs of individuals. The dental shape difference of the fossil pair is then compared to the resulting distributions of extant pairs and probabilities are calculated. We chose extant African apes (*Pan troglodytes* and *Gorilla gorilla*) as our comparative sample.

The maximum observed shape differences for all comparisons in the fossil maxillary dentition are well within the 95% confidence intervals of the extant *Pan* and *Gorilla* samples. These results indicate that in these dental shape characters, differences between these large-bodied Early Miocene hominoid species do not exceed the variability found in any extant species examined here. Thus, we cannot reject the null hypothesis. The application of exact randomization in vertebrate paleontology and taxonomy is addressed.

Saturday 5:15

DIET AND ECOLOGICAL PARTITIONING AMONG THE ARCTOCYONIDAE (MAMMALIA: "CONDYLARTHRA") FROM THE MIDDLE PALEOCENE THROUGH THE EARLY EOCENE OF NORTH AMERICA

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"Condylarths" were among the most abundant and taxonomically diverse mammals during the Paleocene and Eocene, imparting significant ecological importance to the order. Despite that fact, reasons for their subsequent decline between the middle Paleocene and the early Eocene remain poorly understood, particularly in relation to ecologically significant characters (e.g., those relating to diet). As a reliable indicator of dietary adaptation, dental morphology is a logical means for examining these issues within "condylarthran" paleoecology.

"Condylarth" dentitions were analyzed relative to a comparative sample of modern mammals of known diets via a combination of traditional "shearing crest" and wear scoring techniques, as well as occlusal surface characterization through laser-scanning. Based on the modern comparative sample alone, results strongly suggest that functional aspects of tooth morphology may be retained even after significant wear, and that functional dietary groups can be identified on the basis of morphological features, irrespective of phylogeny. Data from the dentitions of one "condylarth" family (the Arctocyonidae), spanning the Torrejonian (middle Paleocene) to Wasatchian (early Eocene) NALMAs of the San Juan (New Mexico) and Bighorn (Wyoming) basins, were then plotted against the modern mammal dataset in order to: (1) ascribe dietary categories to the fossil taxa, based on morphologic similarity to modern analogs; (2) document dental morphologic divergence between taxa and across time intervals; and (3) measure effects of wear in altering functional surfaces of teeth.

This study indicates that the diets of these fossil mammals, with no living direct descendants, may be successfully discerned using a combination of techniques and an adequate modern comparative sample. More specifically, it may be possible to correlate the change in average arctocyonid occlusal morphology through time with environmental events, and subsequently construct potential explanations for the dramatic drop in arctocyonid (and overall "condylarth") diversity between the middle Paleocene and early Eocene of western North America.

Poster Session A

FLUVIAL DISPERSAL OF SHED CROCODILIAN TEETH AND OTHER MICROVERTEBRATE REMAINS

PETERSON, Joseph, Dekalb, IL

Most previous sedimentological analyses of dispersal patterns of microvertebrate remains in fluvial systems have resulted in equivocal conclusions. Consequently, such studies have had limited practical application to quantitative stratigraphic or paleoecological studies. Microvertebrate localities of the upper Cretaceous and Cenozoic show variation in properties of fluvial systems with little variation in the diversity of fossils. A new study is underway, designed to assess the hydrodynamic properties of various microvertebrate remains and to test their susceptibility for fluvial transport and redeposition. Shed teeth from the modern species *Alligator mississippiensis* and skeletal remains of modern specimens of mice, birds, and fish were placed in a large flume to determine hydrodynamic behavior. The skeletal elements selected are modern analogues of common components of many upper Cretaceous and Cenozoic deposits.

The flume used was 2.5 meters wide and 11 meters long, with a total depth of 60 centimeters. The sedimentary matrix in the flume varied from clay to pebble-sized particles with sediment thickness varying from 3 to 20 cm. The flow speed ranged from 2 cm/second to 33 cm/second. Each specimen was weighed, with volume, density, and a shape factor determined. Preliminary data show that the variance in physical and hydrodynamic properties greatly influences the dispersal of microvertebrate remains. The dispersal distance of shed crocodilian teeth is far less than that of water-saturated microvertebrate mammalian and avian bones. While the data are not yet conclusive, the variations in dispersal among the different microvertebrate remains suggest that under proper fluvial conditions, such remains may be useful for paleoecological interpretation. Further controlled experiments are underway to test the dispersal and physical properties of microvertebrate remains under a range of hydrodynamic and sedimentological conditions. The results will help to reconstruct the depositional setting and infer the paleoenvironment of key microvertebrate deposits, notably late Maastrichtian fluvial beds of the Hell Creek Formation in southeastern Montana.

Student Poster Session

AFRICAN CARNIVORAN TAXON-SPECIFIC BONE MODIFICATION PATTERNS: EXPERIMENTAL EVIDENCE

POBINER, Briana, Rutgers Univ., New Brunswick, NJ

Paleoanthropological debate on the nature of early hominin carnivory has focused on the potential acquisition by hominins of larger mammal carcasses by scavenging from carnivorans, especially felids. The precise identity of the carnivorans from which hominins may have scavenged have been hypothesized, but evidence of involvement of these carnivorans with fossil assemblages bearing hominin bone modification has yet to be demonstrated convincingly.

Systematic, comparative, qualitative and quantitative analyses of taxon-specific bone modification patterns by free-ranging and captive larger African carnivorans (*Panthera leo, Panthera pardus, Acinonyx jubatus, Canis mesomelas, Crocuta crocuta*) on different sized ungulate prey carcasses and carcass parts are presented here. These analyses demonstrate the ability to recognize and diagnose the activities of modern felids, canids and hyenids from the traces they leave on bones. Implications for the recognition of the involvement of fossils carnivorans are discussed.

This is the first step towards testing the scavenging hypotheses outlined by previous researchers and documenting the nature of hominin-carnivore interactions during the Plio-Pleistocene at the onset of the hominin invasion of the carnivoran paleoguild.

Saturday 8:30

NEW INFORMATION ON *LESSEMSAURUS SAUROPOIDES* (DINOSAURIA, SAUROPODOMORPHA) FROM THE LATE TRIASSIC OF ARGENTINA

POL, Diego, The Ohio State Univ., Columbus, OH; POWELL, Jaime, Instituto Miguel Lillo, Tucuman, Argentina

New information on *Lessemsaurus sauropoides* from the Upper Triassic of Argentina is presented here. These materials provide unrecorded transitional morphologies between the generalized anatomy of basal forms and the derived condition of Sauropoda. The phylogenetic relationships of this form are approached here through a cladistic analysis of basal sauropodomorphs recorded worldwide in Upper Triassic and Lower Jurassic beds of Pangea. The most parsimonious trees recovered in the cladistic analysis support a paraphyletic arrangement most taxa traditionally referred as Prosauropoda, being depicted as series of clades that form the successive sister-taxa of Sauropoda. The inclusion of the usually overlooked 'melanorosaurids' (e.g., *Lessemsaurus sauropoides*, *Melanorosaurus readi*, *Antetonitrus ingenipes*) is critical due to their unique combination of plesiomorphic and apomorphic characters. The analysis shows that several of the currently recognized sauropod synapomorphies had actually appeared earlier in the evolutionary history of Sauropodomorpha. The stratigraphic fit of alternative phylogenetic hypotheses of basal Sauropodomorpha is contrasted here. This comparison shows that all previously proposed phylogenies have similar degrees of agreement with the temporal data from the fossil record and results in the discovery of a large Norian radi-

ation of sauropodomorph dinosaurs that includes the origins most known 'prosauropod' lineages as well as the sauropod lineage.

Saturday 3:45

THE RARE MOSASAUR GENUS *GLOBIDENS* FROM NORTH CENTRAL TEXAS (MOSASAURINAE:GLOBIDENSINI)

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The durophageous mosasaur genus *Globidens* is a relatively rare yet cosmopolitan faunal component of the Upper Cretaceous seas. Cranial material is mostly fragmentary with only one relatively complete skull from South Dakota currently described. We report new material recovered from Fannin County, Texas that includes a partial skull and some postcrania. The specimen lacks precise locality information; however, the residual matrix indicates it is likely from the Marlbrook Marl of the Taylor Formation and thus Campanian in age, consistent with the Alabama, Kansas and South Dakota material. The pterygoid has ten teeth. They are significantly smaller than the marginal dentition, and are more elongate, slightly recurved and possess crenulated enamel surface and strong carinae. The quadrate was apparently deeply bowled, had a well-developed ascending process, and a largely convex articulation surface for the mandible. A strongly developed supraorbital wing of the prefrontal that does not appear to have contacted the postorbitofrontal lateral to the frontal is consistent with *G. alabamaensis*. The squamosal, supratemporal and exoccipital appear to be tightly co-joined and suggest obliteration of the metakinetic joint. Both the pattern of heterodonty and dentary tooth count is consistent with described *Globidens* material; however, it differs from previously described *Globidens* in that the posterior teeth are not bulbous but instead are more elongate and possess distinct carinae. The bone surface is highly vascularized and indicates the new material is from a sub-adult animal and thus the differences in tooth morphology probably represent ontogentic variation in *Globidens*. The dental attributes in the new material are identical to that in *Platecarpus intermedius* requiring reference of that species to the genus *Globidens*.

Friday 10:15

AETOSAUR PLATES AND WHALE TEETH: ON RECOGNIZING CHARACTER CORRELATION IN CLADISTIC CHARACTER STATE DISTRIBUTIONS

POLLY, P. David, Queen Mary Univ.of London, London, United Kingdom

Character independence is a well-known requirement of phylogenetic analysis. Correlated characters cheat the parsimony algorithm by causing the same underlying evolutionary change to be counted more than once, upping the signal-to-noise ratio. Recently, methods to demonstrate character correlation in cladistic matrixes were proposed in the context of published phylogenies of aetosaurs and whales. One method drops characters that might plausibly be correlated and that have identical state distributions. The second uses Principal Coordinates Analysis (PCO) to identify characters with similar states. Both methods were justified ad hoc without knowledge of how the underlying correlation affects discrete character state matrixes.

Monte Carlo simulations of 20 characters on a tree with 10 tip taxa were used to determine the power and accuracy of these methods. All characters were simulated as continuous traits, 10 with correlations and 10 without, that trigger discrete state changes using a threshold model. Realistic (R=0.60) and unrealistically high correlations (R=0.95) were modelled, as were punctuational and anagenetic modes of evolution.

Only in extreme situations could character correlation be detected. With R=0.60, the chance of the discrete states being identical was less than 1%, no more frequent than in uncorrelated traits. Only when correlations were unrealistically high (R=0.95) and the mode was punctuational was the frequency of identical state distributions higher in correlated characters (17.8%) than uncorrelated ones (0.1%). The positions of correlated were not detectably closer on PCO plots than uncorrelated ones under any of those conditions. The only case in which both methods were efficient at detecting correlation was when the rate of change in correlated characters was higher than in uncorrelated ones, a situation that arises in correlated characters because they are affected directly and indirectly selection and drift. A more sensible strategy for detecting character correlations is to measure them in continuous traits when possible, because these traits have a higher information content than discrete state distributions.

Wednesday, Preparator Poster

RECONSTRUCTION AND CONSERVATION OF A COLUMBIAN MAMMOTH *MAMMUTHUS COLUMBI* (FALCONER, 1857) TUSK IN MONITORED CONDITIONS

POTAPOVA, Olga, Hot Springs Mammoth Site, Inc., Hot Springs, SD

The proboscidean tusks have a huge potential in revealing animals health condition, behavior, migration patterns, season of death, and the information on paleoclimate. If preserved properly, the specimen might yield the kind of information that is unavailable from other sources.

It is well known that the condition of fossil and subfossil tusk material remains uncovered beyond the permafrost zone, buried in loess or clay, usually are poor. Multiple dentin layers are often deeply split and fragmented in radial, tangential and longitudinal directions. After transportation such tusks reach preparation laboratory being severely broken, and leaving no chances to be properly reconstructed. These circumstances impose a very challenging task for preparators. There were several methods of tusk preparation proposed in the past based on research and experiments.

The Mammoth Site represents unique Museum and Laboratory on-site, where it allows salvaging, preserving, restoring and storing valuable specimens under monitored conditions. During 1974-2005 field seasons, there were uncovered 104 Columbian, *Mammuthus columbi*, and possibly, woolly mammoth, *Mammuthus primigenius* tusks from 53 mammoth individuals, which were represented by fragments and complete specimens. Some tusks were removed from the in-situ Bone bed, preserved and stored in the Bone Storage affected by minimum rate of RH and temperature (5-10%) fluctuations.

One of the Columbian mammoth tusks (78-089) with length exceeding nine feet (301.4 cm) was discovered at the Mammoth Site in 1978, in the northeast part of the sinkhole. Due to lack of storage, the tusk was stabilized on its surface, plaster jacketed, and placed into backfill in the northeast area of the Bone Bed by the end of field season, where it was stored for 25 years.

In 2003, the jacketed tusk was removed from the backfill. Parts of the plaster jacket and ivory was severely damaged in three areas.

Experience of the crew preparing and reconstructing the tusk, materials, and methods are described in the paper.

Saturday 11:00

RIBS AND RIB CAGES IN TERRESTRIAL VERTEBRATES: THEIR BIOMECHANICAL FUNCTION AND STRESSING, ANALYSED WITH THE AID OF FESA

PREUSCHOFT, Holger, HOHN, Bianca, DISTLER, Claudia, WITZEL, Ulrich, Ruhr-Universitat Bochum, Bochum, Germany; SICK, Henri, Universite Louis Pasteur, Strasbourg, France

In the literature, ribs are seen as skeletal elements inherited from fish-like ancestors. The "function" of ribs and the rib cage (the thorax) as a whole is usually considered as a protection of the internal organs. We raised the question for the true, biomechanical functions of ribs and the rib cage, in order to get access to a causal explanation for their existence. Persuing this aim, we used basic mechanical principles and three-dimensional FESA to analyse the stresses acting on the ribs in terrestrial animals quantitatively.

In a simple, long-bodied tetrapod, the mechanical loading of the trunk is made visible in quadrupedal and bipedal standing as well as in walking. While quadrupedal standing yields explanations for the axial skeleton and the m. rectus abdominis, the lifting of one or two limbs from the ground shows the necessity of ribs and the oblique muscles of the body wall. Ribs fulfil, in combination with the oblique structures, the requirement to resist compressive and tensile stresses derived from torsion in the body segment between fore- and hindlimbs of tetrapods. These stresses are confined to the periphery of the trunk and leave the body cavities unstressed. Static loading in quadrupedal stance is in accordance with this peripheral arrangement of mechanically relevant tissues, since shearing stresses are perfectly resisted by the dense sequence of tension-resistent muscles and compression resistent bony elements. Reduction of ribs in the lumbar section of mammals is discussed as an adaptation to trunk flexion and extension during asymmetric, "springing" locomotion. The shapes of individual ribs in "large" mammals and some dinosaurs are explained on the basis of mechanical stresses, which are analysed in more detailed FE-models.

Thursday 2:45

TESTING THE UTILITY OF OSTEOLOGICAL CORRELATES PURPORTED TO REFLECT GENDER IN NON-AVIAN DINOSAURS

PRIETO-MARQUEZ, Albert, GIGNAC, Paul, JOSHI, Shantanu, ERICKSON, Gregory, Florida State Univ., Tallahassee, FL

Gender in non-avian theropod dinosaurs has been inferred using attributes in the pelvic girdles and tail skeleton that are presumed to be sexually dimorphic. In theory, wider pelvic canals and shorter, more caudally positioned first chevrons in females act to facilitate the passage of eggs through the cloaca. In contrast longer, more cranially positioned first chevrons in males afford ample attachment area for the "penile retractor" musculature. The American alligator, *Alligator mississippiensis*, has for the most part served as the model taxon for these sexual phenotypes. Nevertheless, little or no quantitative data has been presented showing that these phenotypes truly exist. Here we used wild-caught skeletons of *A. mississippiensis* and the squamate *Iguana iguana* to test whether gender specific morphological differences truly exist in these dinosaurian outgroups. A preliminary sampling of 17 females and 19 males of *A. mississippiensis* and 13 females and 7 males of *I. iguana* were examined. Measurements include: the pelvic canal area; dorsoventral height and mediolateral width of the pelvic canal; height between the dorsal edge of the ilium and the ventral border of the ischium; and lengths and positions of haemal arches 1 and 2. In addition, a new method of shape analysis (Geodesic Distance Analysis) was used to test for morphological differences in the pelvic canal profile. ANCOVA was used to analyze both the data from measurements and the Geodesic Distance Analysis. No significant correlation between sex and pelvic girdle morphology, chevron length, or position was found. Assertions that the gender of dinosaurs can be assessed based upon osteological differences in the pelvic girdles and caudal axial skeleton were not supported.

Saturday 4:30

CRUSHING AND OVERSPLITTING: STATISTICAL APPROACHES TO A RATIONAL TAXONOMY OF THE OREODONT *LEPTAUCHENIA*

PROTHERO, Donald, SANCHEZ, Francisco, Occidental College Dept of Geology, Los Angeles, CA

The Leptaucheniinae was a subfamily of oreodonts that had eyes and ears high on their skulls, a large nasal-facial vacuity, large auditory bullae, and very hypsodont teeth. They were very common in the Whitneyan and early Arikareean of the High Plains and western Montana, yet vanished in the late Arikareean. Their taxonomy has long been confused by post-mortem deformation and lack of statistical analysis, culminating with oversplitting into the 7 genera and 31 species recognized by Schultz and Falkenbach in 1968. Later studies employed multivariate analysis and recognized only two genera, *Sespia* and *Leptauchenia*, the latter only containing two species, but did not group specimens by stratigraphic level, nor address the issue of how much variability is reasonable within a single population. We reanalyzed the problem using both bivariate and multivariate statistics, and thin-plate splines, and comparing samples within stratigraphic levels. There seem to be only three species that are statistically supported and diagnosable: the smaller taxon *Leptauchenia decora* (early Orellan to early Arikareean), the intermediate-sized *L. major* (late Whitneyan to late Arikareean), and the large robust *L. lullianus* (restricted to the early and middle Arikareean). Contrary to previous hypotheses that leptaucheniines were hippo-like aquatic forms or hyrax-like rock dwellers, all the evidence seems to suggest that they lived near the eolian deposits in which they were buried. Their taphonomy is unusual in that very few postcranials are known, and virtually all specimens are isolated skulls found in eolian sands and silts. *Leptauchenia* was restricted to the High Plains and western Montana during the Whitneyan and Arikareean, but is unknown from the similar-looking volcaniclastic deposits in central Oregon, California, nor from the Gulf Coast of Florida or Texas at that time (despite the abundance of other non-leptaucheniine oreodonts in all these deposits).

Friday Fishes Symposium poster

IS *STRIATOLAMIA* A JUNIOR SYNONYM OF *MITSUKURINA*?

PURDY, Robert, Smithsonian Institution National Museum of Natural History, Washington, DC

The teeth of *Mitsukurina owstoni* Jordan are known in the literature from juvenile or young adult individuals; the needle-like form of the teeth from these individuals were used as an autapomorphy for the genus. Several recent papers have remarked about the considerable dental variation in these sharks, but they did not illustrate or give detailed descriptions of these dentitions. Recently the Smithsonian obtained four adult dentitions that are described and compared with *Carcharias taurus* and *Striatolamia macrota*. The reseults of these comparisons suggest that *Striatolamia* Glykman, 1964, may be a junior synonym of *Mitsukurina* Jordan, 1898. The Paleogene *S. macrota* may represent a shallow, warmwater species of *Mitsukurina*.

Wednesday 9:00

MAXILLA AND MANIDIBLE: TOOTH COUNTS, TELESCOPING, AND DENTAL EVOLUTION IN NEOCETI

PYENSON, Nicholas, Univ. of California Museum of Paleontology, Berkeley, CA

Living toothed whales exhibit a diversity of tooth placement and number: maxillary toothlessness; extreme polydonty; and mandibular or maxillary tusks. All extant odontocetes also have single-rooted teeth. In contrast, the living representatives of the odontocetes' sister taxon, Mysticeti, are toothless and have evolved baleen plates. Dorudontine basilosaurids, which are the outgroup lineage to all living cetaceans, exhibit a slightly modified eutherian mammal tooth count, but it is difficult to homologize these teeth with those of living cetaceans. Moreover, the pattern of tooth replacement is better documented in basilosaurids than it is in living odontocetes, which presumably produce only one generation of teeth. Given the disparity in tooth position and number between archaeocetes and odontocetes, how can the introduction of fossil data better resolve the issue?

Mapping the number of premaxillary and maxially teeth and known tooth count variation (among extant taxa) on a composite tree of both extant and fossil Neoceti indicates that: 1) homodonty and monophyodonty are restricted to crown odontocetes; 2) premaxillary tooth loss is plesiomorphic for crown odontocetes; and 3) the highest tooth count variation occurred in delphinids, phocoenids, and physeterids. It may be hypothesized that changes in premaxillary and maxillary tooth count relates to changes in maxillary size and shape in odontocete evolution. Thus, any explanation of the evolution of polydonty and homodonty in odontocetes must also explain the progressive telescoping of the odontocete skull, defined here to include both rostral elongation and supracranial overlapping of the facial bones. Using dorsal images of complete crania from nearly all families of extant and fossil odontocetes, principal components analysis (PCA) of 29 homologous landmarks in the dorsal aspect of odontocete skulls indicates that the anterioposterior elongation of the skull accounts for 62% of the primary component of morphological variation among the odontocete groups. Because longirostral forms often exhibit extreme polydonty, this result suggests a possible link between dental and skull evolution in odontocetes.

Wednesday 8:45

MORPHOLOGICAL DETAILS OF THE PTERYGOID SINUS IN EXTANT AND EXTINCT PORPOISES (CETACEA: PHOCOENIDAE) REVEALED BY CT DATA

RACICOT, Rachel, BERTA, Annalisa, San Diego State Univ., CA

The anatomical structure of the pterygoid sinus in the head of extant and fossil porpoises is a potential source of phylogenetic and functional data previously unattainable by traditional methods of dissection and osteological examination. The pterygoid sinus is an air-filled sac extending from the middle ear into the pterygoid bones in cetaceans. It is one component of a complex sinus system thought to be associated with hearing, echolocation, and pressure regulation around the ears. Indentations in the skulls of basilosaurid archaeocetes indicate that pterygoid and peribullary sinuses were present in archaic cetaceans. Mysticetes and more basal odontocete taxa have less complicated, undivided sinus systems than later-diverging odontocete lineages. Phocoenids, in particular, have a more derived pterygoid sinus system than other odontocetes because of the exceptional dorsal extension of the sinus into the frontals and the presence of a sphenoidal portion of the sinus. These features can be visualized and measured in extinct and extant porpoise skulls using high-resolution X-ray computed tomography (HRXCT), a non-destructive, non-invasive procedure. Three-dimensional casts, or endocasts, of the sinuses were extracted from within the skulls by digitally filling, or segmenting, the spaces that they once occupied. These endocasts reflect the three-dimensional relationship of the sinus system to the rest of the skull and other soft tissues if available. Volumetric and linear measurements based on the CT data quantify the variation of the sinuses among porpoise species. Comparisons of the anatomy of an undescribed fossil porpoise specimen and extant odontocetes provide insight into the evolution of the pterygoid sinus among phocoenids. These results demonstrate the utility of HRXCT for interpreting the internal cranial anatomy of both extant and fossil cetaceans.

Poster Session B

CRANIAL FUNCTIONAL MORPHOLOGY OF SPINOSAURID "CROCODILE-MIMIC" DINOSAURS

RAYFIELD, Emily, MILNER, Angela, Department of Palaeontology, London, United Kingdom

Spinosaurid theropods such as *Baryonyx walkeri* possess a cranium unlike any other archosaur, combining an elongated crocodylian-like snout and bony palate with a narrow yet tall domed skull complete with antorbital fenestration. This unique morphology, part crocodylian, part typical theropod dinosaur, challenges our previous assumptions and assertions concerning archosaur cranial construction and evolution. Here we present a study of the functional morphology of the spinosaur cranium, with specific reference to the function of broad and tubular snouted extant crocodylians.

Simple Finite Element (FE) models of a broad, flat "platyrostral" snout and a tall, domed "oreinirostral" snout were used to test the prediction that a secondary palate strengthens the skull whilst an antorbital fenestra weakens it. Generally this is the case during bilateral and unilateral biting, and oreinirostral snouts were almost always stronger than the platyrostral condition. To see if these predictions held true for more complex morphology, a Finite Element (FE) model of the snout of *Baryonyx walkeri* was created using from CT scan information using Simpleware FE-model generating software. Further FE-models of the snout of *Gavialis gangeticus* and were created as representatives of extant crocodylian taxa bearing a terminal rosette of teeth in the case of the former taxon, and a typical platyrostral snout in the case of the latter.

Here we assess whether spinosaurids were indeed "crocodile-mimics", in the sense they were adapted for torsional feeding behaviour, and their skulls bear structural and functional parallels to the extant crocodylian taxa analysed here. By digitally manipulating FE-models it is possible to test (a) if the spinosaurid bony palate confers structural strength to the skull, and during what kind of feeding behaviour, and (2) if the antorbital fenestra weakens the snout, suggesting non-structural constraints influence archosaur cranial evolution. Spinosaurs present unique functional behaviour and also offer an insight into convergence and constraint in the archosaur lineage.

Poster Session B

ADDITIONAL POSTCRANIAL MATERIAL OF *HELISCOMYS VETUS* (HELISCOMYIDAE: RODENTIA) FROM THE EARLY OLIGOCENE OF WYOMING

REBAR JR., John, WAHL, William, Fort Hays State Univ., Hays, KS

Heliscomys is a small, relatively rare rodent known almost entirely from craniodental material. The only postcranial material recorded for the genus is a complete left radius and manus of *H. hatcheri* described by Albert Wood in 1939. During a recent examination of heliscomyid material housed in the Sternberg Museum of Natural History, a partially exposed skull was discovered within a nodular sandy mudstone. Preparation of this specimen uncovered a partial skull, complete lower jaw, and associated postcranial material. The field data indicates that the specimen was collected *in situ* within the lower Oligocene White River Formation (Brule Member) that crops out in the badlands southeast of Douglas, Converse County, Wyoming. The specimen is referred to *H. vetus* based on the following dental characters: highly brachydont molars, M3 with hypocone absent, p4 lacking hypostylid, and dental measurements within the published range of *H. vetus*.

This new specimen is significant because it provides the first opportunity to compare and

describe the pelvic and hindlimb morphology of *H. vetus*. Postcranial data is important because of its ability to provide new information on phylogenetic relationships, functional morphology, and the presence of sexual dimorphism within a population. This specimen consists of one lumbar vertebra, sacrum, right and left ilia, right and left ischia, partial right pubis, left femur, left tibia and fibula, and a disarticulated pes consisting of individual metatarsals and phalanges. Additional rib and vertebral fragments are present. Preliminary analysis of the new material reveals a pelvic structure that is primitive when compared to other geomyoids. Adaptations for either a saltatorial vs. fossorial lifestyle in the Heliscomyidae can now be discussed.

Poster Session B

THE EFFECTS OF SIMULATED SAMPLING BIAS ON THE APPLICATION OF BIOGEOGRAPHIC ANALYSES TO MODERN AND FOSSIL MAMMALIAN ASSEMBLAGES

RECTOR, Amy, REED, Kaye, Arizona State Univ., Tempe, AZ

The application of biogeographic analysis to the fossil record has always been plagued by processes unique to fossil assemblages, such as collection bias, incomplete sampling, and other taphonomic issues. Several different analyses have been proposed as applicable for fossil communities, but these analyses may or may not take taphonomic biases into account. Methods include Parsimony Analysis of Endemicity (PAE), factor analysis, cluster based methods, and cladistic biogeography. PAE treats the presence/absence of a given taxon at a locality as a 'character' appropriate for systematic analysis intended to find relationships between localities. While this method has been used several times in the study of distributions of various fossil plant taxa, it has not been sufficiently applied and tested using mammalian taxa. Cladistic biogeography focuses on one taxonomic group, identifying links among regions based on relationships among taxa. Factor analysis and clustering methods group sites based on similarities in species composition.

The utility of these methods for fossil mammalian assemblages was analyzed by applying each to extant mammal community assemblages from 43 sites across sub-saharan Africa. These mammalian species lists are complete, but each of the biogeographic methods different analyses were applied on reduced species lists that simulate the effects of taphonomy. The results were then compared to determine which, if any, of these methods can be appropriately applied to fossil assemblages. Preliminary data indicate that PAE is sensitive to the biases inherent to fossil assemblages, and results must be interpreted conservatively. Further, multivariate methods tend to group sites based on shared ecological parameters rather than biogeographic affinities alone.

Student Poster Session

RECONSTRUCTING THE PALEOECOLOGY AND DEPOSITIONAL ENVIRONMENT OF THE BISSEKTY FORMATION

REDMAN, Cory, San Diego State Univ., San Diego, CA

The Kyzylkum Desert in Uzbekistan has produced the greatest diversity of Late Cretaceous eutherians in the world and one of the most diverse Late Cretaceous terrestrial faunas of Eurasia, collected mainly from the Bissekty Formation at the Dzharakuduk escarpment. The goal of this study is to 1) reconstruct the depositional environment and taphonomic history of the fossil localities of the Bissekty Formation, 2) test whether the "Bisseky Fauna" is a autochthonous or allochthonous fauna, and 3) reconstruct the paleoecology of this important Late Cretaceous fauna.

The Bissekty Formation is 70 m thick, dominated by a poorly-lithified, cross-bedded sandstone, with 5-8 laterally extensive, clast-supported, iron-oxidized intraformational conglomerates (IFCs). This study will determine the depositional environment of the IFCs and reexamine the interpretation that the Bissekty sandstone was deposited in a fluvial system. The IFCs could have been deposited as a result of regional transgressions, regressions, or lag deposits from a fluvial system; or represent periods of nondeposition or erosional hiatuses.

These hypotheses for the deposition of the IFCs will be tested by comparing the observed and expected facies changes for each hypothesis across the 10 km escarpment. Cluster analysis was used to determine similarities among the IFCs based on the similarities of presence/absence of taxa. Correlation, Sorensen, and Relative Sorensen distance measurements was used in combination with group average, nearest, and farthest linkage methods to determine the robustness of the clustering pattern. T-test and chi-square test will be used to determine statistical differences of sample sites within an individual IFC.

Preliminary comparisons between the fauna of the IFCs and the sandstone microlocalities suggest that the IFCs' fauna is a subset of the microlocalities' fauna, with some key differences. Marine restricted taxa are found only in the IFCs, but do not drive the clustering pattern. Taxa abundance is also different between the IFCs and the microlocalities, due in part to the size of the taxa relative to the matrix grain size.

Poster Session B

AFRICAN PLIO-PLEISTOCENE MAMMAL COMMUNITIES: DO UNIQUE COMPOSITIONS INDICATE DISTINCT VEGETATION?

REED, Kaye, Arizona State Univ., Tempe, AZ

Both taxonomic and ecological organization of fossil mammalian fauna have been used to reconstruct terrestrial habitats of the African Plio-Pleistocene. However, actual community structure of these fossil communities differs from that of extant large mammal communities. Some of the differences are caused by taphonomic issues such as depositional biases against various sized animals. However, fossil localities show a unique structure when these confounding factors are compensated for through development of appropriate analogs. The mammalian communities of 48 Plio-Pleistocene fossil localities were compared with 43 extant African communities. To address taphonomic issues, three data sets from extant communities were used in the analyses: mammals > 500 grams, mammals > 4 kg, and only ungulate and primate mammals.

In comparisons with each of the extant data sets, the following differences were noted. First, while featuring reduced numbers of browsers compared with the North American Miocene, for example, the African Plio-Pleistocene fossil communities have consistently more browsers than exist in extant communities. Second, terrestrial colobines are often recovered from fossil savanna communities while they are nonexistent in living African communities. Third, 3 to 7 suid species are found at these fossil localities, while extant communities have at most two species.

The differences between extant and extinct communities suggest differences in plant productivity. Trees and shrubs, under certain climatic conditions, produce more leaves than fruits, which would support more browsing ungulates and colobine monkeys. Roots and tubers, often eaten by living suids in particular environments and seasons, may have been more plentiful. Changes in the long-term periodicity of the number of dry season months could account for some of these phenomena. Thus, comparisons of mammal communities give insight into past ecological conditions that might not be readily evident from simple habitat reconstructions.

Poster Session A

A NEW ONLINE DATABASE OF DINOSAUR DISTRIBUTIONS

REES, Peter, Univ. of Arizona, Tucson, AZ; NOTO, Christopher, SUNY Stony Brook, Stony Brook, NY; WEISHAMPEL, David, Johns Hopkins Univ. School of Medicine, Baltimore, MD

Publicly accessible online databases have become an accepted means of synthesizing and disseminating valuable data necessary for a particular scientific field. As technology advances, our ability to integrate multiple databases allows for more powerful data acquisition methods, saving researchers valuable time. Here we announce the launch of a new online database comprising over 4,100 dinosaur occurrences from ~1,150 localities worldwide. All data come from the Dinosaur Distribution chapter of *The Dinosauria* (2004). Occurrences include skeletal material, teeth, eggs, tracks, and coprolites.

The database is searchable by any combination of geologic age, geographic location, formation name, preservation mode (e.g., bone, track) and taxon (to genus level). Reference codes from *The Dinosauria* are included for consulting the original entry in the book. Geographic paleocoordinates for each occurrence were pre-calculated using the ICS 2004 timescale and Chris Scotese's Paleomap rotation program, so the user can analyze paleogeographic patterns of distribution and diversity. Moreover, the database can be searched simultaneously with the Paleogeographic Atlas Project (PGAP, Univ. of Chicago) sedimentary databases. Dinosaur data can now be retrieved alongside that for climate-sensitive sediments (e.g., coals and evaporites), facilitating studies of dinosaur paleobiogeography in the context of Mesozoic environments and climates.

Ensuring the interoperability of these paleontological and lithological databases has been a first step to incorporating other such databases within the broader framework of The Geosciences Network (GEON), providing an invaluable resource to researchers of all backgrounds.

Wednesday 1:30

EVIDENCE-BASED PALEOPATHOLOGY I: ONTOGENETIC AND FUNCTIONAL IMPLICATIONS OF DORSAL SAILS IN *DIMETRODON*

REGA, Elizabeth, Western Univ.of Health Sciences, Pomona, CA; SUMIDA, Stuart, NORIEGA, Ken, California State Univ. San Bernardino, San Bernardino, CA; PELL, Chuck, Duke Univ., Durham, NC; LEE, Andrew, Univ. of California, Berkeley, Berkeley, CA

Histological sections of fossilized skeletal material can generate comparative data on growth rates, developmental timing, and metabolism but the majority has utilized normal specimens. We use pathological material as a natural experiment to test the hypothesis that dorsal sails in pelycosaurian-grade synapsids functioned as thermoregulatory devices. Thin sections from multiple sequential neural spines displaying healed fractures from a late Paleozoic sphenacodontid pelycosaur *Dimetrodon giganhomogenes* (FMNH UC 1134) reveal lines of arrested growth indicating minimum age at death in excess of nine years, with pericortical lamellar spacing indicative of attainment of maturity. The heterogeneous and site-specific healing response ranges from slow-growing zonal lamellar bone to fast growing highly vascularized cortical bone deposited simultaneously, indicating a site-specific response to insult. While lack of subluxation provides indirect evidence for a soft-tissue sail, absence of vascular canals casts some degree of doubt on the widely held notion that the grooves of pelycosaur spines contained blood vessels supplying a thermoregulatory sail. In particular, spine microstructure suggests that the dumb-bell shape (2 intersecting cylinders) is of vital importance. This column shape is highly resistant to deformation, and is utilized in civil engineering for internal bridge supports. Certain morphological features of the neural spines in sail-finned pelycosaurs, especially the dumbbell cross-section, also appear in the vertical septum (VS) of some teleost fishes, specifically the dorsal sail of *Thunnus obesus*, the yellowfin tuna. The VS is comprised of

bone (neural and hemal spines) embedded in a robust web of collagen, whose primary function may be mechanical in minimizing dorso-ventral bending which increases efficiency at lateral undulation. By analogy, we propose a similar function in increasing locomotor efficiency in sail-backed pelycosaurs.

Saturday 11:00

ARTICULATED EMBRYONIC SKELETONS, DEVELOPMENT, AND GROWTH IN THE EARLY JURASSIC PROSAUROPOD DINOSAUR *MASSOSPONDYLUS* (SAURISCHIA: SAUROPODOMORPHA)

REISZ, Robert, Univ.of Toronto at Mississauga, Mississauga, ON, Canada; SUES, Hans-Dieter, National Museum of Natural History, Washington, DC; SCOTT, Diane, EVANS, David, Univ. of Toronto at Mississauga, Mississauga, ON, Canada; RAATH, Michael, Bernard Price Institute for Palaeo Research, Johannesburg, South Africa

The oldest known dinosaurian embryos are preserved inside thin-shelled eggs in a partially preserved clutch from the Lower Jurassic Elliot Formation of Golden Gate Highland National Park in South Africa. They are referable to the prosauropod dinosaur *Massospondylus carinatus*, and comprise a complete, articulated skeleton that is curled up and apparently was close to hatching, and another partial skeleton that shows important details of the skull. The skeletal proportions of the embryo conform to the ontogenetic trajectory provided by an extensive growth series of this dinosaur, but differ dramatically from those in the adult in having short rather than much elongated cervical vertebrae, proportionately very short caudal vertebrae, and short rather than long hemal processes. These vertebral proportions may have been associated with the necessity of fitting the developing animal into the egg. The forelimbs are unusually large relative to the hindlimbs. The prominent head (which is longer than the femur), horizontally held neck, short tail, and large forelimbs indicate that the hatchlings of this prosauropod were obligatory quadrupeds, a derived condition among dinosaurs. In contrast, adult *Massospondylus* were either facultatively or fully bipedal, which is the plesiomorphic condition for sauropodomorphs and other dinosaurs. This has implications for the origin of quadrupedal posture and locomotion in the giant sauropods. The small size and poor ossification of the ventral elements of the pelvis and the presence of an enormous head imply that this prosauropod dinosaur may not have been able to move efficiently when newly hatched, or even feed itself, and may have required extensive parental care. If correct, this would be the oldest known example of altricial behavior.

Saturday 2:00

NEW INSIGHTS INTO THE ORIGIN AND EVOLUTION OF DIPLODOCOID SAUROPODS

REMES, Kristian, Bayerische Staatssammlung für Paläontologie und Geologie, Muenchen, Germany; RAUHUT, Oliver W, Bayerische Staatssammlung für Paläontologie, München, Germany

The diplodocoid branch of neosauropods is well known for the gigantic forms of the Upper Jurassic Morrison Formation of North America, such as *Diplodocus*, *Barosaurus*, and *Seismosaurus*, all members of the family Diplodocidae. The more basal groups of the diplodocoids, the rebbachisaurids and dicraeosaurids, in contrast, have been found relatively rarely, coming almost exclusively from Gondwanan landmasses, and mostly from strata younger than the Morrison Formation. Therefore, little is still known about the origin and early diversification of the Diplodocoidea.

Recent work on Gondwanan diplodocoids provides new data on the distribution and diversity of dicraeosaurids and diplodocids. A new dicraeosaurid taxon from the Upper Jurassic of Patagonia is the first Jurassic representative of his family outside the famous Tendaguru locality of Tanzania, East Africa. With its extremely short neck, it has a remarkable feeding specialization currently not known in any other sauropod dinosaur. The discovery of this taxon in South America indicates that dicraeosaurids were widely distributed and diverse in Gondwana in the Upper Jurassic. The Tendaguru sauropod *Tornieria africana* (Fraas), formerly referred to the North American genus *Barosaurus*, has been revised and is unambiguously a member of the subfamily Diplodocinae, closely related to *Barosaurus* and *Diplodocus*. *Tornieria* shares several synapomorphies with the North American forms, such as pleurocoels and diapophyseal laminae in the anterior caudal vertebrae. Since a dispersal between Laurasia and Gondwana in the Upper Jurassic is improbable due to the existence of marine barriers, which formed already in the Callovian, the existence of a diplodocid on Gondwana is best explained by an early diversification of the diplodocoids on the Southern Hemisphere in the upper Mid-Jurassic. This vicariance model of diplodocoid biogeography implies an extensive gap in the fossil record of this group.

Wednesday 4:30

A TECHNIQUE USING CYANOACRYLATE AND GROUND MATRIX EXCLUSIVELY IN THE PREPARATION AND RESTORATION OF LATE TRIASSIC, CHINLE FORMATION, FOSSIL MATERIAL

RESER, Peter; WILLIAMS, Scott, Petrified Forest National Park, Petrified Forest, AZ

Vertebrate material from the Chinle Formation is usually collected in mudstone or siltstone and is covered by a network of of fractures infiltrated by that matrix which cements these fractures tightly in some places and loosely in others. It is typical for dissolution and recementation to occur in these joints with some movement of the fragments. The goal of preparation is to provide structural integrity by glueing weak joints while correcting deformation, to the extent possible, by re-aligining drifted fragments during this process. A parallel goal is to reduce the amount of possible chemical interactions by introducing the smallest number of new materials into the finished specimen. Here, since matrix in the lattice of fractures is already a significant and irreducible component, only cyanoacrylate is introduced to join fragments and as a binder in the ground matrix used to fill gaps and restored areas. The fill, produced and placed in this procedure, is planed to contour producing a crisp line of demarcation between actual bone and restored areas. This then allows detailed analysis of morphology and surface features to proceed. There is also an asthetic benefit since the color of the fill is natural and pleasing while being distinctly defined.

Wednesday 2:30

MAMMALS, GRASSES AND CENOZOIC PALEOCLIMATE

RETALLACK, Gregory, Univ. of Oregon, Eugene, OR

New records of paleoclimate over the past 45 million years from paleosols in Oregon, Montana, and Nebraska indicate a close relationship between fossil mammals and paleoclimate on all time scales. Paleosols and their fossil mammal assemblages vary cyclically with Milankovitch obliquity cycles (41 k.yr) indicated by carbon isotopic composition, depth to carbonate and trace fossils in Oligocene paleosols from Oregon, and in Pleistocene paleosols from Washington. Iterative evolution on 2.3 m.yr. cycles corresponds with North American land mammal ages, and subdivisions of them, as indicated by Larry Martin and Terry Meehan. Each 2.3 m.yr cycle is often a cutting and filling depositional cycle, with basal paleosols of weaker development, poorer drainage and more humid climate than upper paleosols of the fill. Many cycles conclude with a caliche caprock. The White River (40-23 Ma), Runningwater-Clarendon (22-9 Ma) and Mio-Pliocene (8-0 Ma) Chronofaunas also follow long-term paleoclimatic cycles of late Eocene (40-35 Ma), middle Miocene (19-16 Ma) and late Miocene (9-7 Ma) peaks of warmth and humidity followed by long ramps of cooling and drying. Times of warm-wet paleoclimate were also times of high diversity in mammals, due to evolutionary radiation and to immigration through frost-free high-latitude land bridges. These warm-wet times also coincide with marked advances in grass-grazer coevolution, including the first appearance of bunch grasslands (35 Ma), short sod grasslands (19 Ma) and tall sod grasslands (7 Ma). The paleosol record of North American paleoclimate thus falsifies the views that grass-grazer coevolution was selected by climatic drying and cooling, and that North American Cenozoic mammal diversity was decoupled from paleoclimate, misleadingly inferred from deep-sea oxygen isotope records. Terrestrial paleoclimate from paleosols shows little resemblance to the deep-sea oxygen isotope record, which was compromised by ice volume, salinity, burial diagenesis and crustal recycling. In contrast deep-sea carbon isotope records from the same foraminifera, as well as limited data from stomatal index of fossil ginkgo and oak leaves, support a greenhouse control of global paleoclimate for the past 45 million years.

Poster Session B

MORPHOMETRIC CATEGORIZATION OF CALIFORNIA'S JURASSIC QUADRUPED TRACKS

REYNOLDS, Robert, LSA Associates Inc, Redlands, CA

The Aztec Sandstone in the eastern Mojave Desert of California is early Middle Jurassic. Research on tracks/trackway panels of Aztec Sandstone in the Mescal Range has resulted in the recognition of tracks left by different groups of quadrupeds. Graphing their ratios produces five groups; evaluation of track/trackway morphology increases the number of quadruped groups to eight. Ichnites previously described in the literature include *Brasilichnium*, *Navahopus*, a lacertoid similar to *Rhynchosauroides*, and *Pteraichnus*. Four additional ichnomorphs are represented in the Mescal Range by prints with different morphologies.

The Mescal Range *Navahopus* differs morphometrically from associated *Brasilichnium*. The Mescal Range trackway panels demonstrate fluctuation of *Brasilichnium* morphometrics, suggesting variable ages/sexes of track makers, and changes in consistency of substrate.

Pteraichnus (pterosaur) ichnites from the Aztec Sandstone of the Mescal Range are early Middle Jurassic. *Pteraichnus* tracks from the middle to upper Jurassic at Ferron, Utah, have larger ratios falling into two categories (large and small). Preliminary measurements of *Pteraichnus* tracks from the upper Middle Jurassic Sundance Formation have small ratios. Manus/pes ratios from the Upper Jurassic Morrison Formation fall in an intermediate category These numbers suggest that in the early Middle Jurassic, one *Pteraichnus* ichnomorphology is present, while in the middle to late Jurassic of North America, two ichnomorphologies are present.

In the Mescal Range, seventy percent of the track occurrences are quadrupeds; bipeds account for thirty percent. Conservatively, the Mescal Range Aztec Sandstone contains tracks representing three bipedal theropods and eight quadrupeds. Additional ichnites are attributed to the invertebrates *Octopodichnus* and *Skolithos*.

Wednesday 8:15

A 3-D METHOD FOR THEORETICAL MODELING AND MORPHOMETRIC COMPARISON OF HELICAL FORM OF RODENT INCISORS

RINALDI, Caroline, COLE III, Theodore, Univ.of Missouri-Kansas City School of Medicine, Kansas City, MO; NIEVERGELT, Yves, Eastern Washington Univ., Cheney, WA

Evergrowing incisors are a key adaptation for the order Rodentia. Because they are a record

of longitudinal growth, they afford us a unique opportunity to explore the relationships between development, morphology, and function of both extant and fossil taxa.

Three-dimensional incisor form in rodents can be modeled as a segment of a cylindrical helix by using two parameters: radius and pitch. An incisor can be described more fully with the addition of a measure of arc length.

We show how radius, pitch, and arc length define a theoretical morphospace that can be used to model the possible morphologies that result from perturbations in these variables. We further show how such perturbations can be explained in terms of small changes to the three-dimensional shape of the growing end of the incisor. This model enables us to develop heterochronic models to explain observed differences among extant and fossil taxa.

To demonstrate how the model can be used in an empirical comparison of taxa projected into the theoretical morphospace, we use lower incisors from Recent genera, *Castor* and *Ondatra*, and from the fossil genus *Castoroides*. We begin with three-dimensional landmarks that capture information about the form of a tooth. The landmarks are collected from high-resolution digital reconstructions made using a Breuckmann optoTOP scanner, which measures surface topography using a video camera and fringe pattern projector.

Once landmarks are collected from the digital reconstruction, we use a total least-squares algorithm to estimate the best-fitting helix for a tooth, yielding the radius and pitch. Arc length is calculated directly from the coordinate data. These variables give us a coordinate-system-invariant method (not dependent on arbitrary specimen orientation) of quantifying intraspecific variation and making interspecific comparisons.

Poster Session B

NEW EVIDENCE OF CANNIBALISM IN THE LATE TRIASSIC (APACHEAN) DINOSAUR, *COELOPHYSIS BAURI* (THEROPODA: CERATOSAURIA)

RINEHART, Larry, HUNT, Adrian, LUCAS, Spencer, HECKERT, Andrew, SMITH, Joshua, New Mexico Museum of Natural History, Albuquerque, NM

At least three *Coelophysis bauri* specimens from the New Mexico Museum of Natural History's Late Triassic Whitaker (*Coelophysis*) Quarry block (C-8-82) from Ghost Ranch, NM have cololites (fossil gut contents) and/or coprolites directly associated with articulated skeletal material. The cololites and coprolites occur between the ischia and the proximal caudal vertebrae and postero-ventral to this area. Most of the coprolite material is formless and was apparently somewhat mixed with wet mud and silt at or near the time of death and burial. In one of the specimens (NMMNH P-44552) the coprolitic material contains hundreds of mm-to-cm-size bone fragments including long bone and rib fragments, wrist bones, and thin sheets similar to skull or pelvic bone. Proximal metacarpals, an ulnare, and partial phalanges were prepared from the coprolite and are indistinguishable from those of *C. bauri*, thus providing new and compelling evidence of cannibalism in the species. Assuming that *Coelophysis* was cannibalistic under stress, as are some modern reptiles, the passage of cannibalized juvenile bones completely through the gut probably indicates that the Ghost Ranch *Coelophysis* were under stress for some time prior to death.

Another *Coelophysis* specimen, NMMNH P-44801, has a small amount of coprolite material containing sparse bone fragments. The cololite and coprolite material associated with a third specimen, NMMNH P-42352 is enigmatic; it consists of a few small bone fragments in a densely packed matrix of small (~1 mm long, by ~0.1 mm diameter), rod-shaped material.

Wednesday, Preparator Poster

USES OF HEATING ELEMENTS TO GENTLY AND CHEAPLY WARM DMSO. INEXPENSIVE HOTPLATES AS LABORATORY TOOLS

RINKE, Lydia, Fort Hays State Univ., Hays, KS; WAHL, William, Wyoming Dinosaur Center, Thermopolis, WY

While using warm Dimethyl Sulfoxide (DMSO) to break down Oligocene White River silty clays and Cretaceous sandstone, problems were encountered in the prescribed use of ovens, which require heating at a constant temperature over long periods. In their place a small candle hotplate proved very effective. This product is used to gently warm glass jar candles and is suggested for use in apartment or other enclosed settings requiring the absence of flame. The product costs less than $5.00 at variety and craft stores.

Lab-grade 'hotplates' can routinely over-cook solutions by reaching high temperatures faster, which may result in damage to the specimens; likewise the high wattage (600 watts) may cause expensive appliances to break down with extended use. The low temperature of the candle hotplate produced effective convection turbulence within a heated container. The material was sealed in screw cap mason jars to prevent escape of fumes, and the low wattage (17 watts) even temperature of 45°Celsius produced no danger of boiling over. Experiments on four separate sandstones produced limited (< 3%) condensation of the expensive DMSO.

Another problem of laboratory work is the careful heating of clays or paraffin waxes prior to use, as too much heat will cause the product to denature. Heat projecting lamps or hair dryers may either turn off or burn out with extended use. The small hotplate was left running for approximately four months with no reduction of wear to the thermo contact. As it is designed for wax build up in case of accidents, it can be cleaned with soap and water. This unit can be used to heat waxes, clay surfactants, glues or cleaners as well as readily heat tools for use in clay and wax carving. The only observed drawback is the small size of the appliance constraining the amount heated.

Wednesday 3:45

DENTAL WEAR AND DIETARY EVOLUTION OF ANTILOCAPRIDAE DURING THE MIOCENE-PLEISTOCENE CLIMATIC TRANSFORMATION

RIVALS, Florent, CNRS UMR 5198, Tautavel, France; SEMPREBON, Gina, Bay Path College, Longmeadow, MA

Dietary adaptations of both Tertiary and Quaternary representatives of the family Antilocapridae were examined using both enamel microwear and mesowear analyses of molar teeth. Taxa assessed span from the early Miocene (late Hemingfordian) to the late Pleistocene and include samples from the Central and Southern Great Plains and the Northern and Southern Great Basin. Results are compared to those of the modern pronghorn (*Antilocapra americana*) and depict a surprising array of dietary behavior given the fairly stereotypic gross morphology of molar teeth found throughout the family (hypsodonty). Both microwear and mesowear results show a shift toward more abrasive diets beginning in the Hemphillian (late Miocene-Pliocene). Results are concordant with well-known trends toward increasing aridity and shifts in vegetational structure in the late Miocene-early Pliocene of North America and demonstrate that fossil pronghorn were sensitive to changes in the abundance and quality of their food resources. A return to a less abrasive dietary regime is noted for the duration of the Pleistocene. The less derived merycodontines apparently depended less on grass than the more advanced antilocaprines (more hypsodont, longer limbs), yet even the earliest merycodontines studied apparently relied more on grass as a dietary staple than the modern pronghorn, underscoring the importance such dietary analyses hold for overturning uniformitarian assumptions based upon well-known Holocene forms that might not prove to be good analogs for fossil forms and providing glimpses into a possible reason for the extreme hypsodonty present in the modern pronghorn despite its mainly browsing dietary behavior.

Wednesday 9:30

TAPHONOMY OF WET ALLUVIAL SYSTEMS: A CASE EXAMPLE FROM THE CRETACEOUS WESTERN INTERIOR BASIN OF UTAH

ROBERTS, Eric, Idaho State Univ., Pocatello, ID

Whereas the taphonomy of semi-arid depositional settings is generally well documented, preservation of vertebrates in wet alluvial systems remains poorly studied and is apparently less common in the fossil record. The richly fossiliferous Upper Cretaceous (Campanian) Kaiparowits Formation in southern Utah presents an excellent opportunity to investigate the taphonomy of humid/sub-humid depositional settings. Sedimentological analysis of the formation reveals a paleoenvironment dominated by large rivers, overbank ponds, swamps and lakes. Poorly developed, hydromorphic paleosols, extraordinarily high sedimentation and rock accumulation rates (~41 cm/ka), and near ubiquitous preservation of aquatic invertebrate fossils are all consistent with the perennial availability of water and indicate a humid/sub-humid climate with elevated levels of precipitation. In addition, the Kaiparowits Formation preserves a diverse, moisture dependent palynoflora, and has a highly abundant and diverse aquatic vertebrate fauna.

Based on an analysis of 276 fossil localities in the Kaiparowits Formation, three conspicuous taphonomic trends have been identified and linked to preservation in a wet alluvial system. First, fossils are abundant in both channel and overbank facies due to high sedimentation rates and rapid aggradation. Second, bonebeds are strikingly scarce, which presumably reflects the influence of a stable paleoclimate where mass-mortality events were rare. Thirdly, preservational style and quality varies significantly between channel and overbank facies. Floodplain facies are dominated by poorly preserved, isolated and associated macrosites with copious bone modification features, such as 'wet-rot' bone weathering, carnivore tooth traces, trample traces, and insect borings, which are likely associated with rapid sub-aerial decay and decomposition on the humid floodplain. In contrast, channel facies preserve a range of poorly preserved, isolated macrosites and microsites to exquisitely preserved, fully articulated skeletons (single individuals) with soft tissue impressions, indicative of attritional mortality and rapid burial, but not mass mortality.

Wednesday Mammal Evolution Symposium poster

NEW INFORMATION ON THE EVOLUTION OF THE RINGTAIL POSSUM FAMILY (PSEUDOCHEIRIDAE: MARSUPIALIA), REVEALED BY THE FOSSIL GENUS *MARLU*

ROBERTS, Karen, Univ. of New South Wales, Sydney, Australia

The fossil record of the ringtail possum family, Pseudocheiridae, extends back to approximately 26 Ma, the earliest known date of any marsupial from the order Diprotodontia. Pseudocheirids have enjoyed a particularly rich fossil history during the late Oligocene to middle Miocene. It reveals a family just as diverse as the one living today. Numerous craniodental specimens attributed to the group have been recovered from localities across Australia. However, the published record is only a limited representation of the known and potential fossil diversity. The last major publication was in 1987, identifying most of the fossil ringtail possums present in the literature.

A new study is underway, aiming to provide an indepth review of the majority of unpublished Oligo-Miocene pseudocheirid specimens, recovered primarily from the fossil sites of the Riversleigh World Heritage Area, northwest Queensland. Most extant taxa of the Pseudocheiridae are arboreal folivores, restricted to the high altitude rainforests of northeast Queensland and Papua New Guinea. Through a better understanding of the evolution and dis-

tribution of this family, some insights may be made into changes in the Australian palaeoenvironment throughout the mid- to late Tertiary.

The genus *Marlu* is one of five extinct Oligo-Miocene pseudocheirid groups. In 1987, two species were attributed to the then new genus, based on material from fossil sites in northeast South Australia. Presented here is a new assessment of the diversity of *Marlu* and extends their distribution to northwest Queensland. The position of *Marlu* within the *Pseudocheiridae* is also discussed, providing key information in the evolution of the family.

Romer Prize Session, 11:15

THE EARLY TETRAPOD *KYRINION* AND THE TRANSITION TO HEARING AIRBORNE SOUND

ROBINSON, Jamie, The Natural History Museum, London, United Kingdom

It has generally been presumed that the stapes of early tetrapods supported the braincase against the palatoquadrate, with the notable exception of the Late Devonian *Ichthyostega*. This functional interpretation is heavily based on the morphology seen in the Early Carboniferous colosteid *Greererpeton*. Other early tetrapods, such as the Late Devonian *Acanthostega* and the Late Carboniferous *Pholiderpeton*, provide little conclusive proof for such a function.

The baphetid *Kyrinion martilli*, from the Late Carboniferous of northeast England, clearly does not have a supporting stapes. CT scanning and 3D computer reconstruction of the internal cranial anatomy of *Kyrinion* has revealed a dorsolaterally directed, somewhat laminar, stapes preserved in its original position. The stapes articulated with the parasphenoid at its proximal end and also sat in the fenestra ovalis. Its distal end did not contact the palatoquadrate complex. It is proposed that the stapes was in intimate contact with a space between the braincase and the pterygoid which presumably contained a spiracle. This arrangement may have allowed the stapes to pass some airborne vibration to the inner ear.

Kyrinion's middle ear provides evidence for a functional transition to the tympanum coupled stapes seen in temnospondyls, which were the first tetrapod group to evolve an apparatus adapted to the perception of airborne sound.

Poster Session B

AN UNUSUAL ORNITHOPOD TRACKWAY FROM THE UPPER CRETACEOUS OF THE CERRO DEL PUEBLO FORMATION, COAHUILA, MEXICO

RODRIGUEZ-DE LA ROSA, Ruben, Museo del Desierto, Saltillo, Coahuila, Mexico; EBERTH, David, Royal Tyrrell Museum of Palaeontology, Drumheller, AB, Canada; SAMPSON, Scott, Utah Museum of Natural History, Univ. of Utah, Salt Lake City, UT; BRINKMAN, Donald, Royal Tyrrell Museum of Palaeontology, Drumheller, Canada; AGUILLEN-MARTINEZ, Martha, Museo del Desierto-SEPC, Saltillo, Coahuila, CA, Mexico

A vertebrate trackway was found in a sandstone outcrop belonging to the Cerro del Pueblo Formation of Late Campanian age; it is located close to the town of El Porvenir de Jalpa, Municipio de General Cepeda, Coahuila. The trackway is though to have been made by a hadrosaurian dinosaur walking quadrupedally; the strong heteropody observed as well as the age of the outcrop supports this assignment. It is composed by at least four exposed manus-pes sets; however, among the observed unusual features of this trackway are the presence of toe drag marks before and after each pes impression, presence of mud rims in some areas of the pes impressions, extremely lateral position of the manus in regard to the pes impressions, these manus impressions are arranged in groups of two. By the present evidence, it is assumed that the hadrosaur walked through an extremely muddy and relatively deep surface, it dragged its toes before and after each foot stroke and the foot went deep into the mud possibly to the ankle joint, the mud rims indicate the direction of the travel. The presence of two 'manus' impressions indicates the entrance and exit of the hadrosaur arm when it went into the sediment during the quadrupedal walk. Besides the increasing knowledge of Late Cretaceous paleoichnology of northern Mexico, this report records for the first time the preservation of three-dimensional movements left by a hadrosaurian dinosaur walking in a quadrupedal gait.

Poster Session A

A COMPARATIVE STUDY OF DIAGENESIS IN FOSSIL BONES AND TEETH: A CASE STUDY FROM THE UPPER CRETACEOUS TWO MEDICINE AND JUDITH RIVER FORMATIONS OF MONTANA

ROGERS, Raymond, Macalester College, St Paul, MN; FRICKE, Henry, Colorado College, Colorado Springs, CO; KOENIG, Alan, Geological Survey, Denver, CO; DWYER, Christopher, HARWOOD, Cara, WILLIAMS, Josephine, Macalester College, Saint Paul, MN

The richly fossiliferous Two Medicine (TMF) and Judith River (JRF) Formations of Montana provide an exceptional opportunity to document and compare patterns of fossil diagenesis. Bones and teeth were collected from eight well-documented localities that represent a wide range of lithologies and depositional settings. Sampled paleoenvironments include lacustrine facies from upland and coastal regions, fluvial channel deposits, tidally-influenced channel deposits, and sandy shallow marine facies (shoreface). Authigenic cements in 134 bones and teeth were examined using both polarized light microscopy and SEM-EDS. Rare earth element (REE) concentrations were determined for most of the same samples using LA-ICP-MS. Laser ablation techniques expedited the collection of REE data, and also allowed for the tracking of REE patterns within individual fossils (e.g., marginal enrichment).

Fossil bones collected from fluvial sandstone bodies in the TMF tend to be pervasively filled by calcite and/or iron oxides. Bones and teeth recovered from nearby lacustrine mudstones typically display detrital clay rinds and are infilled with calcite. Bones from a fine-grained paralic TMF site are characterized by fills of calcite and pyrite, and exhibit significant replacement of bone by these same minerals. In contrast, bones recovered from paralic mudstones of the JRF are generally filled with detrital clay and exhibit a paucity of authigenic cements. Bones preserved in shallow marine sandstones of the JRF show abundant pyritization. With regard to REE, TMF fossils tend to have higher overall concentrations relative to JRF fossils and are more enriched in light REE. REE patterns tend to track paleoenvironments closely, and can be used to readily distinguish among localities in both formations. Finally, overall REE patterns in enamel and dentine are similar within a given tooth, but normalized total REE concentrations vary in these tissues from relatively low (enamel) to relatively high (dentine). This pattern is consistent with porosity and crystallite density contrasts in enamel and dentine, and illustrates the importance of these factors in diagenetic processes.

Poster Session B

PHYLOGENETIC POSITION OF *BAURUEMYS ELEGANS* AND THE BIOGEOGRAPHY OF PODOCNEMIDID TURTLES (PLEURODIRA: PELOMEDUSOIDES)

ROMANO, Pedro Seyferth, AZEVEDO, Sergio Alex, Museu Nacional, Rio de Janeiro, Brazil

The phylogenetic relationships of the Pelomedusoides were studied based on re-analysis of morphological data with inclusion of *Bauruemys elegans* as a new operational taxonomic unit. This Late Cretaceous Brazilian side-necked turtle is closely related to the family Podocnemididae, corresponding to the sister-group of *Portezueloemys patagonica* plus Podocnemididae. Sister-group relationships in the most parsimonious tree, combined with historical biogeography hypothesis proposed to several groups of vertebrates (as dinosaurs, crocodiles and frogs), may reflect vicariance events.

Pelomedusidae would have been isolated in Africa at the close of the Early Cretaceous whereas Podocnemididae would have originated in South America. A simplistic explanation would assume a widespread ancestor to *Pelomedusoides* and would avoid continental drift. However, the examination of Cretaceous Podocnemidoidae fossils allows the conclusion that the ancestor of Podocnemididae comes from the Late Cretaceous of South America, since the susceptive sister-groups of this family (*Bauruemys* and *Portezueloemys*) come from the Late Cretaceous of south South America (respectively, South-eastern Brazil and North-eastern Argentina).

Extant Podocnemidinae (restricted to north South America) would derivate from this south South American ancestor and would have had an autochthonous development in South America, expanding its distribution northwards. The presence of Erymnochelyinae in Madagascar would be explained by the migration of a South American ancestor via Antarctica. Since land-bridges between India/Madagascar and Africa during the Cretaceous/Tertiary might have allowed further dispersions through these continents, it is assumed that African Erymnochelyinae derivate from an Indian-Malagasy ancestor. Posteriori local extinctions and habitat reduction would explain the present distribution of Podocnemididae as an *ad-hoc* hypothesis to the correlation of vicariance events and cladogenesis during the Cretaceous.

Poster Session B

SERIES, EXPERIENCE, LIMITED EXPERIENCE AND SEMANTICS OF PROBOSCIDEAN FOREFOOT AND HINDFOOT EROSIONS: DISTINGUISHING MYCOBACTERIAL INFECTION AND SPONDYLOARTHROPATHY

ROTHSCHILD, Bruce, Arthritis Center of Northeast Ohio, Youngstown, OH

The New England Journal of Medicine defined Series, Experience and Limited experience in a manner that clarifies paleopathology: An individual who reported a series had seen two cases; one who reported experience had seen a single case. The one with limited experience had never actually seen a case, but had read about it. Scientific disciplines often share a language that appears common to both, but actually with quite disparate meanings. This is illustrated by misdiagnoses of osseous disruption: Healing wound holes as fungus-derived or by confusion of mycobacterial (e.g., tuberculosis) and spondyloarthropathy-derived erosions.

Recent and Pleistocene proboscidean specimens were examined in the major museum collections of North America and Europe. Spondyloarthopathy was recognized on the basis of fusion of vertebral bodies with marginal syndesmophytes, zygoapophyseal joint fusion, and characteristic erosive arthritis and fusion. Mycobacterial infection was recognized on the basis of subchondral erosions undermining the articular surface, distinct from the fronts of resorption characteristic of spondyloarthropathy.

Spondyloarthopathy was present in 7-16% of *Mammuthus* and 5-8% of contemporary elephants (including forest), but never in 113 *Mammut* ($P < 0.001$). The characteristic mycobacterial lesions were present in 52% of *Mammut* and contemporary elephants (especially, but not exclusively from zoologic parks)(as confirmed by DNA analysis), but never in over 200 *Mammuthus* ($P < 0.00001$).

Even if there could be confusion over the etiology of the fore- and hindfoot pathology in recent elephants, the complete dichotomy of tuberculosis and spondyloarthropathy in the two Pleistocene clades allows unequivocal recognition of mycobacterial infection in *Mammut*.

Predicating diagnosis on osseous impact of disease (independently documented in that individual during life and by DNA analysis) provides an extraordinarily technique, reproducible

across species lines. Hands-on exposure to that approach obviates the challenge of limited experience.

Saturday 2:00

CARBON AND NITROGEN ISOTOPE EVIDENCE OF WEANING IN A JUVENILE WOOLLY MAMMOTH

ROUNTREY, Adam, FISHER, Daniel, Univ. of Michigan, Ann Arbor, MI; VARTANYAN, Sergey, Wrangel Island State Reserve, Pevek, Chukotka, Russian Federation; FOX, David, Univ. of Minnesota, Minneapolis, MN

Examination of growth increments and serial isotopic analyses of dentin in mammoth tusks provide information on diet, nutritional stress, reproduction, season of death, and climate during an animal's life. Increments in the dentin of mammoth tusks indicate years, weeks, and days, and this temporal record accumulates through the life of an individual. The increments allow estimation of age, but the dentin formed in the earliest years of life is often missing due to fracture or abrasion. This introduces error into age estimates. We attempt to mitigate this problem by analyzing the tusks of juveniles with intact tips and identifying an isotopic signature associated with an event (weaning) that occurs at a relatively well known age in early ontogeny. Age estimates from tusks with broken tips could then be constrained either by identification of the weaning signal in the remaining portions of the tusks, or through comparison of circumference/length profiles with the tusks of precisely aged juveniles.

The left tusk of a juvenile (~ five years of age) woolly mammoth from Wrangel Island is our current focus of study. Isotopic analyses of collagen sampled along growth increments gave a mean $\delta^{13}C$ of -21.95 ‰ (s.d. 0.45 ‰) and a mean $\delta^{15}N$ of 9.55 ‰ (s.d. 0.81 ‰). N values through all years of growth are cyclic (possibly reflecting seasonal variations in diet) and have a long-term declining trend as might be expected for a calf decreasing its dependence on milk. The earliest year of growth shows an increase in $\delta^{13}C$ followed by a period in which values remain near constant. The remaining years of growth show a cyclic pattern in $\delta^{13}C$ which is in phase with variations in $\delta^{15}N$. The $\delta^{13}C$ results indicate a change in environment or diet in the early years of the individual's life which may correspond to decreased dependence on milk.

Wednesday 11:15

STRATIGRAPHIC CHANGES IN THE CARNIVORAN ASSEMBLAGE AT HAGERMAN FOSSIL BEDS NATIONAL MONUMENT, IDAHO, AND THE CONNECTION TO PALEOECOLOGY

RUEZ, JR., Dennis, The Univ. of Texas at Austin, Austin, TX

At least 16 carnivoran taxa occur in the 150 meters of Glenns Ferry Formation at Hagerman Fossil Beds National Monument, Idaho (HAFO). This assemblage was examined for stratigraphic changes in the distribution of particular taxa, specimen abundance, and species diversity during the portion of the middle Pliocene represented at HAFO. These stratigraphic changes were then compared to known climatic patterns. Three relatively common mustelids, *Trigonictis cookii*, *T. macrodon*, and *Mustela rexroadensis* occur at most stratigraphic levels, but are absent during a 19-m (~160 kyr) stratigraphic interval coinciding with the coolest time segment at HAFO. It is within this gap that three less-common mustelids, *Sminthosinis bowleri*, *Ferinestrix vorax*, and *Buisnictis breviramus*, first appear at HAFO; they then persist upsection with the more common mustelids listed above. Specimens of *Borophagus hilli* are restricted to the warm intervals at HAFO, irrespective of the relative moisture levels. The other canid at HAFO, *Canis lepophagus*, is much more abundant during the dry intervals at HAFO, regardless of the estimated paleotemperature. Felid specimens, on the other hand, exhibit a stratigraphic trend with increased MNI mirroring increased temperatures. Overall carnivoran diversity (using a sliding stratigraphic interval) is rather constant at around eight species. However, the relative abundance of carnivoran species (as a percentage of total mammalian species per interval) exhibits an inverse relation with that of estimated paleotemperature. This is consistent with the pattern derived from modern ecosystems, where areas of lower mean annual temperatures have a relatively higher proportion of carnivorans.

Poster Session A

ADDITIONS TO THE VERTEBRATE FAUNA OF THE PENNSYLVANIAN (DESMOINESIAN) NACO FORMATION, CENTRAL ARIZONA

RUST, Dylan, ELLIOTT, David, Northern Arizona Univ., Flagstaff, AZ; IRMIS, Randall, Univ. of California-Berkeley, Berkeley, CA

The Pennsylvanian Naco Formation of central Arizona has for many years yielded well preserved invertebrates, a fauna which has recently been supplemented by the publication of a number of chondrichthyan taxa. The published chondrichthyan assemblage is typically Pennsylvanian and includes the fin spine taxa *Acondylacanthus*, *Amelacanthus*, and *Physonemus*, the tooth taxa "*Cladodus" occidentalis*, *Petalodus ohioensis*, *Deltodus sublaevis*, *D. angularis*, *Venustodus leidyi*, *Lagarodus angustus*, *Orodus* sp., and hybodontoids, together with the dermal denticle *Petrodus patelliformis*.

The original material was collected over a period of years from weathered surface material, however, in an attempt to recover the vertebrate microfauna a program of collecting weathered sediment samples, sieving them and then picking the residues was initiated. This program has more than doubled the known number of chondrichthyan taxa from this formation. The newly recognized taxa include the fin spine taxon *Ctenacanthus*, the teeth of *Janassa* spp., *Xenacanthus tridentatus*, *Agassizodus* sp., *Kirkella typicalis*, *Cooperella striatula*, and several unidentified species of *Orodus* and hybodontoids.

This assemblage shows moderate to high homogeneity with faunas in the Grey Mesa Formation of New Mexico and the Minturn Formation of Colorado as well as with Pennsylvanian localities in Ohio, and represents one of the richest chondrichthyan faunas in the Pennsylvanian of North America. The new taxa of *Janassa* spp., *Xenacanthus tridentatus*, *Agassizodus* sp., *Kirkella typicalis*, and *Cooperella striatula* are all also present in the Appalachian basin in Ohio. In addition a number of the taxa are known from localities in Western Europe and Siberia, attesting to the wide distribution of some of these species at this time.

Saturday 2:15

THE LOWER PERMIAN TEMNOSPONDYL *PERRYELLA OLSONI* AND DVINOSAUR INTERRELATIONSHIPS

RUTA, Marcello, BOLT, John, BARBER, Lorie, Field Museum, Chicago, IL

Further preparation of the type material of the Lower Permian temnospondyl amphibian *Perryella olsoni* (Wellington Formation, Oklahoma) has highlighted several new cranial and postcranial features. A more complete picture emerges for the morphology of all palatal bones (and their associated dentition), choanae, basicranial articulation, dorsal surface of parasphenoid, quadrate, lower jaw, as well as fore- and hind-limbs and girdles. The proportions and shape of the palatal bones, and the morphology of the postorbital region of the skull table, quadrate, and parasphenoid reveal striking similarities with the conditions observed in most or all dvinosaurs. These are a clade of Upper Carboniferous to Lower Triassic temnospondyls exhibiting various degrees of snout abbreviation and posterior skull table elongation. A cladistic analysis of assorted temnospondyls, mostly from the Permian and Carboniferous, places *Perryella* well within the dvinosaur clade, in an intermediate position between trimerorhachids and dvinosauroids (the latter including eobrachyopids, dvinosaurids, and tupilakosaurids). While the majority of cranial characters are consistent with this placement, a few of them, notably the presence of a notch along the posterior margin of the pterygoid palatal ramus (pterygoid incisure, a tupilakosaurid synapomorphy) appear to have been acquired convergently in *Perryella* and in derived dvinosauroids. *Perryella* extends the range of morphological variation in dvinosaurs, and bridges in part the anatomical gap between the less and the more derived members of this clade.

Friday 10:30

SOFT-TISSUE STRUCTURE IN TAIL OF *CASTOR*: TOWARD INFERRING TAIL SPECIALIZATIONS IN EXTINCT, SEMIAQUATIC MAMMALS

RYBCZYNSKI, Natalia, Canadian Museum of Nature, Ottawa, ON, Canada; PABST, D., MCLELLAN, William, Univ. of North Carolina at Wilmington, Wilmington, NC

The modern beaver, *Castor* (Castoridae) is characterized by a unique tail morphology that serves multiple functions including thermoregulation, fat storage, and in swimming (e.g. as a 'rudder'). The proximal third of the tail is hair-covered, rounded in cross-section and very muscular, whereas the remainder is scaly, dorsoventrally flattened and dominated by fatty 'connective tissues'. Corresponding to the soft tissue specializations, the caudal vertebrae are distinctive, with dorsoventrally flattened centra and expanded transverse processes. Many fossil castorids (e.g. *Steneofiber*, *Castoroides*) possess caudal vertebrae resembling (to varying degrees) those of *Castor*, and it has been suggested that these forms may have had paddle-shaped tails. In order to test these hypotheses it is important to first understand the relationship between vertebrae and soft tissues in living taxa. In *Castor*most of the tail is soft tissue: At maximum tail width the caudal vertebra span only 20% the total width of the paddle. Lateral to the vertebrae most of the tail volume is an adipose matrix embedded with collagenous structural fibers. I investigated this unusual biocomposite through gross-dissection and by clearing dehydrated tail-sections in methylsalicylate and viewing the structural fibers under a polarizing light microscope. The results show that the biocomposite possesses strong attachments with the dermis and vertebrae. Attachments with vertebrae are associated with osteological correlates, such as raised surfaces on the transverse processes. The structural fibers vary in thickness (100-250 microns) and are often arranged in regular patterns. For example, in longitudinal section the thick connective tissue fibers were oriented at roughly 50 degrees to the horizontal plane and formed a crossing pattern. The presence of strong attachments and crossed-fiber architecture supports the notion that the biocomposite plays an important role in maintaining the tails shape and stiffness. Given the correlation of characteristic skeletal features with the presence of the biocomposite it may be possible to infer tail morphology and function fossil taxa.

Wednesday 8:15

THE MECHANICAL PERFORMANCE OF TOOTH SHAPE VARIATION IN CARNIVOROUS REPTILES: THEROETICAL MORPHOSPACE AND FINITE ELEMENT MODELS

SADLEIR, Rudyard, Univ. of Chicago, Chicago, IL; CHAPMAN, Ralph, Idaho State Univ., Pocatello, ID

We studied the effects of differential forces on tooth shape in carnivorous reptiles-theropod dinosaurs, marine reptiles, crocodiles and varanid lizards. The shape metric used is based on an established morphospace using geometric morphometric models. This morphospace showed subtle shifts in shape—mild heterodonty—depending on the mesial-distal position of

the tooth within the mouth. The analysis of differential forces made use of finite element analysis (FEA), a method commonly used by industrial engineers to estimate the mechanical performance of modeled structures under controlled conditions. Growing in its use to investigate biomechanical design, FEA identifies the location and magnitude of stress and strain concentrations in a model. Thirty-six models were extrapolated from the theoretical morphospace and tested under nine different conditions varying in load magnitude and direction. The teeth were modeled as isotropic cones. The varying cone height, obliquity, and ellipticity then corresponded to the variables measuring tooth morphology (crown height, crown tip asymmetry, and lateral compression). In each case, the crown tip was loaded perpendicular to the base. As the crown tip is increasingly displaced from its base, the maximum principal stress increased linearly and stress and strain concentrations gradually propagated along the tooth-model's anterior margin. Increasing the lateral compression in this test had no effect on the magnitude and location of stress strain concentrations but increasing the crown height increased the moment arm length in the models. This theoretical result—predicting variations in stress patterns from the shape of individual teeth—was then compared with the shape variation observed within the dentitions of the various reptiles. This method of studying tooth shape performance has broad taxonomic applications, establishes a baseline for the investigation of the anisotropic properties of dentin and enamel related to tooth performance, and starts the process of looking at the interplay of tooth shape, performance, mode of replacement, and mode of feeding in carnivorous reptiles.

Student Poster Session

A NEW SPECIES OF THE SPHENODONTIAN REPTILE *CLEVOSAURUS* FROM THE LOWER JURASSIC OF SOUTH WALES, AND THE TETRAPOD DIVERSITY OF ST. BRIDE'S ISLAND

SÄILÄ, Laura, Univ. of Bristol, Bristol, United Kingdom

After the Rheatic marine transgression, a small part of modern day Glamorgan, South Wales, was isolated by sea and formed a small island distant from the mainland. It was composed of a carboniferous limestone plateau and has yielded numerous Lower Jurassic fissure fills containing fossils. The island has been named St. Bride's Island.

Earlier discoveries of a fauna consisting of three members; the pleurodont lepidosaur *Gephyrosaurus bridensis* and two mammals (*Morganucodon watsoni* and *Kuehneotherium praecursoris*) from these fissures were named the *Hirmeriella* fauna, after its association with the conifer *Hirmeriella muensteri*. It has been suggested that the island supported only this depauperate fauna, but subsequent findings from a new fissure reveal that this was not the case.

The reptile remains from the new fissure include one new species of the sphenodontian *Clevosaurus* and a sphenodontian *incertae sedis*. Isolated teeth are identified as theropod or sphenosuchid crocodylomorph teeth, but it is also possible that some belonged to rhamphorhynchid pterosaurs. Additionally, the cynodont *Oligokyphus*, new mammals and the members of the *Hirmeriella* association are present. The reasons for this fauna differing from that of the *Hirmeriella* fauna are uncertain but possible reasons include accumulation by different predators, a totally different mode of accumulation, or a temporal separation.

The new species of *Clevosaurus* represents the first record of the genus in the Jurassic of Britain. Furthermore, the faunal components of the new association are comparable with other contemporaneous assemblages in North America, China and South Africa, lending support to the idea of an unusually homogeneous composition of continental tetrapod communities globally during the Early Jurassic.

Wednesday 8:45

GASTROPUBIC RECOIL ASPIRATION IN CROCODILIANS AND EARLY ARCHOSAURS

SALISBURY, Steven, School of Integrative Biology, Brisbane, QLD, Australia; FREY, Eberhard, Staatliches Museum fur Naturkunde Karlsruhe, Karlsruhe, Germany

Biomechanical investigations indicate that lung ventilation in extant crocodilians is probably aided by kinesis of the gastralia and the cartilaginous costosternal apparatus, coupled with active expansion and passive contraction of the abdominal dermis. We refer to this mechanism as gastropubic recoil aspiration. Crocodilians with an extensively ossified (and thus more rigid) abdominal dermis should have a high breath frequency and low relative tidal volume, while those in which gastral ossifications are reduced or absent should have a low breath frequency and a high relative tidal volume. A higher breath frequency would permit more economic terrestrial activity because it results in more rapid gas exchange, whereas greater relative tidal volume would be beneficial for a deep inspiration after prolonged underwater activity. The presence of a stiff, plate-like gastral shield in many Mesozoic crocodilians and early archosaurs supports the idea that crocodilians were once capable of sustained, vigorous terrestrial activity. The low metabolic requirements of extant crocodilians may therefore be associated with the gradual shift to the semi-aquatic lifestyle of ambush predators that rely on rapid acceleration. Integration of the pubic bones, the gastralia, the cartilaginous costosternal apparatus and the abdominal dermis into the musculoskeletal ventilatory mechanism could only have occurred if these elements were not involved in weight support during terrestrial locomotion. Axial stabilisation that relies on bracing of the dorsal dermal skeleton against the backbone is thus a precondition for the evolution of the crocodilian-type ventilatory mechanism. Similar ventilatory mechanisms are also proposed for early archosaurs with a crocodilian-like axial bracing mechanism.

Poster Session B

POSTCRANIAL MORPHOLOGY OF THE WEST INDIAN EULIPOTYPHLA, *SOLENODON* AND *NESOPHONTES* (MAMMALIA)

SALTON, Justine, Bard College, Annandale-on-Hudson, NY

The phylogenetic and biogeographic history of the two extant West Indian *Solenodon* species is still relatively unresolved within placentalian systematics. Although it has been suggested that the zalambdodont dentition of solenodontids is synapomorphic with that of the afrosoricids (tenrecs and golden moles), *Solenodon* is likely a closer relative of the West Indian subfossil *Nesophontes*, despite the latter's more typical insectivoran dilambdodont dentition. Recent molecular systematic analyses suggest a deep divergence between solenodontids and other mammalian taxa and point to a eulipotyphlan relationship, consistent with *Nesophontes* affiliation. Hypotheses of *Solenodon* and *Nesophontes* phylogeny have not been thoroughly investigated from a morphological perspective, and have not been tested with detailed postcranial evidence.

The present study is a preliminary comparison of *Solenodon* and *Nesophontes* postcrania with additional comparisons to several tenrecid species. Qualitative comparisons and quantitative analyses of index variables demonstrate locomotor-based convergences between *Solenodon* and the digging tenrecids. For example, some features of the humerus, such as a large entepicondylar foramen, proximodistally lengthened humeral head, and broad deltopectoral crest, are shared between *Solenodon* and the tenrecids *Hemicentetes* and *Oryzorictes*. Yet several aspects of joint morphology, particularly characters that tend to be unvarying between tenrecids with different locomotor behaviors, recommend a closer phylogenetic affiliation between *Solenodon* and *Nesophontes*. For example, details of form at the upper ankle and proximal carpal joints are similar between *Solenodon* and *Nesophontes*, and quite different from all of the tenrecoids, regardless of locomotor behavior. These findings contradict the hypothesis of solenodontid/tenrecoid zalambdodont homology and are concordant with recent molecular evidence that ally solenodontids with other eulipotyphlan insectivores.

Friday 9:30

NEW SIRENIAN FOSSILS FROM THE LATE EOCENE OF MADAGASCAR

SAMONDS, Karen, Stony Brook Univ., Stony Brook, NY; ZALMOUT, Iyad, Museum of Paleontology, Ann Arbor, MI; KRAUSE, David, Stony Brook Univ., Stony Brook, NY

The virtual absence of Tertiary vertebrate fossils from Madagascar has greatly inhibited elucidation of the origin and evolution of many of its extant taxa. Although Tertiary rocks have long been mapped, few have been explored for vertebrate fossils since most are located in remote areas of the island. The only mammalian fossils reported from this interval include a small collection of rodents, insectivorans, and bats purported to be of Plio-Pleistocene age, and a fragmentary, non-diagnostic sirenian braincase from the Miocene. While sirenians have a relatively extensive fossil record, they are very poorly known from this region of the southern hemisphere.

Reconnaissance forays in 2001 and 2003 have resulted in the discovery of a fossiliferous horizon near Ampazony, NW Madagascar. The horizon appears to represent a paralic environment with an intercalated marine shell bed, and has yielded diverse invertebrates, sharks, rays, bony fish, turtles, and crocodyliforms. Based on the temporal ranges of various shark taxa, these rocks, though originally mapped as Pliocene, appear to be of late Eocene age.

We report here the discovery of sirenian fossils from these late Eocene deposits. They represent the first diagnostic mammalian fossils from the Paleogene of Madagascar and the first identifiable sirenian material from the island. The recovered sirenian remains consist of a partially preserved skull with braincase, portions of both dentaries, and multiple teeth, as well as pachyostotic ribs and fragmentary vertebrae. Cranial and dental morphology suggests that the taxon represented by these remains shares close affinities with the Tertiary Dugongidae of Egypt.

This first glimpse into the 65 million year gap of the island's mammalian fossil record is potentially highly significant for reconstructing the evolutionary and biogeographic history of sirenian mammals. In addition, the presence of alternating marine and terrestrial sediments, as well as fossil crocodyliforms and turtles, suggests that Ampazony has the potential to yield terrestrial vertebrate fossils, which are well-documented to occur in these types of mixed facies in other parts of the world.

Wednesday 11:30

EVOLITERACY: ESTABLISHING THE EDUCATIONAL RELEVANCY OF EVOLUTION THROUGH CONNECTIONS WITH ECOLOGY AND THE WEB OF LIFE

SAMPSON, Scott, Univ. of Utah, Salt Lake City, UT

Efforts to educate children and the general public about biological evolution have suffered a crisis of relevancy. Even for those that accept its veracity, evolution is generally (and mistakenly) envisioned as a process of the past, encompassed by abstract concepts that have little bearing on humans, let alone the future of Earth's diversity. This educational failure, while complicated by a number of factors, is due in large part to a lengthy history of fragmentation and compartmentalization within academia. It is time to foster connections between and among disciplines, and to express these in our educational initiatives.

The web of life is composed of two distinctly different kinds of threads—those that link organisms at any given moment in time through the flow of matter and energy (ecology), and those that link all lifeforms through deep time via genetic information and shared common

ancestry (evolution). Seen from this dual and complementary perspective, the two themes are inseparable. Without evolution, our vision is severely limited to the present day and we cannot begin to fathom the blossoming of life's diversity from single-celled forebears. Without ecology, the intricate interconnections we share with the current panoply of lifeforms cannot truly be envisioned. United in a single theme, evolution and ecology provide a powerful lens through which to view life's web, forming the foundation of an integrated and underutilized perspective on nature. In short, we need dramatic increases in levels of both ecological literacy, or "ecoliteracy", and evolutionary literacy, or "evoliteracy", with this dynamic pair of concepts reinforcing each other.

Paleontology, with unceasing public interest and an integrative core founded on geology and biology, is uniquely positioned to promote this eco-evolutionary perspective within the context of deep time. Such educational efforts, exemplified by innovative programs being developed at the Utah Museum of Natural History and elsewhere, will contribute directly to reconnecting people with nature, with the potential to fundamentally alter worldviews at a time when the sustainability of global ecosystems, and indeed our own species, is seriously imperiled.

Poster Session B

PATTERNS OF GROWTH AND ONTOGENETIC STATUS IN NEOSAUROPOD DINOSAURS DEDUCED FROM LONG BONE HISTOLOGY

SANDER, Martin, KLEIN, Nicole, Universität Bonn, Bonn, Germany

Large long bones (femora, humeri, tibiae) are the most abundant remains of sauropod dinosaurs and their length is a good proxy for body length and body mass. We sampled growth series of long bones of three diplodocoids (*Apatosaurus*, '*Barosaurus*' *africanus*, *Diplodocus*), two basal macronarians (*Camarasaurus* and *Brachiosaurus*), and two titanosaurs (*Phuwiangosaurus* and *Ampelosaurus*) in order to reconstruct qualitatively parameters of life history. Sampling was performed by core drilling at prescribed locations at midshaft.

Nine ontogenetic histologic stages were recognized that made a comparison accross taxa possible. All diplodocoids and the large basal macronarians have closely comparable life history patterns with a distinct slow-down in growth at mid-ontogeny, possibly correlated with sexual maturity, and little variation in maximum size. Because of the histologic uniformity of non-titanosaurian neosauropods, the ontogenetic histologic stages are a powerful tool for determining the ontogenetic status of any specimen that is represented by the large long bones as well as for testing the unity of such specimens.

Quantification of neosauropod life history using long bone histology is possible in the occasional cases where cyclical growth marks are developed. Alternatively, cortical bone apposition rates are used, but these have a large margin of error. Either method indicates that presumed sexual maturity was reached in the 2nd decade and maximum size in the 3rd or 4th decade of life. Mass-based growth curves can be calculated for single individuals with good growth records because there is a close correlation between cortical apposition rates and bone length, i.e. the bone shaft grows isometrically.

Poster Session B

NEW PLIOCENE FOSSIL PROBOSCIDEAN SPECIMENS FROM LAETOLI, TANZANIA

SANDERS, William, Univ.of Michigan, Ann Arbor, MI

Laetoli is an important fossil site in north-central Tanzania, well known for its important hominid discoveries, including the type of *Australopithecus afarensis* and associated bipedal trackways. It is one of only a handful of sites documenting the early integration of mammalian assemblages characteristic of modern African ecosystems. Over the last seven years, renewed fieldwork has added substantially to prior fossil collections made at Laetoli and nearby geologically related localities during the 1930s and 1970s. The present study provides descriptions of new proboscidean fossils and results of morphometric and taxonomic analyses of the entire proboscidean sample from those collections. The results substantiate that gomphothere remains from the Lower Unit of the Laetolil Beds belong to an advanced form of *Anancus kenyensis*, supporting biochronological correlation of the unit to ca. 4.3-4.0 Ma. *Deinotherium bozasi* is confirmed to be sparsely represented in the Upper Unit of the Laetolil Beds (3.8-3.5 Ma), accompanied by a single tooth fragment marking the first occurrence of a stegodont in Tanzania. Elephant fossils are present throughout the Laetolil Beds and the successive late Pliocene Upper Ndolanya Beds, but have a contentious taxonomic history, with alternative classificatory schemes placing them in *Mammuthus*, *Loxodonta*, *Elephas*, or divided among multiple taxa. The controversy is resolved by the expanded sample, which reveals two patterns of variation, one inter-individual (possibly sexually dimorphic) accounting for contrasts in size and robustness, and another, based on stage-of-wear, accounting for differences in occlusal morphology. Only at mid-crown height do accessory conules become apparent and contribute to the formation of pronounced, distinctive loxodont enamel wear figures. These disappear at the base of the crown with further wear. Thus, morphological variation in elephant molars from these beds can be accommodated by a single *Loxodonta exoptata* lineage, helping to fill in the phylogenetic continuum between archaic, late Miocene loxodonts and extant African elephants.

Poster Session B

LATE CRETACEOUS DINOSAURS, EGGS, BABIES, FIRES, AND DROUGHT IN BIG BEND NATIONAL PARK, TEXAS

SANKEY, Julia, California State Univ. Stanislaus, Turlock, CA

Late Cretaceous dinosaurs from Big Bend National Park, Texas are some of the southernmost in North America. In contrast to northern areas such as Alberta, slower sedimentation rates resulted in fewer fossils in Big Bend and considerably less is known about Big Bend's dinosaurs and other vertebrates. Big Bend was warmer and more arid than northern areas; evidence for periodic droughts comes from abundant horizons of conglomeratic lags with paleocaliche nodules and evidence for fires is from burned wood.

New sites have been collected (surface collected and screened) during the past five years from the inland floodplain deposits of the upper Aguja Formation (latest Campanian to early Maastrichtian) at the Rattlesnake Mountains, increasing the vertebrate record for Big Bend. The most productive horizon is a silty mudstone to fine sandstone with abundant plant fragments, burned wood, clay balls, coprolites, burrows, snails, dinosaur eggshell fragments, and bones and/or teeth from fish, salamander, lizard, turtle, crocodylian, and dinosaur (hadrosaur, ankylosaur, tyrannosaurid, cf. *Saurornitholestes*, and other small theropods). Numerous dinosaur eggshell fragments and small teeth from hatchlings or juveniles of hadrosaurs and theropods (tyrannosaurid and cf. *Saurornitholestes*) demonstrate that dinosaurs nested in Big Bend. However, no nests have yet been found. The Big Bend dinosaur fauna was distinct from northern faunas as a result of the warmer and drier climate in southern North America. Similar results are expected from other Late Cretaceous southern faunas such as those from Mexico.

Saturday 9:15

EVOLUTION OF GRASPING IN EUARCHONTA

SARGIS, Eric, Yale Univ., New Haven, CT; BLOCH, Jonathan, Florida Museum of Natural History, Gainesville, FL; BOYER, Douglas, Stony Brook Univ., Stony Brook, NY; SILCOX, Mary, Univ. of Winnipeg, Winnipeg, MB, Canada

Grasping extremities have long been associated with the origin and diagnosis of Primates. A recent review proposed the following evolutionary sequence for primate grasping: 1) a scansorial, clawed, nongrasping mammal like the shrew *Sylvisorex*; 2) an arboreal, clawed mammal with nonpowerful and nonopposable pedal grasping like the treeshrew *Ptilocercus* (carpolestids were placed at this stage); 3) a terminal branch feeder, with "nonpowerful" pedal grasping and an opposable hallux with a nail, such as the didelphid marsupial *Caluromys*; and 4) a euprimate with grasping hands, nails on all digits, and a powerful, opposable hallux with a large peroneal process on the 1st metatarsal.

We assessed this sequence by analyzing the grasping mechanisms of *Ptilocercus*, *Caluromys*, *Carpolestes*, plesiadapids, paromomyids, micromomyids, and euprimates. We find that the grasping capabilities of plesiadapids, micromomyids, and paromomyids were similar to those of *Ptilocercus*, in which the hallux is divergent but nonopposable, and grasping is less powerful than in euprimates. *Carpolestes* is unlike *Ptilocercus* and other plesiadapiforms, but similar to *Caluromys*, in the possession of a hallucal nail and in the morphology of the entocuneiform-1st metatarsal joint, indicating they share an opposable hallux and similar powerful grasping abilities. Although *Carpolestes* lacks a large peroneal process on the 1st metatarsal, unlike early Eocene euprimates, this does not differentiate it from *Caluromys*. We find no evidence for a shrew stage in the evolution of euarchontan grasping, and we propose that the ancestral euarchontan was capable of *Ptilocercus*-like, nonopposable pedal grasping. This was probably retained in the ancestor of the Scandentia-Dermoptera clade, ancestral scandentian, ancestral primate, and primitive stem primates, such as micromomyids and paromomyids. Effective manual grasping, indicated by euprimate-like prehensility, originally evolved in primitive stem primates. More powerful, *Caluromys*-like pedal grasping probably evolved in the ancestor of the plesiadapoid-euprimate clade.

Poster Session A

PLESIOSAURS (REPTILIA: SAUROPTERYGIA) FROM THE CANADIAN ARCTIC: A PRELIMINARY REPORT ON THEIR SYSTEMATICS AND BIOSTRATIGRAPHY

SATO, Tamaki, WU, Xiao-chun, Canadian Museum of Nature, Ottawa, ON, Canada

This is a preliminary report of on-going research on the Arctic plesiosaurian specimens at the Canadian Museum of Nature (CMN). This study will add new information on the temporal distribution and taxonomic diversity of the Arctic plesiosaurian fauna as well as the details of the anatomy of the relevant taxa. CMN houses many plesiosaurian specimens that have been collected from various localities and horizons in Canadian Arctic since the 1950s. Despite their importance in understanding the paleobiology of Mesozoic marine reptilian fauna in high latitudes, only limited information has been published on them. Plesiosaurian remains are also known from other Arctic localities such as Alaska, Greenland, and Svalbard, mostly from the Upper Jurassic. Stratigraphic distribution of CMN specimens in this study ranges from the Middle Jurassic (Callovian) to Upper Cretaceous (Campanian-Maastrichtian).

Jurassic specimens in CMN are known from the western Queen Elizabeth Islands, which include a partial skeleton collected from Melville Island. It is of a young individual consisting of the skull, mandible, anterior cervicals, and a forelimb. Further preparation of the skull revealed details in the palate, braincase, and postorbital bar. This specimen was previously reported as a cryptoclidid, but characteristics such as the spatulate mandibular symphysis, lack

of anterior interpterygoid vacuity, and double-headed cervical ribs indicate that it is actually a pliosaur *Simolestes*.

Early Cretaceous specimens are rare, with only a few postcranial materials known from the Christopher Formation in the western Queen Elizabeth Islands. Several elasmosaurids and polycotylids were described from the Upper Cretaceous (Santonian-Maastrichtian) of the Anderson River area in Northwest Territory in the 1960s, and a large number of additional Late Cretaceous materials have been collected mainly from the archipelago since the 1980s. These Late Cretaceous specimens are often severely weathered and very fragmentary, but elasmosaurid cervicals and girdle bones have been identified.

Poster Session B

ON A NEW PTEROSAUR SKELETON FROM THE CRATO MEMBER (APTIAN), SANTANA FORMATION, ARARIPE BASIN, NORTHEASTERN BRAZIL

SAYAO, Juliana, KELLNER, Alexander, PAULA, Lucilene, Museu Nacional/UFRJ, Rio de Janeiro, Brazil

Most pterosaur remains from the Santana Formation (Lower Cretaceous) were found in the calcareous nodules of the Romualdo Member (Aptian-Albian). In the last decade, however, remains of those volant reptiles have been more and more collected in the laminated limestone of the basal Crato Member (Aptian). Here we report one of the most complete pterosaur specimen (MN 6588-V) from the latter, consisting of a partial articulated skeleton. Except for the scapulocoracoid all bones are laterally compressed, a typical feature of the fossils from those layers. The following elements were identified: both scapulocoracoids (fused), sternum (preserved in dorsal view), the vertebral column from the last cervical to third caudal (preserved length: 41cm), prepubis (an element rarely preserved in pterosaurs), pelvic girdle (ilium, pubis and ischium, also fused), several ribs and elements of the gastralia. The dorsal series is formed by 11 elements (two less than the anhanguerid *Anhanguera santanae* form Romualdo Member). The first five dorsals are fused forming a notarium as observed in several pterodactyloid taxa including the pteranodontoid *Arthurdactylus conandoylei* also recorded from the Crato lagerstatte. The last five dorsals are fused too and form a sinsacrum. Based on the fusion of several elements MN 6588-V represents an adult individual. The new specimen differs from *Arthurdactylus* by having the scapula longer than the coracoid and by showing a quite distinctive morphology of the pelvic elements. The pelvic girdle of MN 6588-V, however, is very similar to the tapejarid pelvis by forming a puboischiadic plate with no lateral opening. The exact phylogenetic position of MN 6588-V cannot be established at the present time but as far as comparisons can be made it apparently represents a member of the Tapejaridae (recorded in that deposit). If this assignment is correct, this new specimen will provide new anatomical information for the members of this clade such as the shape of the prepubis and the count of the dorsal vertebrae.

Poster Session B

TAPHONOMY OF A JUVENILE LAMBEOSAUR BONEBED IN THE TWO MEDICINE FORMATION OF MONTANA

SCHERZER, Benjamin, VARRICCHIO, David, Montana State Univ., Bozeman, MT

Hadrosaurid bonebeds are a hallmark of the Two Medicine (Campanian) Formation of Montana, providing the basis for much of the interpretation of dinosaur ecology in the Late Cretaceous. A recently discovered bonebed in the Disturbed Belt of North Central Montana, the Sun River Bonebed, has produced abundant lambeosaur material from a presently unidentified species. Almost all material excavated is restricted to late juvenile individuals, with femur lengths of 52-55 cm.

Approximately 600 elements have currently been excavated from the bonebed, representing an MNI of 4. Preliminary bone examination shows the elements to be predominantly unweathered with moderate levels of abrasion. Approximately 10% of elements show fracturing, largely restricted to spiral and transverse fractures. Bone density, bone size, and caliche nodule diameter all increase with depth, with bone density reaching a maximum of 135 bones/m^2. The bonebed matrix is a uniform silty mudstone throughout the entire 45 cm depth, suggesting deposition in a floodplain environment. The assemblage is biased against smaller elements, suggesting it is also winnowed.

Paleoecologic implications of the bonebed complement the hypothesized social nature of hadrosaurids. The Sun River Bonebed shares a number of unusual features with other hadrosaurid bonebeds of the Two Medicine, such as highly skewed age class representation and low species diversity. Interpretation from the material of the Sun River Bonebed supplements the concept of gregarious hadrosaurids, possibly exhibiting age class segregation.

Poster Session B

IS A "BULLETPROOF VEST" LINKED TO THE EVOLUTIONARY SUCCESS OF SOFT-SHELLED TURTLES (TRIONYCHIDAE)?

SCHEYER, Torsten, SANDER, P. Martin, Univ. of Bonn, Bonn, Germany; JOYCE, Walter, Yale Peabody Museum, New Haven, CT; BOEHME, Wolfgang, Zool. Forschungsinst. & Museum A. Koenig, Bonn, Germany; WITZEL, Ulrich, Ruhr-Universität Bochum, Bochum, Germany

Since the Late Jurassic, crocodilian predators are the main threat to adult aquatic turtles. A bite by a crocodilian may result in fatal injury by either tooth penetration or crushing of the shell. Bone histological evidence is presented that the soft-shelled turtles (Eucryptodira: Trionychidae) may have adapted to this threat by evolving a fiber-reinforced shell. Here, a composite structure of fossil and living trionychid turtle shells is described; a natural body armor. The composite consists of ordered arrangements of structural collagen fiber bundles within the bone and skin resembling man-made plywood materials.

This structure is hypothesized to greatly improve the biomechanical properties of trionychid shells by increasing penetration resistance, as in a bulletproof vest. Furthermore, the bracing abilities of the shell are increased. Evolutionary advantages are a reduction in shell weight and greater flattening of the shell, both enabling the turtle to swim faster. Loss of the keratinous shields further helps the turtles to stay submerged due to a heightened ability to breath through the skin. The fiber-reinforced shell is thought to have ensured the survival of the Trionychidae for the last 140 million years, making them excellent examples of living fossils.

Poster Session A

RECOGNITION OF PALEOGASTROLITHS FROM THE CEDAR MOUNTAIN FORMATION OF NORTHERN UTAH, USING A SCANNING ELECTRON MICROSCOPE

SCHMEISSER, Rebecca, Northern Arizona Univ., Flagstaff, AZ; FLOOD, Tim, St. Norbert College, De Pere, WI

Gastroliths are stomach stones swallowed by certain extant and extinct organisms. Paleogastroliths are stomach stones associated exclusively with extinct organisms. Definitive recognition of paleogastroliths is problematic and controversial. The best method for recognition of genuine paleogastroliths is polished, rounded stones associated with dinosaur and plesiosaur skeletal remains. Recent work on stones associated with sauropod skeletal remains has led to the suggestion that paleogastroliths can be identified on the basis of distinct surface textures. These textures develop due to the unique movement of the stones within the stomach or gizzard. Recognition of these surface textures could be used as a method for identification of possible paleogastroliths not associated with skeletal remains.

The Cretaceous Cedar Mountain Formation is composed of alternating layers of sandstone and mudstone. Within the formation, rounded, polished pebbles and cobbles occur in clusters in the fine-grained mudstone. No intermediate grain size is present. Samples of these stones were collected from Dinosaur National Monument, Utah and to the west of the monument in Steinaker Reservoir. It has been suggested that these may be paleogastroliths based on their overall appearance, the surrounding matrix, and the presence of skeletal remains of sauropod dinosaurs within the Cedar Mountain Formation, although no associated skeletal material is present. The samples from the Cedar Mountain Formation have been examined with a Scanning Electron Microscope to determine if microscopic surface texture can be used as an independent test for their origin as stomach stones. In fact, the distinctive surface textures that were noted on paleogastroliths found in association with skeletal material are very similar to those seen on the stones from the Cedar Mountain Formation. Therefore, the geologic occurrence combined with the microscopic surface texture supports the interpretation that these stones are paleogastroliths.

Wednesday 4:15

EXPLOSIVE RADIATION OF DUROPHAGOUS MARINE REPTILES DURING THE POST-PERMIAN RECOVERY

SCHMITZ, Lars, Univ.of California, Davis, CA; JIANG, Da-yong, Peking Univ., Beijing, China; MOTANI, Ryosuke, Univ. of California, Davis, CA; HAO, Wei-cheng, Peking Univ., Beijing, China; SUN, Lin-yuan, Peking Univ., Beijing, China

The Panxian Fauna from Guizhou Province (SW China) yields articulated skeletons of middle Anisian marine reptiles, providing a fresh perspective of the evolution of marine reptiles in the Middle Triassic. The fauna of this lagerstaetten is characterized by a high proportion of durophagous species, which is reflected in both relative abundance and generic diversity. More than 700 of the 800 specimens collected have a strong crushing dentition, and four of the seven genera that can be recognized in the fauna are durophagous.

A literature survey reveals that durophagous forms were abundant and taxonomically diverse in many Middle Triassic localities worldwide. For example, the Sulphur Mountain Formation is dominated by the ichthyosaur *Phalarodon*, which has crushing teeth. The Ladinian of Spitsbergen (Upper Saurian Level) is also dominated by *Phalarodon*. The taxonomic composition is biased toward durophagous forms in the Anisian of Nevada. Given that many groups of durophagous marine reptiles have their first definitive fossil record in the Anisian, a hypothesis emerges that there was an explosive radiation of shell-eating marine reptiles in the Anisian.

We tested this hypothesis based on the global generic diversity of durophagous and non-durophagous marine reptiles, including ichthyosaurs, sauropterygians, thalattosaurs, and the controversial *Omphalosaurus*. Only 10% of the Early Triassic forms are durophagpus, whereas shell-eating taxa represent more than 35% of all marine reptiles in the Anisian, Ladinian, and Carnian. No durophagous marine reptile is known from the Jurassic.

The generic diversity pattern indicates that there was a rapid diversification of durophagous marine reptiles in the Anisian (or possibly the latest Olenekian). The timing of the diversification roughly corresponds to the stabilization of carbon isotope ratio fluctuation, which indicates the overall environmental instability after the Permian came to an end. It is possible that these marine reptiles quickly took advantage of shelled invertebrates, which in turn were recovering from the end-Permian extinction, in the environment that was being stabilized.

Wednesday 4:45

BOVID PALEODIETS AND THE PALEOECOLOGY OF MAKAPANSGAT LIMEWORKS CAVE, SOUTH AFRICA: A COMPARISON OF FIVE PALEODIETARY PROXY MEASURES

SCHUBERT, Blaine, East Tennessee State Univ., Johnson City, TN; UNGAR, Peter, Univ. of Arkansas, AR; SPONHEIMER, Matt, Univ. of Colorado, CO; REED, Kaye, Arizona State Univ., AZ; LEE-THORP, Julia, Univ. of Capetown, South Africa

The determination of diet and/or habitat of taxa is one of the primary means of environmental reconstruction, and taxonomic uniformitarianism assumptions are commonly used. These assumptions were recently tested by applying ecomorphology and stable carbon isotope analyses to bovids from Makapansgat Limeworks, a well known Plio-Pleistocene cave site in South Africa. Here, dental mesowear and microwear are applied to the same bovids to further refine their diet and habitat reconstructions. With one exception, mesowear grouped the taxa into the same dietary categories as stable carbon isotopes and combined ecomorphology data. Microwear separated an extant baseline of bovids into expected dietary categories and the Makapansgat bovids clearly fell into two groups with the same degree of separation as the extant grazers and browsers.

Overall, the results indicate that a multidisciplinary approach allows more accurate reconstruction of past diets and habitats. For example, isotopes cannot confirm whether or not an animal was a C3 grazer or C3 browser. However, microwear and mesowear are particularly well suited for answering this question. Microwear resolved that *Gazella vanhoepeni* had wear features unlike extant C3 grazers. Thus, based on its $\delta^{13}C$ values it was most likely a browser. Similarly, both mesowear and microwear indicate that *Aepyceros* sp. was a browser and not a C3 grazer.

The different methods provide a temporal continuum, with genetic signals such as ecomorphology and taxonomic uniformitarianism indicating behavioral adaptations over longer periods, with stable carbon isotopes and mesowear reflecting different aspects of average diet over months of an animal's life, and dental microwear providing dietary snapshots. This study showed that multidisciplinary paleodietary studies should include both nongenetic and genetic signals because such analyses can lead to a better understanding of the range of possible diets in lineages, the average paleodiets of taxa, and the types of habitats and paleoenvironments that organisms have inhabited through time.

Poster Session B

STABLE ISOTOPE ANALYSIS OF MOSASAUR TEETH FROM THE TYPE MAASTRICHTIAN

SCHULP, Anne, Natuurhistorisch Museum Maastricht, Maastricht, Netherlands; VONHOF, Hubert, Vrije Universiteit Amsterdam, Amsterdam, Netherlands

Carbon and oxygen isotope profiles along teeth of the mosasaurs *Mosasaurus hoffmanni* and *Prognathodon saturator*, both from the type Maastrichtian, were measured. The signal recorded in the tooth enamel appears at least partially unaltered by diagenesis.

Oxygen values, compared to the signal obtained from calcareous nannofossils, indicate that mosasaur teeth could have formed at higher temperatures than those of the surrounding sea water, suggesting that even the 'cold-blooded' metabolism of these large marine reptiles resulted in an elevated body core temperature. Assuming that a tooth took at least a year to develop fully, the temperature profile suggests that these mosasaurs experienced only limited seasonal temperature variations.

The carbon isotope data recorded from these teeth could potentially yield information on trophic relationships within the type Maastrichtian marine foodweb, but more data are needed before meaningful comparisons can be made.

Friday 9:45

THE LATE MIDDLE DEVONIAN FISH FAUNA OF RED HILL, NEVADA, AND ITS PALEOBIOGEOGRAPHIC CONNECTIONS

SCHULTZE, Hans-Peter, Lawrence, KS

The fauna of the Middle Devonian Red Hill locality is unusual in the co-occurrence of a rich fish fauna with a rich invertebrate fauna. Sponges are second in abundance only to the fishes and occur together with other invertebrates (conodonts, conulariids, dacryoconarids, gastropods, bivalves, brachiopods, not identifiable ammonoids and echinoderms). The invertebrates indicate a marine depositional paleoenvironment. The conodonts indicate a placement within the lower *disparalis* zone, late Givetian. The fish assemblage is dominated by the antiarch *Asterolepis*. All the other fishes, acanthodians, actinopterygians and sarcopterygians, are less common. The closest relationship of the fish fauna is with the Middle/Late Devonian fish fauna of the Baltic region, followed by that of Miguasha, eastern Canada, Scotland and Iran. That corresponds to the Devonian Euramerican faunal province with connection to eastern Gondwana (Iran and Australia). All the localities with the same genera as Red Hill are interpreted as marine with the exception of the Scottish localities. *Asterolepis* is the most widely distributed genus, mostly marine, but it may be able to enter freshwater like *Eusthenopteron* if one accepts a freshwater depositional paleoenvironment for the Scottish localities.

Poster Session B

UNIQUE PADDLE MORPHOLOGY OF THE PLIOSAUR (PLESIOSAURIA) *BRACHAUCHENIUS LUCASI*

SCHUMACHER, Bruce, Sternberg Museum of Natural History, La Junta, CO; LIGGETT, Gregory, Sternberg Museum of Natural History, Hays, KS

An articulated group of exceptionally large plesiosaur paddle elements (FHSM 13997) from the basal Lincoln Limestone Member, Greenhorn Limestone (Middle Cenomanian) of central Kansas displays unusual morphology and represents only the second record of paddle material for *Brachauchenius lucasi*. The elements include sixteen articulated epipodial, mesopodial, metapodial, and phalangeal elements, measuring 60 cm in proximo-distal dimension and 35 cm in antero-posterior dimension. Fused distal mesopodial 2-3 is a massive element that is markedly wider than long and is larger in overall size than the overlying mesopodial. Fused distal mesopodial 2-3 is generally equi-dimensional in other plesiosaurs, and is not nearly as large relative to other podials.

More striking is the configuration of the fourth metapodial. Sir Richard Owen was the first to note that the fifth metapodial is shifted proximally into the distal mesopodial row in plesiosaurs, a character that unites all members of the order. FHSM 13997 reveals that the fourth metapodial is also shifted proximally into the mesopodial row. This results in the contact of fused distal mesopodial 2-3 with seven other podials, including the fourth metapodial, a unique configuration among plesiosaurs. Williston's referred specimen of *B. lucasi* (USNM 2361) includes articulated paddle material that also clearly exhibits proximal shift of the fourth and fifth metapodials, and contact of fused distal mesopodial 2-3 with the fourth metapodial. Based upon this, FHSM 13997 is referred to *B. lucasi*, and this taxon's peculiar paddle morphology is noted here for the first time.

A scaled restoration of the complete FHSM 13997 paddle was prepared, based upon comparison with many other plesiosaur taxa, to arrive at an estimate of the overall size of the paddle and the skeleton as a whole. Were it complete and including the propodial, the paddle of FHSM 13997 would measure some 2 meters in length, and by comparison with pliosaur body plans this equates to an animal roughly nine meters in total length.

Poster Session B

***ECTYPODUS LOVE*I (MULTITUBERCULATA) FROM THE MEDICINE POLE HILLS LOCAL FAUNA (EARLY CHADRONIAN) OF BOWMAN COUNTY, NORTH DAKOTA**

SCHUMAKER, Karew, South Dakota School of Mines and Technology, Rapid City, SD; KIHM, Allen, Minot State Univ., Minot, ND

Ectypodus lovei from the Medicine Pole Hills Local Fauna is one of only two early Chadronian occurrences of *E. lovei*. The Medicine Pole Hills specimens match the published descriptions of *E. lovei* with the only difference being a slightly lower cusp formula on the M1. The sample is the largest known (65 specimens), represents a complete dental arcade (never before recorded at a single site), includes the first known anterior upper premolars and the first unbroken P4 and p4 for the species.

The P1 is somewhat rectangular with three cusps, two small anterior accessory cusps and a large anterior-posterior elongate cusp posterior to the two accessory cusps. The P2 is similar to the P1 except it is more rectangular and has three anterior accessory cusps and the main cusp is on the buccal margin of the tooth. There are no cusps on the posterior one-third of the tooth. The P3 is rectangular with four main cusps (cusp formula of 2:2) and a series of small cusps along the anterior and buccal margins of the tooth. The P4 is gently arched in profile view with the anterior slope straight and the posterior slope variable, ranging from straight to slightly concave. The cusp formula is 2-4:5-6:0. The p4 is large and blade-like with eight serrations and one pseudoserration. The anterior margin is more arcuate than the posterior margin and the leading edge of the tooth below the pseudoserration is nearly straight. There is a well-defined posterobuccal ledge which descends from the most posterior serrations and has no development of cusps.

The sample supports ideas suggested by earlier authors. First, the structure of the p4 supports the assignment of the species to *Ectypodus* as opposed to *Parectypodus*. Second, there appears to be a slight increase in size from the Duchesnean to the middle Chadronian for the species. Third, there is an increase in the development of the first cusp in the medial row of the M^2 over this same time. The large sample size also allows for the assessment of individual variation, supporting the idea that only one species is present at the Badwater Creek Localities.

Saturday 9:00

DENTAL DEVELOPMENT AND LIFE HISTORY IN ONE OF THE LARGEST SUBFOSSIL MALAGASY LEMURS, *MEGALADAPIS EDWARDSI*

SCHWARTZ, Gary, MAHONEY, Patrick, Arizona State Univ., Tempe, AZ; GODFREY, Laurie, Univ. of Massachusetts at Amherst, Amherst, MA; JUNGERS, William, Stony Brook Univ., Stony Brook, NY

Teeth are a unique biological system in that their component hard tissues (enamel and dentine) preserve a permanent record of their growth in the form of long- and short-period incremental markings. As a result, direct evidence for the timing of important developmental events (gestation, birth, M1 emergence, weaning) may be available even from fragmentary fossil remains. Here we utilize these incremental markers to reconstruct the dental developmental

schedule and life history profile of one of the largest extinct primates (ca. 88 kg, the size of a female gorilla), the subfossil lemur *Megaladapis edwardsi*.

Large-bodied anthropoids exhibit prolonged dental development and slow life histories. One might expect the same for giant lemurs; indeed, slow reproduction is sometimes cited as a factor contributing to their extinction. However, few bear the classic eruption sequence signature of anthropoid species with slow crown formation and slow life histories. *Megaladapis edwardsi* is one of the largest-bodied extinct lemurs; yet its eruption sequence (with most permanent molars erupting prior to the eruption of the replacement teeth) is typical for mammalian species with "fast" life histories. We examined dental development in *M. edwardsi* by charting the chronology of molar formation in a juvenile from Anavoha with a slightly worn M1 and an unerupted M2. Fourteen sections were prepared and incremental lines used to provide a chronology of molar development. Calculations yielded an M1 crown formation time of 383 days (1.05 yrs.), which is slow in comparison to the smaller-bodied *Palaeopropithecus ingens*, but fast in comparison to the even smaller-bodied *Archaeolemur majori* and *Hadropithecus stenognathus*. Our data show there is no simple relationship between crown formation time and either body size or eruption sequence in the lemurs of Madagascar.

Romer Prize Session, 11:30

MAXIMISING THE EVIDENCE: WHAT THE 'LEFTOVERS' TELL US ABOUT AUSTRALIA'S MID-TERTIARY

SCHWARTZ, Leah, Monash Univ. Sch. of Geosciences, Clayton, VIC., Australia

Australia's pre-Pliocene Tertiary terrestrial vertebrate record is sparse in comparison to that of most other continents. A number of faunas are known at the Miocene/Pliocene boundary, but earlier Miocene and particularly Paleogene faunas are rare. While two mid-Tertiary sites, the Etadunna Formation of South Australia and the Riversleigh site in Queensland have produced impressively diverse faunas, the faunas at other sites appear far less so.

This study examined two Northern Territory sites, Bullock Creek and Kangaroo Well. The former was known to have produced six mammalian species, and the latter, only one. Working with the isolated small mammal teeth and jaw fragments, as many as 13 new taxa were recognised at Bullock Creek, and six at Kangaroo Well, significantly expanding these sites' faunal lists. As well as dispelling the myth of low diversity at these locations, the subsequent increased understanding of the mammalian fauna has important implications for biochronological and paleoenvironmental interpretations of Australia's mid-Tertiary.

Examination of the new material also challenged the systematics of many taxa present in the faunas, demonstrating that the morphological evolution of several Australian mammalian groups is not yet fully resolved. Consequential to this study, the macropodoid genus *Nambaroo*, upon which a new subfamily was recently based, was recognised as paraphyletic. Material from Bullock Creek, currently assigned to Phalangerida *incertae sedis*, suggests that the placement of the pilkipildridid family within the Phalangeroidea is invalid, and that its petauroid affinities may bear re-examination. A new genus of miralinid present at both sites studied, demonstrates that metaloph formation in this family followed a different trajectory to that of phalangerids. With so much information to be gained, it is clear that examination of the 'leftovers'—incomplete specimens to which previous workers have paid little attention—is both worthwhile and necessary, particularly in a record as sparse as that of Australia.

Friday 8:15

DINOSAURIAN SOFT TISSUE TAPHONOMY

SCHWEITZER, Mary, WITTMEYER, Jennifer, North Carolina State Univ., Raleigh, NC

We previously reported the recovery of soft, pliable and transparent blood vessels and microstructures with cell-like morphologies recovered from the bones of an exceptionally well-preserved *Tyrannosaurus rex* (MOR 1125). Continued investigation of other well-preserved fossil material reveals that this is not an isolated event. Indeed, while bone matrix materials show degradation across time, vessels and their contents, as well as structures with osteocyte morphology, can be recovered from a wide range of material derived from various depositional settings. Here we present a comparison of vessels and cell-like microstructures recovered from a variety of fossil specimens, from a Recent moa to several Cretaceous dinosaurs. We illustrate micromorphological variation within a single sample that indicates multiple taphonomic modes. We discuss features common to all specimens preserving this type of material, and using new analytical data, propose testable hypotheses of taphonomic mode that may account for this degree of preservation. These data suggest that some of our basic assumptions about processes of fossilization may need to be reexamined in the future.

Poster Session B

AN UPPER CRETACEOUS (SANTONIAN) NONMARINE DEPOSIT IN EASTERN USA—WITH FOSSIL FEATHERS

SCHWIMMER, David, Columbus State Univ., Columbus, GA; BINGHAM, Patrick, KNIGHT, Terrell, Auburn Univ., Auburn, AL

An 80-cm thick lens of carbonaceous claystone in the Eutaw Formation, Russell County, Alabama, contains abundant fossils preserved as pyritic and carbonized films. Among these fossils are three feathers. Other terrestrial or nonmarine fossils in the deposit include numerous plant compressions, conchostracan (Crustacea) carapaces, insect wings and body parts, spiders, and fungal hyphae. The admixture of fossils and sedimentary characteristics shows that the deposit is non-marine and likely formed in a short-lived oxbow or tidal creek of an estuary. The carbonaceous claystone lens is bounded above and below with cross-stratified marine sandstones containing shark teeth and ammonites: thus the deposit most likely formed at or near the Santonian seashore in eastern Alabama. This deposit is the only non-marine Santonian stratum known in eastern USA and is among the very few nonmarine Upper Cretaceous fossil sites in the eastern continent.

The feathers are all small (less than 3.0 cm long) and appear to be contour feathers. Two have open pennaceous morphology, and one of these is extraordinarily well preserved, with morphological detail sufficient to resolve barbules on both part and counterpart. The third feather has closed pennaceous morphology, with overlapping barbules. Microscopy to date has not resolved barbicels; thus, none of these feathers definitively indicates whether they come from a volant or non-volant theropod. The small sizes suggest they are from juveniles, and carbonaceous material associated with the feathers has mammillary surface texture suggestive of eggshell. However, the ostensible eggshell is completely decalcified and the cross-sectional microstructure is ambiguous.

Wednesday 12:00

CASE STUDIES: A NEW VENUE FOR SHARING EVOLUTION RESEARCH WITH A BROADER AUDIENCE

SCOTCHMOOR, Judith, THANUKOS, Anna, CALDWELL, Roy, LINDBERG, David, Univ. of California Berkeley Museum of Paleontology, Berkeley, CA

A recent informal survey by the National Science Teachers Association revealed that more than 30% of teachers feel pressure to omit or downplay evolution in their teaching and to include nonscientific alternatives. Bruce Alberts, the president of the National Academy of Sciences, has recently called upon the NAS to confront those challenges, telling *USA Today* that teachers "need more support from scientists...one of the foundations of modern science is being neglected or banished outright from science classrooms in many parts of the United States."

It was in response to teachers' needs that the UC Museum of Paleontology (UCMP), in collaboration with the National Center for Science Education, developed what has become an award-winning website, *Understanding Evolution*. Now in response to the ongoing attacks on evolution, the UCMP is expanding this site to include resources that emphasize the importance of evolution both to research and to society.

There are a wealth of stories that reflect the importance of evolution to our understanding of the world around us and to our health and economy. These stories will be represented in the form of Case Studies that focus on three components: the principles of evolution on which the research is based, how the science was done, and the broader impact of the study to additional areas of research and/or to society. Case Studies will be accessible to a broad audience by using explanatory graphics and links to areas within the UE site to provide additional information. In addition, the Case Studies reinforce science as a personal endeavor and provide a method through which scientists can share their research with a broader audience.

Poster Session B

NEW SPECIES OF *CYRIACOTHERIUM* (MAMMALIA, PANTODONTA) FROM THE PALEOCENE OF ALBERTA, CANADA

SCOTT, Craig, Univ.of Alberta, Edmonton, AB, Canada

Cyriacotheriidae is a family of small-sized North American pantodonts known from the late Paleocene of the Western Interior of Canada and the United States. Although considerably smaller than most contemporary pantodonts, cyriacotheriids display a suite of dental characters consistent with those of other pantodonts (e.g. dilambdodonty, absence of hypocones, lingual hypoconulids); despite these resemblances, the affinites of Cyriacotheriidae have been challenged, and their origin remains obscure.

Recent collections from the Paleocene of south central Alberta have resulted in discovery of two new species of *Cyriacotherium*, both significantly older than either of the previously recognized species. The first, from the late Torrejonian Who Nose? locality, represents the oldest occurrence of *Cyriacotherium*; the second, from the middle Tiffanian DW-2 and Birchwood localities, is known from nearly all the postcanine teeth. Collectively, the dentitions of these new taxa exhibit a mosaic of derived characters typical of other cyriacotheriids (e.g. robust conules, strong dilambdodonty) in addition to a number of putative plesiomorphies seen in more basal pantodonts (e.g. large entoconids, deep premolar stylar shelves) and, importantly, posterior premolars that are only incipiently molariform and dilambdodont.

When *Cyriacotherium* was first comprehensively described, its ancestry was sought among basal pantolambdoids, particularly North American *Pantolambda*; consequently, *Cyriacotherium* was classified as a pantolambdoid in a separate family, Cyriacotheriidae, a view that has since prevailed. The coronal features of the new species from Alberta confirm *Cyriacotherium* as part of the pantolambdoid clade, yet derivation from known basal North American pantolambdoids is doubtful. Although a number of dental similarities between *Cyriacotherium* and the pantodonts *Altilambda* and *Hypsilolambda* suggest possible derivation from an Asian pantolambdoid, many of these features are considered plesiomorphic, or are outnumbered by conflicting characters; as such, a closer affinity for *Cyriacotherium* with either North American or East Asian pantodonts remains equivocal.

Poster Session A

***EQUUS IDAHOENSIS* FROM THE PLIO-PLEISTOCENE OF ARIZONA, AND ITS ROLE IN PLESIPPINE EVOLUTION IN THE AMERICAN SOUTHWEST**

SCOTT, Eric, San Bernardino County Museum, Redlands, CA

Later Pliocene and early Pleistocene plesippine equids from western North America have been interpreted to form a morphoclinal lineage native to Idaho: *Equus (Plesippus) shoshonensis* to *E. (P.) stenonis anguinus* to *E. (P.) fromanius*, with the latter species presaging subsequent North American caballine equids such as *E. scotti*. Another large late Pliocene plesippine, *E. (P.) idahoensis*, is also known from western North America, but is not considered a part of this morphocline; the origins and subsequent evolution of this species have not been fully defined.

Renewed field investigations at the Plio-Pleistocene 111 Ranch locality in Graham County, Arizona have resulted in the recovery of numerous vertebrate fossils, including remains of extinct equids. These newly-recovered fossils augment earlier collections by various institutions over the past several decades. At least two and possibly three or more species of extinct *Equus* (including the subgenus *Plesippus*) are represented in the 111 Ranch assemblage, as is the more diminutive Pliocene equid *Nannippus*.

Large, slender metapodials from 111 Ranch fall within the size range of *Equus idahoensis*. Associated teeth exhibit short protocones in the upper premolars and reduced ectoflexids in the lower molars. These characters also resemble *E. idahoensis*, and so these fossils warrant assignment to that species. Large metapodials from 111 Ranch are also similar in size and proportion to like elements of *E. enormis* from Anza-Borrego, California; however, *E. enormis* exhibits elongate protocones in the upper premolars that are derived relative to *E. idahoensis*. The similarity of these taxa suggests that *E. idahoensis* and *E. enormis* may be closely related, constituting a previously unrecognized Plio-Pleistocene large equid lineage in the southwestern United States — one that parallels the smaller native Idaho plesippines in evolving towards a caballine condition. This interpretation suggests in turn that not all subsequent North American caballine equids can be proposed to derive solely from the Idaho lineage.

Poster Session B

NEW CROSSOPTERYGIAN MATERIAL FROM AND NEW THOUGHTS ON THE DEPOSITION OF THE HALGAITO SHALE, CUTLER GROUP, SOUTHEASTERN UTAH

SCOTT, Kim, SUMIDA, Stuart, California State Univ.San Bernadino, San Bernardino, CA; WIDERMAN, Natalia, Univ. of California at Los Angeles, Los Angeles, CA

The last known members of the crossopterygian lineage are *Ectosteorhachis nitidius* (Cope 1880), known from the Permian of Texas and possibly from southeastern Utah, and *Lohsania utahensis* (Thomson and Vaughn 1968) known only from the Late Pennsylvanian(?) to Early Permian of southeastern Utah. New material collected from the Halgaito Shale (Cutler Group, southeastern Utah) consists of several vertebrae, ribs, scales, and a partial palate with at least the vomer, two vomerine tusks, and a pterygoid. A crushed ethmoid is also tentatively assigned to the genus. The vertebra and associated scales are *Lohsania* sp. cf. *L. utahensis*, and the cranial material is most parsimoniously assigned to ?*Lohsania* sp. Both thin section and SEM images of the scales provide additional information about *Lohsania*. As the scales of both genera are macroscopically identical, the assignment of this new material to Lohsania has brought into question prior identifications of *Ectosteorhachis* from southeastern Utah.

The best preserved material of *Lohsania* to date was recovered from the loessite deposits of the Halgaito Shale. Retreat of the epeiric sea to the north exposed the sand-rich carbonate platform of the Hermosa Group. Weathering and a strong onshore flow resulted in sand dunes and a primarily massive loessite deposit inland. Also, a sabkha was located to the east during deposition. The Halgaito is unusually thick for a desert loess and the red color is also unusual. With 87% of the silt between 30-60 μm, and grain size fairly constant, the deposit required a critical wind velocity of 20cm/sec to transport. Sediment grains of this size are subject to both wet and dry cohesion. Also, the presence of ionic bonds reduces the Debye screening length and limits Coulomb repulsion. The presence of large plants has also been confirmed from the deposit. It is our thought that the presence of salts in the air, and a moisture-rich onshore flow, created a trap for the silt utilizing capillary action and a limited, while interacting with ground foliage. The color of the formation lends support as the presence of moisture and salt would have encouraged oxidation along with sediment entrapment.

Poster Session B

AN UNUSUAL *PENTACERATOPS* FROM NEW MEXICO

SEALEY, Paul, SMITH, Joshua, WILLIAMSON, Thomas, New Mexico Museum of Natural History, Albuquerque, NM

Pentaceratops sternbergi is a large chasmosaurine ceratopsid dinosaur found only in the Upper Cretaceous (Campanian) Fruitland and lower Kirtland formations of New Mexico, and is well represented by at least 12 skulls and partial to nearly complete skeletons. It is characterized by a large, keyhole-shaped medial embayment surrounded by four large epoccipitals on the dorsal margin of the parietosquamosal frill. In 1998 the New Mexico Museum of Natural History (NMMNH) collected a partial skull and associated partial skeleton of *P. sternbergi* (NMMNH P-27468) from the Hunter Wash Member, Kirtland Formation in the Bisti/De-na-zin Wilderness area. Recovered skull elements include a largely complete parietal (one of the most complete known for this taxon), incomplete left and right squamosals, and a right jugal. We refer this specimen to *P. sternbergi* because it preserves the diagnostic medial embayment and associated epoccipitals on the parietal. However, the specimen also shows features that are unusual for *P. sternbergi*. The parietal of P-27468 is small compared to all other specimens. Also, the parietal differs from other specimens in the unusual laterally-constricted shape and small size of the dorsal medial embayment, and the aberrant positioning of the adjacent epoccipitals away from their usual location. We propose three hypotheses (not mutually exclusive) to explain the unique conformation of this specimen; first, that the parietal of P-27468 displays unique individual variation, second, that it is a pathologic individual, and third, that it represents an early ontogenetic stage not previously documented.

Thursday 2:30

MORPHOLOGICAL INNOVATION VIA HETEROCHRONY: AN EXAMPLE IN THE EVOLUTION OF THE GIANT EXTINCT KANGAROOS (MACROPODIDAE: STHENURINAE) OF AUSTRALIA

SEARS, Karen, Univ. of Colorado Health Sciences Center, Aurora, CO

Despite the pervasiveness of heterochrony as a concept, the complex relationship between development and evolution is still unclear. To help remedy this situation, I undertook the study of a unique test case for the role of development in guiding evolutionary change: the evolution of sthenurine kangaroos (Macropodidae: Sthenurinae).

Sthenurines form a distinct lineage that diverged from the Macropodinae, modern kangaroos, before the mid-Miocene. Extinct sthenurines are unique among kangaroos in their large body size (some stood over 2m), short muzzles, and in the morphology of their post-cranial skeleton. In particular, sthenurine scapulae have a distinctive shape (very short and broad) that resembles that of the scapulae of newborn macropodines and likely evolved in response to their specialized browsing behavior. Based on this, I hypothesized that sthenurine scapula evolved via the heterochronic process of paedomorphosis, in a manner similar to that proposed for many human skeletal elements. I tested this hypothesis using morphometric data from adult and juvenile macropodids.

I found that the scapulae of the putative ancestors of sthenurines and macropodines, the balungamayines, and of the most basal sthenurine, *Hadronomas*, resembled those of adult macropodines. In contrast, the scapulae of more derived sthenurine adults are similar to those of newborn macropodines, not to those of adults. Additionally, the evolutionary change in scapular morphology from balungamayines to derived sthenurines is negatively correlated with that observed during macropodid ontogeny. Taken together, these results and information from other sources (e.g., reproductive biology) suggest that derived sthenurines underwent a paedomorphic shift in the timing of scapular development, most likely due to neotenic processes, shortly after the divergence of *Hadronomas* in the late Miocene.

That groups as phylogenetically and developmentally divergent as sthenurines and humans could evolve a similar morphology (i.e., short and broad scapulae) via the same developmental processes suggests that, at least within mammals, these processes and the ontogenetic patterns underlying them may be conserved.

Wednesday 2:15

PALEOENVIRONMENTAL INTERPRETATION OF AN EARLY EOCENE FAUNA USING STABLE ISOTOPES FROM MAMMAL TEETH

SECORD, Ross, WING, Scott, Smithsonian Institution, NMNH, Washington, DC

The stable isotope composition of tooth enamel was analyzed for an early Eocene fauna consisting of 17 mammalian herbivores and omnivores from the central Bighorn Basin of Wyoming (YPM-45). Data were used to infer whether the fauna lived in a closed-canopy forest or a more open environment, and to explore the possibility of recognizing trophic partitioning in mammals that live in C3 vegetation using $\delta^{13}C$ and $\delta^{18}O$. Studies of modern mammals show that $\delta^{13}C$ in teeth faithfully reflects the composition of diet with predictable metabolic enrichment. Mean $\delta^{13}C$ in plants generally increases from closed forests to open environments, while the range decreases. The lowest $\delta^{13}C$ in modern terrestrial plants is found in understories of closed-canopy tropical forests and reflects slow photosynthesis (low solar radiation) and low water-use efficiency (high humidity). A gradient of ~10 per mil in $\delta^{13}C$ can exist from the understory to the canopy and from the understory to open areas.

Mean annual temperature at the time of the YPM-45 fauna was ~16°C and precipitation ranged from ~100-150 cm, based on paleobotanical data, indicating subtropical or warm temperate conditions. Atmospheric carbon isotope composition is assumed to have been similar to today, based on data from marine carbonate. $\delta^{13}C$ in the YPM-45 fauna has a mean of -13.0 per mil and range of 3.5 per mil. An average metabolic enrichment factor of 13 per mil yields a mean of -26 per mil and range of ~-28 to -24 per mil for their diets. The high mean $\delta^{13}C$ is consistent with herbivore diets dominated by plants growing in open areas and/or experiencing water-stress; the low range of $\delta^{13}C$ is consistent with open vegetation, but not closed-canopy forests. Alternatively, the low range of $\delta^{13}C$ in the mammalian herbivores may reflect a low degree of dietary specialization. Artiodactyls exhibit significantly higher $\delta^{13}C$ than perissodactyls on average (1.2 per mil; p=0.003), which indicates either food plant specialization, the evolution of ruminant digestion in the former, or both.

Wednesday 3:30

MIOCENE SAVANNAS AND THE GREAT TRANSFORMATION: TESTING DIETARY SHIFTS WITHIN THE EQUIDAE USING LOW-MAGNIFICATION STEREOMICROSCOPY

SEMPREBON, Gina, Bay Path College, Longmeadow, MA

The Miocene epoch was a time of extensive change in mammalian communities in North America. Several ungulate lineages independently acquired hypsodonty (high-crowned teeth) in the early-middle Miocene of North America, leading to a classic story in paleontology that savanna grasslands spread during this time replacing more closed habitats and precipitating this "Great Transformation". In addition to having the distinction of being the time when certain clades of horses first became hypsodont, the early Miocene was a time of major morphological reorganization of equid skulls and jaws as well as a shift from a predominantly crushing occlusal mode to one which incorporated transverse shearing. To test the hypothesis that the transformation in crown height in fossil horses coincided with a shift to more abrasive diets in the early Miocene of North America, dietary trends were assessed in Oligocene and Miocene (Orellan-Barstovian) Anchitheriinae and Equinae via stereoscopic microwear analysis of molar teeth. Results indicate a peak shift toward more abrasive diets (coarser scratches, more large pitting, and gouging) by the earliest Miocene (late Arikareean) in the Anchitheriines studied (e.g., *Parahippus, Desmathippus,*). This trend toward the inclusion of more abrasive grasses preceded the acquisition of hypsodonty. Within the earliest hypsodont Equinae studied (e.g., *Merychippus*), a diversity of enamel microwear is apparent even within the same species from different localities. Thus, this study shows that the initial dietary shift to increased and coarser grass consumption in equids preceded the transformation in gross craniodental morphology and that fossil equids were more finely partitioning available resources than previously supposed.

Saturday 11:15

EVIDENCE FOR OBLIGATE BIPEDALITY IN THE BASAL SAUROPODOMORPHS *PLATEOSAURUS* AND *MASSOSPONDYLUS*

SENTER, Philip, Lamar State College Orange, Orange, TX; BONNAN, Matthew, Western Illinois Univ., Macomb, IL

Basal sauropodomorph dinosaurs are often portrayed as habitual quadrupeds. Evidence cited in support of this hypothesis includes supposed prosauropod trackways, trunk to hindlimb length ratios, and vertebral dimensions. However, it has generally been assumed that basal sauropodomorph forelimb morphology allowed efficient quadrupedal locomotion. Utilizing a standardized measurement and photography protocol, we examined the range of forelimb movement in two basal sauropodomorphs, *Plateosaurus engelhardti* and *Massospondylus carinatus*, and several outgroup taxa: *Varanus*, *Alligator*, *Anser*, *Struthio*, *Acrocanthosaurus*, and *Apatosaurus*. We show that the range of humeral extension and antebrachial flexion were limited and probably prevented the forelimb from moving in a dynamically similar pattern to the hindlimb. Moreover, the palmar surfaces of the manus faced medially because the forelimbs were unable to achieve pronation. In this orientation, carpal and digital flexion would have produced a medially directed force, instead of the caudally directed propulsive force typically observed in habitual and obligate quadrupeds. Our results also suggest that the use of the pollucal claws as defensive weapons was unlikely: the limited forelimb movements would have only allowed the pollucal claws to be used on objects beneath the chest of the animal, and were therefore of little use in defense. We conclude that the proposed prosauropod trackways could not have been produced by basal sauropodomorphs and that limb ratios and vertebral dimensions provide only equivocal data on limb and body posture.

Saturday 8:00

BASAL SAUROPODOMORPH PHYLOGENY: A COMPARATIVE ANALYSIS

SERENO, Paul, Univ. of Chicago, Chicago, IL

Central issues in basal sauropodomorph phylogeny include the basis for or against (1) basal singleton stem taxa, (2) the monophyly of prosauropod dinosaurs, (3) structure within Prosauropoda if such a clade exists, (4) the affinity and order of basal members of Sauropoda. Taxonomic issues concern phylogenetic definitions for principal taxa and how they might best be formulated to maintain utility in the face of a diversity of phylogenetic opinions. Differing phylogenetic results are seen to arise from a number of factors which include (1) inclusion/exclusion of characters, (2) marked differences in scoring of characters, (3) inclusion/exclusion of taxa, (4) ineffective comparison of results, and (5) the aggrandizement of fairly unstable phylogenetic conclusions. Standard *post-hoc* techniques for comparing cladograms and measuring robustness address point 5 but leave the operationally more fundamental points 1-4 unexamined in a systematic fashion. Analyses of basal sauropodomorph phylogeny are compared by logging characters and taxa across analyses, determining the scope of taxonomic overlap, and comparing shared, rejected and novel data components. Using this method, it is possible to locate major differences in character usage, character scoring, and the inclusion/exclusion of taxa that are responsible for differing results. Prosauropoda, defined in an effective manner, is deemed an heuristic and well-supported clade among basal sauropodomorphs.

Poster Session B

DINOSAURS OF KENYA'S RIFT: FOSSIL PRESERVATION IN THE LUBUR SANDSTONE OF NORTHERN KENYA

SERTICH, Joseph, SAMPSON, Scott, LOEWEN, Mark, Utah Museum of Natural History, Salt Lake City, UT; GATHOGO, Patrick, BROWN, Francis, Univ. of Utah, Salt Lake City, UT; MANTHI, Frederick Kyalo, National Museums of Kenya, Nairobi, Kenya

While the presence of dinosaur remains in sediments adjacent to Lake Turkana in northwestern Kenya has been known for over 35 years, these deposits have never been the target of a formal expedition. In the summer of 2004, the National Museums of Kenya and the Univ. of Utah undertook a joint paleontologic expedition to the Lubur sandstone. This project yielded a relatively diverse vertebrate fauna, resulting in a more complete understanding of the age and depositional history of these sediments.

The Lubur Sandstone of the Lapurr Range comprises a succession of coarse arkosic sandstones, conglomerates, and mudstones that can be easily divided into three distinct facies. Facies 1 rests nonconformably on Precambrian basement and is composed of basement-derived metamorphic clasts supported in a muddy coarse sandstone matrix. Facies 2 consists of 30 meters of pedogenically altered muddy sandstone with conglomeratic lenses and root traces. Facies 3 is composed of over 500 meters of coarse unaltered arkosic sandstone and conglomerate. The entire sequence is capped by Eocene basalts.

Most of the Lubur Sandstone deposits are afossiliferous; however, the lowest beds of Facies 3 contain relatively abundant isolated vertebrate macrofossils. In addition to remains of turtles and two crocodyliform taxa, the fauna contains multiple dinosaur taxa, including at least three large-bodied theropods and two sauropods. Preservation of these bones is highly variable, with a majority of elements exhibiting rounding and abrasion as a result of high energy transport. Interestingly, a small number of fossils are better preserved, indicating minimal transport. Numerous elements show intense modification by invertebrates, the result of pre-depositional feeding or nesting activities; these insect ichnofossils can be subdivided into three distinct morphs.

Sedimentologic and taphonomic data from Facies 3 are consistent with deposition in a large braided fluvial environment with occasional surges of coarse sediment influx. These sediments were most likely deposited within the Anza Rift Basin in association with extensive Cretaceous rifting across central Africa.

Wednesday Mammal Evolution Symposium poster

THE PALEOBIOLOGY OF THE ROBUST AUSTRALOPITHECINES (*PARANTHROPUS*): A TEST OF THE DUROPHAGE MODEL WITH CARBON ISOTOPE ANALYSIS

SHABEL, Alan, Univ. of California Berkeley, Berkeley, CA

The robust australopithecines (*Paranthropus*) are one of the most well-studied fossil mammals, with specimens known from Plio-Pleistocene sites across eastern and southern Africa. It has long been argued that *Paranthropus* was a trophic specialist because of the massive postcanine dentition, the hypertrophied masticatory musculature, and the overall robusticity of the skull. Because *Paranthropus* fossils are typically found in association with early *Homo*, the competitive exclusion principle has been used to support the argument for niche specialization. Until the application of isotope analysis, *Paranthropus* was reconstructed as a strict vegetarian (the different models variously emphasized hypogeous tubers, grass seed, and hard fruits and nuts). The isotope analyses falsified each of the vegetarian models, and researchers now argue that *Paranthropus* was omnivorous. However, an omnivore model cannot explain the postcanine occlusal morphology of *Paranthropus* nor the mechanism for coexistence with *Homo*. Here I advance a model that is consistent with all existing evidence from comparative anatomy, taphonomy and synecology. The new model reconstructs *Paranthropus* as a member of a guild of hard-shelled invertebrate consumers in wetland and mesic ecosystems. In Africa today, these ecosystems are particularly rich in macroinvertebrates such as potamonautid crabs and achatinid molluscs, and the extant mammal consumers of these prey include the marsh mongoose (*Atilax*) and the clawless otter (*Aonyx*). Here I provide a test of the wetland model through a study of carbon isotopes in modern *Atilax*, *Aonyx* and their preferred prey, the potamonautid crabs. The carbon isotope value ($\delta^{13}C$) of crab tissue from the Transvaal region of South Africa was -20.6 per mil (n=23, sd=1.3). The $\delta^{13}C$ value of bone collagen for Transvaal specimens of *Atilax* (x=-16.5 per mil, sd=1.2, n=3) and *Aonyx* (x=-16.0 per mil, sd=1.5, n=5) match that expected for a local cancrivore. These data are compared with the isotope values known for *Paranthropus robustus* fossils from the Transvaal, and the durophage hypothesis is found to survive a first test.

Poster Session A

SKELETAL AND DENTAL ANATOMY OF THE LATE CRETACEOUS LAMNIFORM SHARK, *CRETALAMNA* (=*CRETOLAMNA*) *APPENDICULATA*

SHIMADA, Kenshu, DePaul Univ., Chicago, IL

LACM 128126 housed in the Natural History Museum of Los Angeles County, California, is a partial skeleton of the Late Cretaceous cretoxyrhinid lamniform shark, *Cretalamna* (=*Cretolamna*) *appendiculata* (Agassiz), from the Niobrara Chalk of western Kansas. The specimen consists of a pair of nearly complete palatoquadrates, a pair of incomplete Meckle's cartilages, a string of 35 well-calcified vertebrae, and approximately 120 teeth that are mostly disarticulated. The estimated maximum mesiodistal length of each palatoquadrate is about 28

cm. The maximum height of the palatine process and that of quadrate process measure approximately 4 cm and 10 cm, respectively. The mesiodistal length of each Meckel's cartilage is estimated to be about 24 cm (with a maximum depth of about 7 cm), suggesting an upper jaw overbite, which concomitantly implies a subterminal mouth in the shark. The vertebrae, presumably from the trunk region, are amphicoelous and asterospondylic with tightly spaced radial cartilage plates, which is typical of Lamniformes. The vertebrae are heavily distorted taphonomically, but one of the least distorted centra measures about 40 mm in diameter and 16 mm in anteroposterior length. If the vertebral diameter is used to compare with the previously published data on the relationship between the total body length and vertebral diameter in another cretoxyrhinid shark, *Cretoxyrhina mantelli* (Agassiz), the *Cretalamna appendiculata* individual is conservatively estimated to be about 230 cm in total body length. Faint depressions indicating the positions of tooth rows are found on the lingual side of the right palatoquadrate in LACM 128126, and they are suggestive of juxtaposed tooth rows. The reconstructed dentition, which is partially corroborated with a few teeth still *in situ* on the right palatoquadrate, suggests that the shark had a lamnoid tooth pattern with at least 15 upper tooth rows on each side, consisting of at least two symphysial, two anterior, one intermediate, and at least 10 postintermediate teeth. The lower dentition is poorly represented in the specimen, but it apparently consisted of more than 8 tooth rows on each side.

Wednesday 5:00

BSV SCALING: A SIMPLE VISCOSITY SCALE FOR ADHESIVES AND CONSOLIDANTS AND ITS APPLICATIONS

SHINYA, Akiko; BERGWALL, Lisa; VAN BEEK, Constance, Field Museum of Natural History, Chicago, IL

Rather than using arbitrary 'thin', 'medium', or 'thick' solutions, simple viscosity scale BSV was devised. BSV 1 is one part resin and one part solvent, BSV 2 is one part resin and two part solvent, and so on. Acryloid B-72 BSV 1 is the equivalent of Koob Tube, widely used for the repair of archaeological ceramics, with B-72 and acetone with 0.1% of fumed silica by weight. Following the Koob Tube method, BSV 1 was prepared in the lab and stored in large paint tubes, but it was later transferred into small eyedroppers, which were more economical and practical than the tubes. The remaining BSV scales were prepared in the field. To simplify their production, a large jar was marked for proper volumes of acetone and the weight of B-72 in a measuring cup was recorded prior to departure to the field.

Applications of various BSV scales, BSV 1 to BSV 6, were initially tested in the summer of 2004 during fieldwork in the Cloverly Formation of Wyoming. Generally, the matrix is poorly consolidated, consisting predominantly of buff to gray sandstones and shaly sandstones, and the fossils near the surface are highly weathered and flaky. Under high heat and aridity, BSV 1 was used best as an adhesive, while BSV 4 most effectively consolidated the loose surface material. BSV 5 was suitable for consolidating material in the overturned plaster jacket. During transport back to the lab, some material became unconsolidated inside the jacket, but it is thought that the use of BSV 3, applied each time after th BSV 4 and BSV 5, would further consolidate the surface and prevent the loosening of material during shipping.

BSV scales will be further tested during the 2005 field season to simplify the collecting of fossil material exposed at of near the surface in its entirety, thereby preserving the morphological information associated with it.

Saturday 5:30

NEW MAMMALS FROM THE DESEADAN (LATE OLIGOCENE) OF SALLA, BOLIVIA

SHOCKEY, Bruce, Florida Museum of Natural History and Dept. of Zoology, Gainesville, FL; ANAYA, Federico, Universidad Autonoma, "Tomas Frias", Potosi, Bolivia; CROFT, Darin, Case Western Reserve Univ., Cleveland, OH; SALAS, Rodolfo, Universidad Nacional Mayor de San Marcos, Lima, Peru

New remains of carnivorous marsupials and a new genus of mylodontid sloth were collected during recent National Geographic sponsored fieldwork at Salla (late Oligocene, Bolivia). The marsupial specimens include a partial cranium of a short-faced, dog-like borhyaenid and the mandibles of a much larger beast. The smaller, dog-like borhyaenid was collected from Poco Poconi North, of Unit 3 of the Salla Beds. It appears derived relative to most other borhyaenids in having only two upper premolars. The first upper molar has short, blunt para- and metacones and the M2-3 are distinctive in having obliquely oriented carnassial blades. The blade of the M3 is nearly perpendicular to the long axis of the skull. The animal is so distinctive that we have been unable to refer it to any known genus, just referring it for now to the Borhyaeninae. The jaw of a much larger sparassodont, similar to that of *Proborhyaena gigantean*, was discovered in Pasto Grande at the base of Unit 3. It measures 154 mm from the canine to m4. The hemimandibles are solidly fused at the symphysis. The right lower canine is over 7 cm long and is worn much like the canines of *P. gigantea*, but it is not as vertically placed as those of *P. gigantea*. The m4 is a hypercarnassial tooth, being exceedingly broad, but quite thin for its large size. The specimen is tentatively refered to *Paraborhyaena*, a taxon known from Salla.

The partial cranium of a mylodont sloth is not referable to any known genus. It is smaller than other Deseadan sloths (e,g., *Octodontotherium*, *Orophodon*). Derived characters include its very reduced caniniform, broad muzzle, and its distinctive tooth histology (well-developed vasodentine and thick cementum). Characters plesiomorphic to most other mylodontids include the relatively simple, figure eight in cross section shaped molariforms (though, more complex than the peg-like teeth of *Orophodon* and *Pseudoprepotherium*), the lack of any significant gap between the molariform and caniniform teeth, and the small size of the last molariform (inferred from alveolus).

Wednesday 2:15

UPPER PERMIAN CAPTORHINID AND PAREIASAUR REPTILES FROM NIGER: NEW DATA AND INTERPRETATION

SIDOR, Christian, New York College of Osteopathic Medicine, Old Westbury, NY; LARSSON, Hans, McGill Univ., Montreal, QB, Canada; O'KEEFE, F. Robin, New York College of Osteopathic Medicine, Old Westbury, NY; BLACKBURN, David, Harvard Univ., Cambridge, MA; SMITH, Roger, South African Museum, Cape Town, South Africa

Recent fieldwork in the Upper Permian Moradi Formation of northern Niger has yielded a tetrapod fauna that is strikingly different from coeval faunas known elsewhere on Africa. Amphibians include the cochleosaurid *Nigerpeton ricqlesi* and stem-edopoid *Saharastega moradiensis*, the latter representing the most primitive temnospondyl from Gondwana. Two reptiles have been reported to date, the giant captorhinid *Moradisaurus grandis* and the pareiasaur *Bunostegos akokanensis*. We report here on a second captorhinid from the Moradi Formation and on new data concerning the skull and skeleton of *Bunostegos*. The new captorhinid is represented by three partial skulls with articulated vertebral columns and disarticulated limb and girdle material. All of the material comes from a single locality approximately 25 km to the south of the *Moradisaurus* type locality and slightly higher in section. Although the skulls are only half the length of the *Moradisaurus* holotype, we consider them to represent adults based on the degree of neural arch fusion. The presence of several characters support a derived position for the new taxon within Captorhinidae, including the maxilla being dorsoventrally low and the short anterior process of the coronoid. The results of a preliminary cladistic analysis place the new taxon with *Labidosaurikos*, *Captorhinikos*, and *Moradisaurus* in the Moradisaurinae. New pareiasaur material from the Moradi Formation includes three partial skulls of *Bunostegos*, one of which was associated with a complete scapulocoracoid and two presacral vertebrae. Isolated pareiasaur material, including a femur, partial pelvis, several vertebrae (including an incomplete sacrum), and an articulated forelimb, is more difficult to assign to *Bunostegos*. The relationships of *Bunostegos* remain enigmatic due to the mosaic of primitive and derived characters observed and may indicate the presence of a second Moradi pareiasaur. The Moradi reptile fauna is taxonomically unique, suggesting limited faunal interchange between central Pangea and better known faunas to the north and south.

Wednesday, Preparator Poster

PREPARING DINOSAUR EGGSHELL FOR MUSEUM DISPLAY

SLEZAK, Jim, Mundelein, IL

Apparent *Mega-elongoloothis* specimens encased in cemented red clays are undergoing preparation for public display. Eggshell preserved in position close to original shape have a coating of secondarily deposited calcite on the 'external' surface. Preparation efforts are intent on moving all extraneous matrix so that all of the eggshell displays the black glassy surfaces matching the look of fragments found in the interior of the preserved egg. Efforts to optimize the speed and quality of preparation required explorations of a variety of tools and materials including acid baths, pin vises, toothbrushes, abrasive powders, air scribes, and adhesives. Pros and cons of each these suggest a single process flow to apply when discovering which techniques to apply to each fragment.

Wednesday 2:30

THE CHALLENGES OF MOLDING PALEOZOIC FOOTPRINTS AT A REMOTE, HIGH ALTITUDE SITE

SMALL, Bryan, Denver Museum of Nature & Science, Denver, CO

During the summers of 2002 and 2003 the Denver Museum of Nature and Science made two trips to a recently discovered Early Permian (Maroon Formation) vertebrate track site in the Elk Mountains, Maroon Bells Wilderness Area (White River National Forest), near Aspen, Colorado. The site is at 3,600 meters (11,800 feet) altitude, in rugged mountainous terrain with no maintained trails leading to the site. The tracks occur in large multi-ton blocks that have fallen into a glacial cirque from above. The vertebrate ichnotaxa represented are *Ichniotherium cottae*, *Dimetropus* sp., *Varanopus* sp., and *Tambachichnium* sp., along with invertebrate traces and plant impressions.

Fossil collecting is prohibited in the Maroon Bells Wilderness Area. The collecting prohibition, large size of the blocks, and difficult site access make recovery of the actual tracks impossible, so a decision was made to use molding latex to make a record of the prints. However, time constraints and cold, unsettled high altitude weather make latex mold making difficult, so the Accelerated Curing of Latex Peels method of Hamley and Thulborn was used. This process involves the application of dilute acetic acid to the latex to accelerate curing. The process should take 5-10 minutes between coats, but the cold, moist weather conditions slowed even the accelerated curing process to 20-30 minutes. Although we camped overnight in order to increase working time, fewer coats than were needed were applied due to the slow curing rate, causing some flattening of the molds after removal. Acetic acid impregnated burlap was incorporated into the backs of the molds as an improvised stiffener, since rigid mother molds were impractical to pack out of the site. This approach resulted in successful casts and, com-

bined with extensive photo documentation, provided adequate information for research and exhibition purposes.

Saturday 2:00

FIRST REPORT OF TETRAPOD TRACKS FROM THE MESETA BLANCA MEMBER OF THE LOWER PERMIAN YESO FORMATION, CENTRAL NEW MEXICO

SMITH, Joshua, LUCAS, Spencer, HUNT, Adrian, New Mexico Museum of Natural History and Science, Albuquerque, NM; SCHNEIDER, Joerg, Freiberg Univ., Freiberg, Germany

The Meseta Blanca Member of the Lower Permian Yeso Formation in central New Mexico is a 70-m thick sequence of fine-grained, quartz-rich sandstone and minor intercalated siltstone. It holds up the Los Vallos Member of the Yeso Formation and has an interbedded contact with the underlying Abo Formation. Meseta Blanca sandstones are mostly trough cross-bedded, frequently display climbing ripples, and represent eolian and fluvial deposits of a marginal marine setting. Oxidized plant remains are present in the form of compressed trunks up to 5 cm in diameter, and the thall's green algae *Schizopteris* is reported for the first time from red beds as a complete 30x30 cm brush possibly attached to a plant trunk. The lower surfaces of sandstone beds often preserve casts of mudcracks, salt crystals, and mm-sized invertebrate traces. Common *Scoyenia* burrows indicate moderately wet conditions of a semiarid climate.

Tetrapod tracks recently discovered in the Meseta Blanca Member are the first indication of vertebrate traces from the Yeso Formation. Tracks were found throughout the entire Meseta Blanca section, as well as in the interbedded zone of the Abo-Yeso contact. The Yeso tetrapod ichnofauna includes three medium- to large-sized tracks and at least one small form. The best-preserved trackway is of a quadruped with a relatively small manus imprint that shows consistent overstepping, with the manus imprints immediately posterior to the pedal imprints. The pedal impressions have a pace angulation greater than 90 degrees and are positively rotated, with blunt toes and a long heel. The manus impression is wider than long. We tentatively assign this trackway to *Limnopus* sp. Several large tracks preserve narrow, elongate digits, and we assign them to *Dimetropus* sp. A single, isolated pedal(?) impression is wider than long, preserves five, short digit impressions and is assigned to *Amphisauropus* sp. Smaller tracks are rare, and some may be referable to *Batrachichnus*, whereas others may represent *Dromopus*. The presence of *Amphisauropus* indicates an alluvial plain ichnofacies that is typical of portions of the subjacent Abo Formation.

Poster Session B

MORE TRAVELS IN STROMER'S FOOTSTEPS: LATE CRETACEOUS VERTEBRATES FROM THE NILE VALLEY, EGYPT

SMITH, Joshua, NOVAK, Stephanie, Washington Univ. Earth & Planetary Sciences, St Louis, MO; ISSAWI, Bahay, Egyptian Geological Museum, Cairo, Egypt

Latest Cretaceous (Campanian-?Maastrichtian, ~70 Ma) African tetrapods are very poorly known, and are best represented by a few finds from Dahkla and Kharga oases and the Nile Valley near Mahamid, Egypt. Most of the Nile Valley record was amassed by E. Stromer and colleagues in the early 20th Century. As with Stromers collection from the Cenomanian (~97Ma) of Bahariya Oasis, the majority of his Nile Valley fossils (including all tetrapods) were destroyed during WWII (46 specimens, mostly fish teeth, remain). Several specimens were subsequently described by S.E. Nakkady, but their present location is uncertain. As problematic, later authors have had difficulty in pinning down from which specific stratigraphic horizon the remains came, and beginning with Stromer's papers, ages ranging from Cenomanian to Maastrichtian have been applied to the strata in question (this has been complicated by landscape modifications from phosphate mining in the last decade). No Cretaceous rocks older than Campanian are currently thought to crop out near Mahamid. In March of 2005, as the initial phase of a new project to better understand the latest Cretaceous of Egypt in the western and eastern deserts, we prospected the Upper Cretaceous nearshore and coastal sequence (the Campanian Nubia Formation and the overlying Maastrichtian Duwi Formation) exposed in the Mahamid area to the east of the Nile. We identified productive horizons at the base of the Duwi and discovered phosphatic bonebeds in the upper Quseir Member of the Nubia. The most promising of the Quseir localities is 25.9 meters below the base of the Duwi and provides us with precise stratigraphic information for Nile Valley Cretaceous fossils for the first time. The material from the Duwi consists of shark and fish teeth. At the Quseir localities we discovered shark, bony fish, and mosasaur teeth, as well as turtle, crocodyliform, and putative dinosaur remains. Preservation quality is very good and as the tetrapods are among youngest the known from Africa, the Mahamid area looks to be quite promising.

Poster Session B

MAMMALS OF THE MONARCH MILL FORMATION AT EASTGATE, CHURCHILL COUNTY, NEVADA

SMITH, Kent, Oklahoma State Univ., Tulsa, OK

The first Eastgate locality (Churchill County, Nevada) was discovered by D. I. Axelrod in the late 1950s. Since the initial discovery of fossil vertebrates at Eastgate, researchers from the Univ. of California at Berkeley (D. E. Savage, J. H. Hutchison) and the Univ. of Oklahoma (K. S. Smith, N. J. Czaplewski) have collected fossil remains from the rock exposures of the Monarch Mill Formation near the town of Eastgate. In 1995, a Univ. of Oklahoma based expedition recovered fossil remains from numerous localities. Fossils were collected from the volcanic tuffs that occur in the basalmost section of the Monarch Mill Formation. To date, nearly 20 localities within the Monarch Mill Formation have revealed fossil vertebrates.

The Eastgate local fauna represents a very diverse, early Barstovian (Miocene) assemblage of mammals, fish, amphibians, reptiles, and birds. The focus of this study was the alpha taxonomy of the mammals from Eastgate, which included Insectivora (plesiosoricids, talpids, heterosoricids, soricids), Chiroptera (chiropterans), Lagomorpha (ochotonids, leporids), Rodentia (aplodontids, mylagaulids, sciuirids, castorids, eomyids, heteromyids, geomyids, zapodids, cricetids), Carnivora (canids, procyonids, mustelids, felids), Artiodactyla (dromomerycids), and Perissodactyla (equids, chalicotheriids, rhinocerotids). Several new taxa of mammals from Eastgate are likely, and at least one rodent *Apeomyoides savagei* has been described as new and is endemic to Eastgate.

Wednesday 9:15

BETA DIVERSITY IN ANCIENT AND MODERN BIOTAS

SMITH, Krister, Yale Univ., New Haven, CT

The difficulty in discerning true patterns in past biodiversity is symptomatic of the more specific problem of deconvoluting spatial from temporal patterns in the fossil record. But how species richness changes through space—beta diversity, broadly construed—is itself an important desideratum in ecology, and one from which the search for global patterns has distracted us. This is unfortunate, for the fossil record presents a huge repository of diachronic data that could meaningfully be accessed for testing ecological hypotheses, yet we lack many tools that would help us do so.

Here I present a new metric for beta diversity. The method is predicated on the observation that the fossil record consists of more or less isolated localities. Numerical methods are used to estimate the path of minimum length that connects all coeval localities of interest (by analogy with species-area curves). Either specimen data or choropleth maps may be used to generate species occurrence data. Cumulative species richness and cumulative distance are then measured along the path. Remarkably, the resultant graph appears to be a line in linear space, and I suggest that the slope of this line be taken as beta diversity.

The method is applied to the Australian squamate fauna, which generally shows high alpha and low beta diversity, and to the mammal fauna of the United States, demonstrating that the metric should be meaningful in modern ecological studies. Application to the fossil record, like the use of modern specimen data, requires only that the data be normalized by a simple rarefaction-like procedure. The new metric should contribute to the further unification of paleo- with neoecology and promote the temporal expansion of ecological theory.

Wednesday 1:45

THE USE OF CASTS WITHIN NOVEL EXHIBIT DESIGNS

SMITH, Matthew; FREMD, Theodore; KILPATRICK, Cindy, John Day Fossil Beds National Monument, Kimberly, OR

Use of paleontological casts in museum exhibits can take many forms. Here we concentrate on two separate examples where casts were utilized as design elements in the Thomas Condon Paleontology Center. In one instance casts of museum specimens were used in an outdoor sculptural installation to introduce visitors to iconography that would follow the visitor throughout their museum experience. These icons act as a touchstone that provides the visitor with temporal orientation and the spatial extent of geologic deposits across the state of Oregon.

In a different exhibit casts of museum specimens from a variety of institutions and North American localities are used to draw attention to the species diversity and temporal extent of fossil equids from Oregon. Through the use of color these casts highlight specimens that were collected within the John Day Basin. Although they may be less visually impressive than the material collected elsewhere, they are very biostratigraphically significant. Additionally many of the equid casts are used in the park's Horse Fossil Study Kit which is sent out as an educational tool to schools around the nation. The use of these various casts within exhibit media allows development of designs that would not have been possible with the use of actual fossil material due to curatorial constraints.

Poster Session B

OSTEOLOGY AND PHYLOGENETIC RELATIONSHIPS OF *CRYOLOPHOSAURUS ELLIOTI* (DINOSAURIA: THEROPODA): IMPLICATIONS FOR BASAL THEROPOD EVOLUTION

SMITH, Nathan, Univ. of Iowa, Iowa City, IA; HAMMER, William, Augustana College, Rock Island, IL; CURRIE, Philip, Royal Tyrell Museum of Palaeontology, Drumheller, AB, Canada

The Lower Jurassic Hanson Formation in the Central Transantarctic Mountains has yielded a diverse terrestrial fauna, including tritylodonts, pterosaurs, prosauropods, and *Cryolophosaurus ellioti*, which is the most complete non-avian theropod from Antarctica. *Cryolophosaurus* possesses a suite of morphological characters intermediate with respect to basal theropods and more derived members of Tetanurae. The phylogenetic position of *Cryolophosaurus* has varied in several studies, but all have been consistent in placing *Cryolophosaurus* as the oldest member of Tetanurae. Here we provide an in-depth osteological description of new and previously collected materials of *Cryolophosaurus*. We also discuss the phylogenetic placement of *Cryolophosaurus*, and the implications these relationships hold for early theropod evolution.

The nasals possess inclined lateral ridges that are pinched posteriorly between dorsal expan-

sions of the lacrimals. The prefrontal contributes slightly to the anterodorsal rim of the orbit. The anterior process of the jugal is expanded dorsoventrally below the lacrimal, and has a distinct jugal antorbital fossa. The paraoccipital processes are robust and strongly backturned. A single opening is present for the trigeminal nerve, as in most basal theropods. The surangular is tall dorsoventrally, and possesses a robust lateral ridge.

The posterior cervical and dorsal vertebrae are amphiplatyan, with strongly constricted centra. One pair of pleurocoels is present on the cervical centra. The ilium possesses a large ischial peduncle and a narrow brevis fossa. The pubis has a well-defined obturator foramen, but the subacetabular plate is not extensive. A well-defined distal 'boot' is present on the ischium, and a distinct posterodorsal crest on the ischial shaft is similar to that of several basal tetanurans. The femoral head is directed anteromedially, and the proximal femur possesses a low, weakly developed lesser trochanter. The calcaneum and astragalus are not fused to each other, or to the tibia and fibula. Posteriorly, the distal articulation of the fibula is confined to the calcaneum, and the distal tibia does not extensively back the calcaneum.

Poster Session B

ACQUIRING 3-D DATA FROM SMALL MAMMALIAN TEETH: LASER SCANNING EOCENE MARSUPIALS

SMITH, Nicholas, STRAIT, Suzanne, NEFF, David, Marshall Univ., Huntington, WV

Recent technological advancements have yielded various methods of 3-D data acquisition that permit more sophisticated and accurate measurements of paleontological specimens. This study assessed the relative ability of one technique, laser scanning, to acquire 3-D data from small mammalian specimens. Specifically, data were collected on accuracy and precision using a LDI RPS 120 probe, mounted on an ISEL, tri-axial automated stage. Additionally, to highlight the potential of this method for both phylogenetic and functional studies, 3-D analyses of dental morphology were made on a sample of sympatric Eocene marsupials.

To determine accuracy, a machine-tooled screw with a known thread pitch of 250 microns and a sphere were used as a test objects. The scanner, emitting a spread laser beam (670 nm), probed the objects within predefined limits. The reflected light was collected by two CCD arrays, and via triangulation, a 3-D point cloud was generated. These data were then exported into Geomagic Studio 6.0, where a 3-D polygonal surface model was rendered. The number of polygons was decimated by 90%, while still maintaining the integrity of the model. These surfaced models were then exported into Autocad 2000i for measurement.

These data suggest that the 10-micron step size is the most effective for small specimens (< 2.5 mm). The manufacturer claims an accuracy of ± 0.00635 mm, and our error study indicates an accuracy of ± 0.001 mm, and a repeatability of ± .0005mm for linear measurements.

Scans were made of four small marsupial species from a single earliest Eocene (Wa-0) locality (UCMP V99019, Castle Gardens) in the Bighorn Basin, Wyoming. Measurements from these scans allowed for traditionally qualitative taxonomic characters to be assessed quantitatively (e.g., angle of entoconid notch). Additionally, relative molar shearing was calculated and comparisons with extant marsupials demonstrated that all these taxa were primarily faunivorous. However, there was sufficient variation in shearing crest development between the species to be suggestive of dietary niche partitioning.

Saturday 1:45

NOTES ON A SPECIES OF RHIZODONT FROM IOWA, AND DIRECTIONS FOR FURTHER RESEARCH IN THE STUDY OF RHIZODONTS AND THE TRANSITION OF VERTEBRATES TO LAND

SNYDER, Daniel, Univ.of Iowa, Iowa City, IA

Rhizodonts have been hypothesized to lie close to but outside of Tetrapodomorpha. To understand the ancestral conditions of the first terrestrial vertebrates, it is crucial to understand rhizodont morphology. This study will focus on a Lower Mississippian taxon, previously known but not described from the same Iowa site known for the enigmatic tetrapod *Whatcheeria deltae*. Reconstruction of the rhizodont's cranium shows that it is similar to other rhizodonts from this time period known from North America and may be a member, or a close relative, of *Strepsodus*. A bone from the posterior of the cranium is strongly suggestive of an exoccipital similar to that seen in the tristichopterid *Mandageria fairfaxi*. If correct, this diagnosis forces a reappraisal of the rhizodont endocranium, which had previously been supposed to be unossified. An unusual bone in the mouth of one specimen appears to be exogenous, suggesting a prey item. Evidence for choanae in the rhizodont is highly equivocal.

Poster Session A

THE RACE TO RESTORE THE FIRST COMPLETE SAUROPOD SKELETON: THE 1905 AMNH MOUNT OF *APATOSAURUS*

SOUTHWELL, Elizabeth, BREITHAUPT, Brent, Univ. of Wyoming, Laramie, WY;
WEEGE, Christopher, EnCana Oil and Gas (USA), Inc, Denver, CO

The history of the discovery, restoration and public display of the American Museum of Natural History's original *Apatosaurus* mount provides an interesting glimpse into the media excitement and fierce scientific competition created by early 20th century paleontology. The partially articulated specimen (AMNH 460) was discovered in 1898 by W. P. Granger alongside the wagon road at the Ninemile Crossing of the Little Medicine Bow River in southern Wyoming. The following summer over 100 scientists visited the excavation site and national newspapers and magazines enthralled the general public with the latest paleontologic news from the "wild and wooly West." Pittsburgh's Carnegie Museum was also in Wyoming in 1899 excavating its own sauropod skeleton: *Diplodocus carnegii*. The two museums then began a race to be the first to restore and mount their respective dinosaur giants as the centerpiece exhibit of their brand new display halls.

Because the *Apatosaurus* was the largest and heaviest fossil specimen that had, at that time, ever been mounted, A. Hermann spent three years on the preparation of the fragile bones and on the mechanical difficulties of erecting a 17-ton mount. W. D. Matthew and Granger studied alligator anatomy to correctly pose the limbs. Missing parts were casted, erroneously in the case of the head. C. Knight's models and front-page images of the restored animal bolstered the public's interest and created intense anticipation of the completed exhibit. A "Dinosaur Tea", hosted by AMNH trustees and their wives, was held in Feb., 1905, to celebrate the grand opening of the new Dinosaur Hall and the unveiling of its prize *Apatosaurus* mount. Although the Carnegie Museum had created a temporary mount of its *Diplodocus*, that skeleton was then dismantled for molding and casting, making the AMNH sauropod the first complete, permanent mount in the world. Interest in the Ninemile *Apatosaurus* continues with the relocation and work in the original quarry and the specimen's remounting in the 1990s.

Poster Session B

THE TERRESTRIAL VERTEBRATE FAUNA OF THE UPPER TRIASSIC (RHAETIAN) REDONDA FORMATION

SPIELMANN, Justin, HUNT, Adrian, LUCAS, Spencer, HECKERT, Andrew, New Mexico Museum of Natural History and Science, Albuquerque, NM

The tetrapod body fossil assemblage of the Redonda Formation in east-central New Mexico characterizes the Apachean land vertebrate faunachron (lvf), the youngest of the Late Triassic lvfs, and is interpreted as a near-terminal Triassic fauna.

The terrestrial vertebrate fauna is diverse and includes metoposaurid amphibians, phytosaurs, aetosaurs, sphenosuchians, theropods, and the enigmatic archosauromorph *Vancleavea*. Smaller tetrapods are also present in the form of a possible cynodont, a sphenodontid, and a procolophonid.

Phytosaurs dominate the Redonda fauna. Their remains include extensive skull material of two morphs of *Redondasaurus*, various post-crania, and isolated teeth. Overall the phytosaur fauna is thought to include *Redondasaurus gregorii* and at least one other species. The metoposaurid amphibian *Apachesaurus gregorii* is locally common in the Redonda. Representative fossils include the holotype skull, more fragmentary skull material, isolated portions of the axial skeleton, nearly complete clavicles, and a complete ilium. Aetosaurs are represented by various osteoderms and osteoderm fragments. These represent at least three taxa, *Redondasuchus reseri*, a *Typothorax*-like form, and another taxon characterized by thin, small, nearly unornamented osteoderms. Sphenosuchians include the giant *Redondavenator* and an isolated *Dibrothrosuchus*-like cervical vertebra. Theropod material from the Redonda consists of isolated teeth and fragmentary limb material. The enigmatic archosauromorph *Vancleavea* is represented by isolated osteoderms.

Overall, the Redonda fauna is notable because: (1) several taxa (phytosaur, aetosaur, sphenosuchian) are of very large body size (among the largest known for each group); (2) the fauna has the overall aspect of Carnian-Norian tetrapod faunas in being dominated by phytosaurs, metoposaurs, and aetosaurs, in contrast to broadly contemporaneous faunas in South America, South Africa, and Europe that are dinosaur dominated; and (3) the Redonda is unusual in preserving Late Triassic vertebrate fossils in a range of taphofacies from shallow water lacustrine to paleosol.

Wednesday, Preparator Poster

THE DISCOMBOBULATED COLLECTION: TURNING A CURATOR'S NIGHTMARE INTO A RESEARCHER'S DREAM

SROKA, Steven, FINLAYSON, Heather, BENNIS-SMITH, Mary Beth, Utah Field House of Natural History, Vernal, UT

Since 1948 the Utah Field House has been collecting natural history items primarily from northeastern Utah. Prior to this century, these collections have not been curated to modern standards, resulting in a plethora of problems. These problems can be summarized into four main categories: space issues, care, cataloging, and record keeping. Past curators tried to deal with these issues but no comprehensive plan dealt with the problems in a consistent manner. A new museum facility and a partnering with the NPS to build a new repository, allowed for a renewed interest in collection care and management.

Many specimens were piled in wooden drawers two layers high or in non-archival boxes. These items were stored in a four-foot high crawl space in the old facility, accessible only by narrow stairways. Through a BLM grant, the museum purchased modern metal cabinets that can be retrofitted to space saver units. The cabinets were placed in the old exhibit halls, eliminating the need for the crawl space. Trimming off excess matrix from specimens, putting them in archival boxes and reorganizing them into a system that meets the partnership criteria, resulted in a more efficient use of limited space within the old building and the new cabinets.

New staff was challenged by problems with past cataloging and record keeping systems. Some specimens had no numbers or as many as four, and accession and catalog numbers were used interchangeably. Furthermore, many specimen numbers were transcribed, duplicated, or undecipherable. After some discussion, it was decided to start over with a new acronym (FHPR) and new catalog numbers for all specimens in the collections. In the past, associated

records were not kept together or were non-existent for most specimens, with the exception of recent acquisitions. All records are now organized by accession number and kept in a fireproof file cabinet; however, many specimens still exist without any locality information or data, making them of limited value. Proper curation of the collection as a whole provides a more valuable asset to researchers and educators, especially as we move toward the new repository.

Poster Session B

PANTODONTS (MAMMALIA) FROM THE EARLY TIFFANIAN (PALEOCENE) OF THE CRAZY MOUNTAINS BASIN, MONTANA

ST CLAIR, Elizabeth, KRAUSE, David, BOYER, Doug, Stony Brook Univ., Stony Brook, NY

Pantodonta is a clade of large eutherian mammals known from the Paleocene and Eocene of North America, Europe, and Asia. Two genera have been identified from late Torrejonian (To) and early Tiffanian (Ti) land mammal age sites in the Crazy Mountains Basin (CMB), Montana: 1) *Pantolambda*, which is known from biochron To3 (but has tentatively been identified from the earliest Ti elsewhere); and 2) *Titanoides*, which has been described from both the To and Ti, though there is some consensus that the sole Torrejonian representative, *T. simpsoni*, is a subjective synonym of *Pantolambda intermedium*.

Between 1983 and 1993, pantodont fossils were collected from early Ti deposits in the CMB. These include approximately 20 whole or partial teeth and several unassociated postcranial elements from Glennie Q, Bingo Q, Douglass Q (all Ti1), and Scarritt Q (Ti2), as well as a partial subadult mandible with three teeth and several tooth fragments from Paleosol Hill (Ti1). Material collected earlier from the CMB includes three previously described specimens from Douglass Q assigned to *Titanoides* sp., and an undescribed maxilla with M2-3 from the Pseudo-Scarritt Locality (Ti1 or Ti2).

It might be expected, on the basis of temporal and geographic context, that these fossils belong to *Titanoides*. Even within a single locality sample (Douglass Q) there is only mixed support for this hypothesis. For example, the relative size of the trigonid and talonid in the lower molars, and characteristics of the lower premolars resemble *Titanoides* (though p2 is smaller than that in contemporary *T. major*), but the presence of conules and shallowness of the ectoflexus in the upper molars are more similar to *Pantolambda*. The morphology of the m3 talonid, which possesses a distinct hypoconulid and entoconulid, is unlike that described for either genus. The taxonomic position and phylogenetic significance of these early Tiffanian pantodonts from the CMB, including determination of whether or not more than one taxon is represented, remains to be resolved through the collection of additional material and further analysis.

Friday 2:15

FAMILY-LEVEL COMPOSITION OF THE THOMAS FARM AVIFAUNA OF FLORIDA (EARLY MIOCENE; HEMINGFORDIAN LAND MAMMAL AGE)

STEADMAN, David, Univ. of Florida, Gainesville, FL

Only seven species of non-passerine birds (in six genera and five families) have been described previously from Thomas Farm, an early Miocene (Hemingfordian LMA) locality in northern Florida. Since the 1950s and continuing today, excavation crews from the Florida Museum of Natural History have produced many hundreds of previously unstudied bird fossils from Thomas Farm. These specimens represent at least 20 non-passerine species in 19 genera and 16 families. Thomas Farm (age ~18.5 Ma) is taxonomically richer in birds than any Arikareean, Hemingfordian, or Barstovian (~30 to 12 Ma) site in North America. Thus far, each of the non-passerine avian fossils can be assigned confidently to a living family of aquatic or terrestrial birds, although six of these families no longer occur in temperate North America, being confined to either the Old World or New World tropics. On the other hand, most if not all of the numerous fossils from Thomas Farm of Passeriformes (songbirds, which consist of more than 50% of the living genera and species of birds in North America and worldwide) seem to represent one or more extinct, undescribed families. Thus, at least in the northern hemisphere, the major family-level radiation of passerines apparently post-dates the Thomas Farm site. It probably began in the middle Miocene (~16 to 10 Ma), which is at least ~15 to 25 million years later than the family-level radiation of most non-passerine orders. The global fossil record of birds supports a Paleogene radiation of non-passerine birds followed by a dramatic middle Neogene radiation of Passeriformes.

Friday 10:45

NEW PALEOGENE MAMMALS AND OTHER VERTEBRATES FROM THE RUKWA RIFT BASIN, SOUTHWESTERN TANZANIA

STEVENS, Nancy, O'CONNOR, Patrick, Ohio Univ., Athens, OH; GOTTFRIED, Michael, Michigan State Univ., East Lansing, MI; ROBERTS, Eric, Idaho State Univ., Pocatello, ID; NGASALA, Sifael, KAPILIMA, Saidi, Univ. of Dar es Salaam, Dar es Salaam, United Republic of Tanzania

An abundance of Paleogene fossils has been recovered from deposits in North America, Europe, northern Africa, and increasingly from Asia. The relative scarcity of Paleogene specimens from sub-equatorial Africa has resulted in significant gaps for our global understanding of the evolutionary history and paleoecology of vertebrate terrestrial communities. Recent work in the Rukwa Rift Basin of southwestern Tanzania continues to provide windows into a diverse fauna including gastropods, crustaceans, fish, anurans, crocodilians, birds and small mammals. Numerous microsites within the study area reveal isolated and articulated postcrania, teeth and jaws. Mammal specimens recovered to date include representatives of at least three orders. Phiomorph rodents dominate the assemblage, including *Metaphiomys*, multiple species of *Phiomys*, and a new larger phiomorph represented by numerous teeth and jaws. Microsites have also revealed postcranial specimens of both anthropoid primates and macroscelideans. Many Tanzanian taxa appear to share close affinities with fossils recovered from the late Eocene and early Oligocene deposits of Egypt, Libya and Oman, supporting previous geological studies that have suggested a Paleogene age for some of the Red Sandstone Group deposits in this portion of the Rukwa Rift Basin. Yet other taxa appear unique, perhaps reflecting the geographic or temporal distinctiveness of this fauna. Such discoveries constitute an important bridge to Paleogene faunas in other locales. Moreover, these new finds extend the roots of East African Neogene taxa to document the rich fauna inhabiting the landscape prior to faunal exchange initiated by collision between the Afro-Arabian and Eurasian landmasses. Hence this expanding vertebrate assemblage offers insights for unraveling the evolutionary and biogeographic history of mammals and other vertebrates in this region.

Wednesday 8:15

PERMIAN TEMNOSPONDYLS FROM THE SAHARA SHOW EDOPOID COLONIZATION OF AFRICA

STEYER, J. Sebastien, CNRS-MNHN, Paris cedex 05, France; DAMIANI, Ross, Bernard Price Institute for Palaeont. Research, Johannesburg, South Africa; SIDOR, Christian, NYCOM, New York, NY; SMITH, Roger M.H., South African Museum, Cape Town, South Africa; O'KEEFE, F. Robin, NYCOM, New York, NY; LARSSON, Hans C.E., Redpath Museum, McGill Univ., Montreal, QB, Canada

Recent fieldwork in the Upper Permian of Niger (Moradi Fm.) led to the discovery of a remarkable tetrapod fauna, consisting of temnospondyls, a pareiasaur, a giant captorhinid, a probable actinopterygian, and a probable gorgonopsian. This endemic fauna is strikingly different from the other Permian ones: the herbivores are mainly captorhinids and pareiasaurs, whereas the carnivores are mainly temnospondyls.

The temnospondyls are the croc-like *Nigerpeton ricqlesi* and *Saharastega moradiensis*. *Nigerpeton* bears a unique dentition in an very elongate snout, with three large caniniform teeth on a maxillary bulge, inner premaxillary tusks, and anterior paired fenestrae piercing the skull roof for the mandibular tusks. *Saharastega* is very peculiar in possessing narrow, elongated, and transversely oriented nostrils, an extensive tongue-and-groove premaxilla-maxilla contact, and very large, lateroventrally directed tabular horns. A phylogenetic analysis shows that the Nigerien temnospondyls do not form an African clade, but share affinities with the edopoids, a clade of basal temnospondyls from the Upper Carboniferous-Lower Permian of Euramerica: *Nigerpeton* is the sister-taxon to the American *Chenoprosopus*, while *Saharastega* is the sister taxon to the edopoids+*Eryops*. Both are hence relicts of Carboniferous lineages that diverged 40-90 million years earlier.

These results suggest that edopoids were relatively widespread, dispersed across Central Pangaea at least twice, and had a longer history than previously realized. This distribution was later fragmented with the onset of Late Permian warming which restricted them to northern Africa. Coupled with a scarcity of therapsids, these findings suggest that faunas from the poorly sampled xeric belt that straddled the equator during the Permian differed markedly from well-sampled faunas that dominated tropical-to-temperate zones to the north and south. Our results show that longstanding theories of Permian faunal homogeneity are likely oversimplified as the result of uneven latitudinal sampling.

Poster Session B

A NEW LOOK AT OLDUVAI BIRDS (AVES, TANZANIA): A PLEISTOCENE AVIFAUNA IN THE CHANGING LANDSCAPE OF EARLY HOMININ EVOLUTION

STIDHAM, Thomas, Texas A&M Univ., College Station, TX

The Olduvai Gorge in northern Tanzania records a rich record of Oldowan stone artifacts and hominins deposited between approximately 2.0 and 1.7 Ma. Previous research has focused on paleoanthropology and the fossil mammals from this sequence. Renewed research by the Olduvai Landscape Paleoanthropology Project has produced a significant collection of fossil birds. Birds provide a new and different perspective on the reconstruction of the Olduvai paleolandscapes and the biogeography of the region. Previously, new species of extinct ostrich, pelican, owl, and cormorant have been described from Olduvai Beds I and II. The new collections of bird remains that are derived mostly from Bed II (1.79-1.71 Ma) and have been collected from an area greater than 200 square kilometers include pelicans, anhingas, cormorants, and in particular swans. These new fossils confirm previous reports of swans at Olduvai. This is important because swans are extinct in Africa today and the fossil Olduvai swans probably represent an extinct migratory population of Holarctic swans in Tanzania, south of the equator. The large number of waterbird specimens, especially divers, helps to indicate the past presence of permanent relatively deep water during the lake transgressive phase at approximately 1.79 Ma. The Olduvai avifauna is in many ways unique and differs significantly from penecontemporaneous Pleistocene avifaunas of South Africa. Likely this reflects the effect of the Zambezian Ecozone as a biogeographic boundary on birds (in addition to mammals) during this temporal interval. The presence of some ubiquitous species in South Africa and Olduvai (ostrich, greater flamingo, and barn owl) demonstrates that dispersal between eastern and southern Africa did occur. However, a certain level of endemicity seems to have been present

in the birds of the Olduvai Gorge and they help to emphasize the extraordinary vista that Olduvai provides of the African past.

Friday 12:15

DINOSAUR FEVER: ISOTOPIC EVIDENCE FOR LOCALLY ELEVATED TEMPERATURE SURROUNDING HEALING INJURIES IN HADROSAUR BONE

STRAIGHT, William, KARR, Jonathan, Duke Univ., Durham, NC; WOODWARD, Holly, Texas Tech Univ., Lubbock, TX; BARRICK, Reese, College of Eastern Utah Prehistoric Museum, Price, UT; TANKE, Darren, Royal Tyrrell Museum of Palaeontology, Drumheller, AB, Canada; DWYER, Gary, Duke Univ., Durham, NC

Bones bearing partially healed pathologies indicate that dinosaurs endured and recovered from fractures and other osteopathy over their lifetimes. Healing mechanisms differ between modern endotherms and ectotherms, particularly in the ability of endotherms to sustain elevated temperatures, sometimes for years, in tissue enveloping a healing injury to repel infection and speed repair. Where prolonged fever is associated with abundant new or repaired bone, the thermally sensitive oxygen isotopic ratio of the phosphate will preserve a record of localized relative warmth. A series of powder samples for isotopic analysis were collected along a 30-cm-long adult hadrosaur proximal caudal neural spine from the Campanian of Dinosaur Provincial Park, Alberta; this specimen bears two pathologies, one at its midpoint and another near the tip. The general profile of $\delta^{18}O$ measurements in non-pathologic samples of cortical bone shows warming (~4°C) from base to tip, with the coolest point about 7.5 cm above the base. Samples from the midpoint pathology are 1.3 per mil lower (5-6°C warmer) than adjacent non-pathologic bone and are warmer than bone near the tip; the tipward pathology is smaller but is also relatively warm. Additional pathologic specimens show similar isotopic deflections associated with partly healed pathologies. Diagenesis of these specimens can be ruled out by comparing isotopic values of adjacent cortical and cancellous bone, and by an evaluation of trace-element variation within the bone. While not necessarily mammalian in nature, hadrosaurine thermoregulatory mechanisms were evidently capable of sufficient homeostasis to maintain long-term fevers in damaged tissue and bone.

Wednesday 4:15

ECOSYSTEM EVOLUTION IN THE EASTERN MEDITERRANEAN DURING THE MIOCENE: CORRELATION BETWEEN FAUNAL, FLORAL AND CLIMATIC CHANGE

STROMBERG, Caroline, WERDELIN, Lars, Swedish Museum of Natural History, Stockholm, Sweden

The arrival of the hypsodont horse *Hipparion* in the Mediterranean region between 10.9 and 10.7 Ma has classically been thought to signal the concomitant spread of savannah vegetation across Europe and Asia Minor. However, current research indicates that this scenario is highly simplified. Data from tooth wear, stable carbon isotopes, and functional morphology suggest that late Miocene ecosystems in the eastern Mediterranean were more likely sclerophyllous woodlands or forests with rare grasses. The scarcity of grass macrofossils and pollen in Miocene sediments supports this interpretation. Thus, it is now believed that heightened levels of hypsodonty in ungulate faunas starting in the late Miocene (11-8 Ma) correlated with increased aridity and landscape openness, but not necessarily with the development of grass-dominated ecosystems.

To shed new light on the evolution of eastern Mediterranean ecosystems during the Miocene, we used phytolith assemblages preserved in direct association with faunas as a proxy for paleovegetation structure (grassland vs. forest). We extracted phytoliths and other biogenic opal from sediment samples from well known early to late Miocene (~20-7 Ma) faunal localities from the eastern Mediterranean region (Greece, Turkey, and Iran). Phytolith analysis shows that grass phytoliths (silica short cells) dominate phytolith assemblages from the early Miocene onward. Forest indicator phytoliths from dicotyledons and palms are also present, but have become rare by the late Miocene (9-7 Ma). Grass short cell assemblages, consisting largely of pooid morphotypes, show that diverse C_3 grasses dominated grass communities throughout the Miocene; this analysis is consistent with evidence from stable carbon isotopes from paleosols and ungulate tooth enamel. Although only a tentative interpretation of habitat openness is possible at present, phytolith data indicate that open-habitat C_3 grasses formed an important part of ecosystems in the eastern Mediterranean region >7 million years before hipparionine horses reached Europe and arid conditions ensued, as judged by hypsodonty levels.

Student Poster Session

EVIDENCE FOR A VERY COMPLEX TAPHONOMIC HISTORY OF THE EARLY CRETACEOUS CRYSTAL GEYSER DINOSAUR QUARRY, EAST-CENTRAL, UTAH

SUAREZ, Celina, Temple Univ., Philadelphia, PA

The Crystal Geyser Dinosaur Quarry (CGDQ) is located southwest of Green River, Utah in early Cretaceous (Barremian) sediments of the Yellow Cat Member, Cedar Mountain Formation. The ~1 m thick bone-bearing unit contains a large, near-monospecific assemblage of basal therizinosauroid dinosaurs. The CGDQ has a very complex taphonomic history. Classical methods of taphonomic analysis were supplemented by REE analysis of fossils in CGDQ. Lithologic evidence (pisolites and travertine) suggests fossil accumulation in a spring environment. Bones accumulated in four units likely representing at least three distinct fossilization events or environments, possibly separated by thousands of years. Bones in Units 1 and 2 are flat lying. Based on variability in REE signatures, partially to fully fossilized bones were significantly spatially averaged by erosion, transportation, and redeposition in these units, whereas bones in Unit 3 were fossilized in-situ. Bones in Unit 4 are vertically oriented due to trampling, and may have been reworked from Unit 2 or fossilized separately in a calcareous paleosol horizon. The distinct mass mortality events that concentrated therizinosaur bones at the site suggest that therizinosaurs may have frequented this area and/or that some trapping/mass mortality mechanism caused these animals to die in great numbers. The occurrence of several near monospecific therizinosaur bone accumulations suggests gregarious behavior. This may be supported by a newly discovered site less 0.7km from the CGDQ that also contains a large quantity of therizinosaur bones. Bone size variation suggests that these animals lived in groups which included hatchlings to adults. The paleoenvironment in which the CG therizinosaurs are found is different from that of the Asian therizinosaurs. Pedogenic carbonates in the CGDQ suggest a semi-arid to semi-humid or seasonally dry environment with small springs or streams, whereas bones from Asia are often found in wetter environments, such as lacustrine or fluvial sandstones and conglomerates.

Student Poster Session

DEPOSITIONAL ENVIRONMENTS OF THE CRYSTAL GEYSER DINOSAUR QUARRY: AN UNUSUAL DINOSAUR IN AN UNUSUAL ENVIRONMENT

SUAREZ, Marina, Temple Univ., Philadelphia, PA

The Crystal Geyser Dinosaur Quarry (CGDQ) is at the base of the Early Cretaceous (Barremian) Yellow Cat Member of the Cedar Mountain Formation, near Green River, Utah. The quarry fauna is a nearly monospecific accumulation of Therizinosauroid theropods. Therizinosauroids are unusual theropods, mostly known from Asia, and noted for their long recurved claws, small teeth, and large bodies.

The CGDQ consists of a basal, bone-bearing limestone; bone-bearing, sandy mudstone unit; interbedded sandy mudstone and limestone; and a silicified limestone caprock. The basal carbonate consists of a micritic limestone with clay clasts, pebbles, and dinosaur bones. This limestone layer has a maximum thickness of 12 cm and laterally pinches out to a pisolitic horizon. The overlying bone-bearing mudstone consists of smaller clay clasts, pisolites, isolated pebbles, carbonate nodules and concretions. The nodules and concretions increase toward the top of the bone-bearing mudstone. Bones are often encrusted with micritic calcite, and some concretions contain dinosaur bone or bone fragments. The interbedded mudstones and limestones above the main bone-bearing units coarsen upward with cross-bedding toward the top. The caprock is a silicified micritic limestone, which contains stromatolitic structures and/or tufa mounds, and small spelean-like vertical structures.

Petrographic analysis of the carbonates reveals a variety of calcite morphologies including spherulitic crystals, feather dendrites, and tufa clasts. These morphologies, along with associated macroscopic features, including pisolites and travertine banding, suggest that the CGDQ was preserved in or near a spring. Relatively few dinosaur bone-beds have been described from spring deposits. The association of this unusual dinosaur with an unusual environment may have behavioral or paleobiological implications for understanding this species.

Wednesday 5:00

THALATTOSAURS (REPTILIA: DIAPSIDA) FROM THE LATE TRIASSIC (CARNIAN) OF NEVADA AND THEIR PALEOBIOGEOGRAPHIC SIGNIFICANCE

SUES, Hans-Dieter, National Museum of Natural History Smithsonian Institution, Washington, DC; CLARK, James, George Washington Univ., Washington, DC

Thalattosaurs (Thalattosauriformes) are a clade of small to medium-sized marine diapsid reptiles known from the Middle to Late Triassic of East Asia, Europe, and North America. We have recovered numerous skeletal remains referable to this group from what appears to be a single limestone horizon in the lower member of the Natchez Pass Formation on the southern side of Buffalo Mountain in Humboldt County, northwestern Nevada. The age of the fossiliferous horizon is early Late Triassic, specifically early Carnian, and is well-constrained by marine invertebrates. Most of the thalattosaurian specimens are isolated, well-preserved cranial and postcranial bones, but articulated cranial remains have been recovered. The majority of the already prepared material represents a new taxon closely related to the claraziid *Hescheleria ruebeli* Peyer, 1936 from the Anisian-Ladinian Grenzbitumenzone of Monte San Giorgio, Switzerland. The new form is characterized by a strongly deflected premaxillary rostrum, indicating that Peyer's original reconstruction of the skull of *Hescheleria* was accurate in this respect. The premaxilla is devoid of true teeth, as in *Thalattosaurus* and unlike *Hescheleria*. The presence of a *Hescheleria*-like claraziid thalattosaur in Carnian-age strata in Nevada is consistent with other evidence suggesting faunal ties between the western Tethys and the eastern Pacific realm during the Middle and early Late Triassic.

Wednesday 8:30

STRUCTURE AND FUNCTION OF THE TARSUS IN CRUROTARSAN AND PROTEROCHAMPSID ARCHOSAURS

SULLIVAN, Corwin, Harvard Univ.Museum of Comparative Zoology, Cambridge, MA

The ankle joint is a major contributor to propulsion in walking tetrapods, but the exact mechanism by which the ankle generates force varies among taxa. In "high walking" crocodylians the ankle normally undergoes simple plantarflexion, with increased leverage provided

by a posterior calcaneal tuber. However, in order for this mode of force generation to be effective, the metatarsus must remain aligned with the direction of forward movement throughout the stance phase. Three-dimensional analysis of cineradiographic footage of walking *Alligator mississippiensis*, using the animation package Maya 5.0, shows that a combination of rotation at the knee joint and long-axis rotation of the femur allows the metatarsus to maintain its orientation despite the tendency toward lateral rotation imposed by the alligator's partly sprawling posture. Cineradiographic footage of *Varanus exanthematicus*, by contrast, confirms reports that the metatarsus of lizards rotates laterally on the substrate and is then everted, as well as plantarflexed, to propel the animal forward. The moment arm of the peroneus musculature with respect to this eversive movement is increased by the proximally expanded fifth metatarsal and, in some lizards, by a lateral process on the calcaneum. Both osteological features are present in proterochampsids, which probably represent the nearest outgroup to crown-Archosauria, and other basal archosaurs. Furthermore, the calcaneum of proterochampsids was fixed with respect to the crus, rather than integrated with the pes and forming mobile articulations with the fibula and astragalus as in crocodylians and other crurotarsan archosaurs. Proterochampsids probably bore a closer resemblance to *Varanus* than to *Alligator* with respect to tarsal kinematics, despite lacking the specialized ridge-and-groove articulation between the calcaneum and the fourth distal tarsal that facilitates eversion in *Varanus*. The subsequent appearance of the crurotarsan ankle joint primarily involved changes in the structure and articular relationships of the calcaneum.

Wednesday 1:45

EVIDENCE-BASED PALEOPATHOLOGY II: IMPACT ON PHYLOGENETIC ANALYSIS OF THE GENUS *DIMETRODON*

SUMIDA, Stuart, California State Univ.San Bernardino, San Bernardino, CA; REGA, Elizabeth, Western Univ. of Health Sciences, Pomona, CA; NORIEGA, Ken, California State Univ. San Bernardino, San Bernardino, CA

Historically, the majority of characters utilized in the phylogenetic analysis of fossil vertebrates have been grossly visible, external morphological characters. More recently advances in scanning technology and the utilization of serial thin sections have added internal and histological features that that traditional dataset. Despite this, the limitations of available specimens still restrict most analysis to those of normal, adult animals. By assessing the condition in a pathological specimen of the Early Permian pelycosaurian-grade synapsid *Dimetrodon gigan-homogenes* (FMNH UC1134), additional important information was revealed. Among other things this species is characterized by a subrectangular cross-section of part of the neural spines that support the dorsal sail. Histological analysis of normal and pathological sections of the spines shows a series of lines of arrested growth (LAGs) that are subrectangular superficially, but dumbbell-shaped in deeper (younger) layers, suggesting strongly that cross-sectional shape of the spines may be an ontogenetic feature. This in turn might provide a greater degree of resolution to the analysis of this feature, one often used to distinguish different species within the genus. This preliminary analysis points out three other important points: (1) although phylogenetic context is a critically important feature in generating hypotheses of the evolution of functional complexes, function and ontogeny can also provide phylogenetic data; (2) response to insult in *Dimetrodon* is quite different from that in more advanced mammalian-grade synapids. While not surprising give the hundreds of millions of years separating them, it leads to point (3). Many diagnoses of pathological specimens from the fossil record depend solely on radiographic comparison with extant humans. If extant Homo sapiens is not even comparable to another basal synapsid, then diagnoses based on human radiological models for taxa as phylogenetially distant as dinosaurs demand an unrealistic degree of convergent evolution, an oversimplified view of the evolution of infection and response to insult, and ignore the utility of histological data that are becoming an important new component of vertebrate paleontological study.

Poster Session B

RECENT MID AND EARLY PLEISTOCENE VERTEBRATE DISCOVERIES FROM GRAIN VALLEY, MISSOURI AND BELOIT, KANSAS

SUNDELL, Craig, Midwest Paloentological Institute, Lawrence, KS; MARTIN, Larry, Univ. of Kansas Natural History Musuem, Lawrence, KS

During July-Oct 2004 a new Pleistocene vertebrate locality was discovered and excavated on Sni-A-Bar Farms property in Eastern Jackson Co., MO. About 10% of a single adult mammoth was found in situ along with elements of *Equus*, a partial cervid antler and skullcap, ground sloth (*Megalonyx*) teeth, armadillo scutes and two rodent femora. The site is in situ below 15m of clay and lying atop reworked Pennsylvanian gravel. This is important since most Pleistocene fossils from the Missouri-Kansas area are displaced and deposited along large rivers and do not have taphonomic context. A single molar from *Mammuthus* was recovered and is extremely primitive in form. It has only 4 dental plates per 10cm. The presence of this primitive molar suggests an age of 500,000 years b.p. or older. The presence of the armadillo scutes support an interglacial designation.

In June 2004, L.D. Martin, Gail Pearson, Craig Sundell and Harry Bartholomew located a new Pleistocene microvertebrate locality in Mitchell Co., KS. Since the initial discovery, more than 5,000 bones and teeth have been recovered using wet screening techniques from the original site (S-1) and a second site 100m to the north (C-1). The S-1 site has a primitive *Microtus* with three alternating triangles and a simple anterior loop. The C-1 site seems to be later in age. A tentative age greater than 500,000 years b.p. is indicated for S-1. A diverse fauna with at least seven different kinds of rodents, five different kinds of amphibians, five different kinds of snakes, five different kinds of lizards, two different kinds of turtles, six different kinds of fish, two different kinds of birds, one small carnivore, and one insectivore have been found so far. An extensive sample of molluscs and gastropods have been collected. These sites represent a new and important set of Pleistocene microfaunas for a time interval that is not well known from Kansas and from a region where there are few other Pleistocene localities. They appear to be samples from interglacial intervals.

Friday 11:00

A REAPPRAISAL OF THE GENUS OF NORTH AMERICAN FOSSIL ERETHIZONTIDS (PORCUPINES)

SUSSMAN, David, CROXEN, Fred, Arizona Western College, Yuma, AZ; SHAW, Christopher, The Page Museum at the La Brea Tar Pits, Los Angeles, CA

By three million years ago, the formation of the Panamanian Land Bridge had allowed several previously restricted South American taxa to migrate into North America. Porcupines (Family Erethizontidae) are thought to have been among these immigrants.

In his 1970 review of the fossil porcupines of North America, John White concluded that they represent the South American genus *Coendou* and considered *Erethizon* (the extant monotypic North American species) to be an autochthonous genus derived from *Coendou* in the early Rancholabrean. However, in his revision of the Family in 1981, Michael Frazier concluded that all North American fossils represent species of *Erethizon*, which may have evolved, along with *Coendou*, from a common ancestor in tropical South America prior to the opening of the land bridge. Subsequent publications on fossil porcupines in North America have followed Frazier's interpretation, but support for this explanation is not universal.

An ongoing study of Colorado River-derived deltaic sediments has yielded Irvingtonian-age plant and vertebrate fossils from badlands located near the town of El Golfo de Santa Clara, Sonora, Mexico. Over the past decade, more than four thousand specimens have been recovered, including two erethizontid dentaries. These two dentaries stimulated the present study, which will attempt to clarify the taxonomy and phylogeny of the New World taxa by pursuing morphologic features of mandibles that reliably distinguish between the two porcupine genera. This project involves the biometric, photographic, and visual examination of over 160 modern specimens of *Coendou* and *Erethizon*, and over 40 fossil specimens, in tandem with previously published data and conclusions.

Poster Session B

NEWLY FOUND HADROSAUR FOSSIL CO-PRODUCING BROADLEAF FOSSILS FROM SUMOTO, WEST CENTRAL JAPAN

SUZUKI, Daisuke, Sapporo Medical Univ., Sapporo, Japan; SAEGUSA, Haruo, FURUTANI, Hiroshi, Museum of Nature and Human Activities, Sanda, Japan

Hadrosaurs are one of the most well known dinosaurs in the Late Cretaceous. Since the first description in 1856 by Joseph Leidy, fossils of hadrosaurids have been most abundantly discovered. However, most information is from North America and that of Asian hadrosaurs is still limited.

The new hadrosaur fossils from Sumoto city (Hyogo prefecture, West Central Japan) consist of a right dentary with teeth, right surangular, three cervical vertebrae, and a right coracoid. The dentary teeth form the dental battery, which is closely packed teeth: more than 35 tooth positions and three to five successional teeth as tooth family. The length of the dentary is more than 53cm in spite of its lacking the posterior part with the coronoid process. This size suggests the specimen reached adulthood judging from the size of other discovered North American hadrosaurids. The morphology of the dentary and teeth indicate that the specimen is a member of the Lambeosaurinae. This specimen was found in the Kita-Ama Formation in the Izumi Group. Molluscan fossils such as *Nostoceras hetonaiense* and *Inoceramus shikotanesis* suggest an early Maastrichtian age . In addition, the plant fossils, particularly broadleaf leaves were commonly co-produced. The structures of both fossils are relatively well preserved, suggesting they had inhabited near the area. The dental battery of hadrosaurids is well known as an adaptation to hard angiosperm leaves, which were predominant in the Late Cretaceous. However, the direct evidence is few, and some appearing gastric contents are conifer needles and branches. Although those specimens are not direct evidences, it suggests the hadrosaur had lived in abundant broadleaf plants, and they might eat these plants.

Wednesday 9:00

TETRAPOD EVOLUTION AND ATMOSPHERIC OXYGEN IN THE LATE TRIASSIC

TANNER, Lawrence, Le Moyne College, Syracuse, NY; LUCAS, Spencer, ZEIGLER, Kate, New Mexico Museum of Natural History, Albuquerque, NM

The Late Triassic is a particularly significant episode in tetrapod evolution in that it marks the first appearance of mammals and of the crown-group archosaur clades, including pterosaurs and dinosaurs. Even the earliest mammals were unquestionably endothermic, although this trait may have been inherited from their therapsid ancestors, and the evidence for enhanced metabolic activity in dinosaurs remains equivocal. There is little doubt of tachymetabolic endothermy in pterosaurs, however. Available data suggest that even the earliest pterosaurs were active fliers, potentially capable of hovering flight. Pterosaurs, therefore, had

high oxygen demands. Notably, however, Triassic pterosaurs apparently lacked the skeletal pneumaticity of Jurassic forms. We propose that the appearance of diverse organisms with enhanced metabolisms occurred during an interval in which atmospheric oxygen levels increased.

Previous mass-balance geochemical models based on sediment abundance and isotope fractionation calculations indicated that atmospheric oxygen fell during the Triassic Period to the lowest levels since the Late Devonian. Models of atmospheric oxygen based on sediment abundance underestimate the Late Triassic recovery from the Triassic coal gap, however, and therefore underestimate the level of oxygen present in the atmosphere at that time. The use of isotope fractionation models is hampered by unresolved questions regarding various feedback mechanisms and the record of isotopic fractionation in plants. The presence of fusain (fossil charcoal) in sedimentary rocks is widely regarded as evidence of paleowildfire, and a perceived scarcity of fusain in strata of Triassic age has been cited as evidence of relatively low levels of atmospheric oxygen during this time interval. We find, however, a record of abundant fusain in Upper Triassic strata. This is consistent with new geochemical feedback models that indicate oxygen levels rising during the Late Triassic to levels equal to or greater than present. We therefore suggest that tetrapod evolution at this time was linked to this change in atmospheric oxygen.

Student Poster Session

POSTCRANIAL SKELETON AND ONTOGENY OF *EUOPLOCEPHALUS TUTUS* (ORNITHISCHIA, ANKYLOSAURIDAE)

TANOUE, Kyo, Univ.of Pennsylvania, Philadelphia, PA

Previous studies on ankylosaurid dinosaurs have focused mainly on the skulls, which are relatively well preserved. By contrast, the postcrania of ankylosaurids have not been studied thoroughly except for a few reconstructions of skeletons, dermal armor, and muscles, even after a century has passed since the first finding of this taxon.

A *Euoplocephalus tutus* specimen (NSM PV 20381) was collected in 1995 from the upper Campanian Two Medicine Formation of northwestern Montana. This is one of the most complete *E. tutus* specimens, with a skull and most parts of its postcranial skeleton, namely cervical, dorsal, sacral and proximal caudal vertebrae, pectoral girdle, forelimb except for the manus, pelvic girdle without pubis, and hindlimb except for the pes preserved. Although the elements of the skeleton were disarticulated, they are of same size class without any duplicates and appear to belong to a single individual. In addition, each element of the postcranial skeleton is approximately three quarters of the maximum size. Although the elements are similar in shape to those of mature specimens, fusion of the centrum to the neural arch in the proximal caudal region and the fusion of scapula to coracoid have not yet occurred, indicating the immature state of this specimen. The observation of this specimen should elucidate the ontogeny of ankylosaurid dinosaurs.

Wednesday 2:45

THE PRODUCTION OF RIGID BASES FOR THE LONG-TERM STORAGE AND EXHIBITION OF LARGE FOSSIL BONES

TEDROW, Allen, Idaho Museum of Natural History, Pocatello, ID

The safe storage and handling of large fossil bones poses many problems for museum collections personnel. These large, unwieldy and deceptively fragile objects require total support of their surface areas if damaging forces are to be negated. Rigid supportive bases constructed from Random Mat Fiber and FGR 95 LE Hydrocal cement can be designed to provide excellent support for even the most structurally complex and fragile specimens. The fabrication of the base relies upon the often elaborate construction of wax forms into and upon which hydrocal-saturated fiberglass and other reinforcing materials are cast. The added advantages—mostly related to specimen transport—of producing this type of specimen support includes increased worker safety, excellent protection for the fossil during transport, and reduced need for direct collection staff oversight during handling. For exhibition purposes, these supports can be made to be either aesthetically pleasing or nearly invisible.

Wednesday 10:45

EVOLUTION EDUCATION IN THE TIME OF THE WEDGE

TERRY, Mark, Northwest School, Seattle, WA

Teaching about evolution in the United States has always been controversial. We are currently experiencing the fourth major wave of opposition, and the new tactics are different from those of the past. The challenge to evolution education today has been seized upon as a means to promote a much wider agenda of cultural reform intended to affect science in general, as well as all aspects of public life.

The Discovery Institute's "Wedge Strategy" targets public school curricula, state-level science education guidelines and the popular media to convince the general public that a major scientific revolution has just occurred. Biologists, geologists and paleontologists who have missed this revolution, since it hasn't occurred in the scientific literature, need to familiarize themselves with the Wedge's arguments to be effective in promoting evolution education.

Evolution education can be improved at all levels in ways that are valuable in their own right and that meet the Wedge Strategy head-on. All those concerned with the quality of science education in the United States need to be prepared for a long and contentious journey in the years ahead.

Wednesday 9:30

RAPTORS, RODENTS, AND PALEOECOLOGY: THE PERSISTENCE OF SKELETAL DAMAGE PATTERNS IN THE HOLOCENE FOSSIL RECORD

TERRY, Rebecca, Univ. of Chicago, Chicago, IL

Small-mammal remains concentrated by raptors can accumulate in rock-shelters over 10^2-10^3 years. Such deposits represent important paleoecological archives, capturing time-series information on both raptor identity and prey community structure. However, the distortion of ecological information that results from differing rates and selectivities of post-mortem loss remains unexplored. For example, using a modern pellet dataset, I show that owls and hawks inflict statistically distinct assemblage-level damage patterns on prey remains. But two actualistic experiments on pellet/carcass decay in temperate forests indicate that damage patterns can change with increased time on the land surface pre-burial, due to pellet disarticulation and bioturbation; small fragile bones are preferentially lost, leaving assemblages enriched in robust skeletal elements. Changing damage patterns have the potential to mask original signals and must be accounted for if raptor identity is to be inferred. In arid settings—well known for the preservation of Holocene fossil records—it is unknown what impact these processes might have on skeletal damage patterns. To quantify possible effects, I analyzed modern Barn Owl (*Tyto alba*) pellets and associated stratified deposits from Tulelake, California for shifts with elapsed time-since-deposition in (i) bone size-classes, (ii) element types, (iii) unidentifiable remains, and (iv) degree of fragmentation. Unlike temperate forests, preliminary results suggest no significant shifts in the proportion of small fragile skeletal elements over time. Instead, proportional representation of bone size-classes and bone types from buried deposits are concordant with frequency distributions from fresh pellets. The high compositional fidelity between skeletal input and subsequent buried deposits in this arid setting supports the use of subfossil assemblage-level damage patterns for raptor identification. The ability to infer raptor identities over time will contribute to our ability to accurately distinguish between environmental vs. taphonomic drivers of observed faunal shifts in paleoecologically important stratified cave deposits from the Holocene.

Thursday 1:45

OLFACTORY BULB SIZE AS AN INDICATOR OF OLFACTORY ACUITY IN NON-AVIAN THEROPODS

THERRIEN, Francois, Royal Tyrrell Museum of Palaeontology, Drumheller, AB, Canada; ALI, Farheen, WEISHAMPEL, David, Johns Hopkins Univ.Sch of Med, Baltimore, MD

The size of olfactory bulbs relative to that of cerebral hemispheres (called olfactory ratio) is considered an indicator of olfactory acuity (i.e., ability to discriminate various odors). Although olfactory bulb size has been quantitatively evaluated in birds and mammals, only limited, and often qualitative, data have been reported for non-avian theropods. To compare olfactory ratios among non-avian theropods, it is essential to identify osteological correlates marking the precise location of the olfactory bulbs in these animals. Comparison with birds and crocodilians reveals that the olfactory bulbs in non-avian theropods were located within a trough-shaped element bounded anteriorly by a median septum, previously referred to as ?ethmoid complex? or sphenethmoid; this element is homologous with the avian mesethmoid and with the cartilaginous *planum supraseptale* of crocodilians.

After determining the location of the olfactory bulbs in non-avian theropods, olfactory ratios based on endocast and endocranial cavity dimensions have been calculated for several taxa and compared to *Crocodylus acutus*. *Tyrannosaurus rex*, *Carcharodontosaurus saharicus*, *Giganotosaurus carolinii*, and *Allosaurus fragilis* possess higher olfactory ratios than *C. acutus*, suggesting greater olfactory acuity than the later taxon. The dromaeosaurid *Saurornitholestes langstoni* possesses an olfactory ratio similar to that of *C. acutus*, indicating similar olfactory acuity. Finally, the troodontid *Troodon formosus* and ornithomimid *Dromiceiomimus brevitertius* have lower olfactory ratios than *C. acutus*, indicating lower olfactory acuity in these theropods and supporting previous hypotheses that these taxa relied primarily on vision and hearing to locate and capture prey. Although lower than previously estimated, the olfactory ratios of *Tyrannosaurus rex* are still higher than those of any other theropod taxa studied, including *Giganotosaurus* and *Carcharodontosaurus*, indicating that the enlarged olfactory bulbs of *Tyrannosaurus rex* are not merely an allometric consequence of large body size but reflect an adaptation to better discriminate odors.

Poster Session B

TAPHONOMY AND PALEOECOLOGY OF THE LATE PLEISTOCENE MAMMALIAN FAUNA FROM SANDIA CAVE, NEW MEXICO

THOMPSON, Jessica, SUGIYAMA, Nawa, Arizona State Univ., Tempe, AZ; MORGAN, Gary, New Mexico Museum of Natural History, Albuquerque, NM

Sandia Cave is an important latest Pleistocene (late Rancholabrean) vertebrate fauna, with more than 30 species of mammals, including 9 members of extinct Pleistocene megafauna: *Nothrotheriops shastensis*, 2 species of *Equus*, *Camelops hesternus*, *Hemiauchenia macrocephala*, *Capromeryx minor*, *Bison antiquus*, *Mammut americanum*, and *Mammuthus columbi*. When Frank Hibben excavated Sandia Cave in the late 1930s , he used the presence of these extinct species to argue that associated archaeological materials were also Pleistocene in age. A taphonomic study of the large mammals has not shown any instances of human modification on extinct or extralimital species, lending no support to Hibben's argument. Instead, extensive carnivore and rodent damage suggests that non-human agents accumulated and modified most

of these fauna. However, a small proportion of unidentifiable bone fragments do display human damage in the form of cut and percussion marks, and bone tools. The ages of these activities will be determined by pending radiocarbon dates. Taphonomic analysis of the lagomorphs and larger sciurids shows no positively identifiable cultural modification, indicating that these smaller mammalian species were accumulated by carnivores or raptorial birds, and then further modified by rodent gnawing. The faunal assemblage from Sandia Cave (elevation 2165 m) also has important paleoecological and paleoclimatological implications. Several cold-adapted small mammals extralimital to the modern Sandia Mountains (maximum elevation ~3250 m) have been identified, including the yellow-bellied marmot, *Marmota flaviventris*. Radiocarbon dates of 16,290 and 24,050 yrBP on *M. flaviventris* bones from a neighboring cave and 11,850-13,700 yrBP on large mammal bones from Sandia Cave indicate that faunal assemblages from the Sandia Mountains sample the interval from the last glacial maximum through the latest Pleistocene. Holocene bone fragments have likely also been introduced more recently by a combination of human, carnivore, and raptor activity.

Poster Session B

THE FIRST RECORD OF *HAINOSAURUS* (REPTILIA: MOSASAURIDAE) FROM THE PIERRE SHALE OF SOUTH DAKOTA, AND IMPLICATIONS FOR DIFFERENTIATING BETWEEN THE TYLOSAURINE GENERA *TYLOSAURUS* AND *HAINOSAURUS*

THOMPSON, Wayne, South Dakota School of Mines, Rapid City, SD

A specimen of a tylosaurine occurs at the Brown Ranch, Pennington County, South Dakota. This locality has been a source of numerous specimens of late Cretaceous (Campanian) mosasaurs, plesiosaurs, birds, and fish. Until recently, the mosasaurs at this locality consisted of *Clidastes*, *Platecarpus*, *Plioplatecarpus* and *Tylosaurus*. Morphological comparisons to existing specimens of tylosaurine mosasaurs led to a number of characters that may differentiate *Hainosaurus* and *Tylosaurus*.

The relatively complete skeleton differs from *T. proriger* in the presence of a double buttressed premaxilla-maxilla suture, a parietal foramen which is shared by the frontal and parietal, heterodont dentition with three different tooth morphologies, well developed carinae on the marginal teeth, minute serrae on the pterygoid teeth, and a greater number of vertebrae anterior to chevron-bearing caudals.

The specimen differs from *H. bernardi* in the presence of a more robust infrastapedial process, large suprastapedial process, asymmetrically bicarinate teeth with gently convex buccal side and deeply convex lingual side, marginal teeth with strongly developed facets, and a humerus which is longer than the femur.

Osteological features common to both *Tylosaurus* and *Hainosaurus* are exhibited by this specimen. Natural log ratios of cranial elements were also compared in order to determine a statistical basis by which to separate tylosaurine species. Results indicate a gradual progression in size and form through the Campanian. Whereas species of the genus *Tylosaurus* display a great deal of overlap, *Hainosaurus* does not display a large amount of variation. This evidence leads to the conclusion that the new specimen, while sharing a number of characters in common with *Tylosaurus*, possesses derived characters unique to *Hainosaurus*.

Poster Session B

A REEXAMINATION OF *MOROSAURUS AGILIS* (SAUROPODA) FROM GARDEN PARK, COLORADO

TIDWELL, Virginia, CARPENTER, Kenneth, Denver Museum of Nature & Science, Denver, CO; MILES, Cliff, North American Museum of Ancient Life, Lehi, UT

In 1883 a small sauropod cranium and the first three cervical vertebrae were recovered from the Marsh/Felch Quarry in Garden Park, Colorado. Marsh's notes written at the time indicate his original opinion that this braincase belonged to *Diplodocus longus*, whose holotype skeleton was recovered only a meter away. Two additional, nearly complete adult skulls of *Diplodocus* were also found at the quarry. Later, Marsh briefly described and named this cranium and articulated vertebrae *Morosaurus agilis*, citing similarities with the juvenile cranium of *Morosaurus lentus* previously named from a Wyoming site. Subsequent authors however, have long questioned this designation, noting few distinctly camarasaurid characters in the Colorado specimen, a position we support.

Our recent examination of the original cranium suggests that Marsh was correct in his initial assessment of the skull as belonging to *Diplodocus*, based on the following characters: small, ventrally directed occiputal condyle; parietals antero/postiorly very short and transversely wide; prominent parietal depression laterally flanks the supraoccipital crest; hook-like process on ventrolateral corner of supraoccipital; paroccipital process distal end is rounded, rather than straight. The cervical vertebrae are extremely long and gracile, and the neural spine of the axis does not overhang the posterior end of the centrum, supporting the *Diplodocus* designation. Juvenile characters include unfused parietals and frontals lacking a lateral emargination over the orbit. All elements are too gracile to belong to *Apatosaurus*, the other diplodocid known from the Marsh/Felch quarry. The current material closely resembles a juvenile *Diplodocus* recently found in Wyoming, suggesting that *Morosaurus agilis* is a junior synonym of *Diplodocus longus*.

Saturday 8:00

TETHYAN TRIASSIC FISHES FROM EUROPE TO CHINA

TINTORI, Andrea, LOMBARDO, Cristina, UNIMI, Milano, Italy

In northern Italy a rich succession of Middle-Late Triassic fish-rich units represents the western Tethys coastal environments. Many taxa have been recently described, also providing an interesting and quite complete stratigraphic record. The most representative sites of this fossil fauna are at the boundary between Italy and Switzerland where, in the Monte san Giorgio area, the Middle Triassic yields at least seven superimposed different fish assemblages. Further fish assemblages are found in the Early Carnian and in the Norian of the Italian Prealps. The stratigraphic record of these units has been confidently defined, allowing very reliable comparisons inside the Tethys realm: in some other sites, in fact, both in the Westernmost regions (Spain) and in the Far East (China) fossil fishes are coming to light. At Montral-Alcover (Catalunia, Spain) the early Ladinian fish fauna shows a remarkable resemblance at generic level (*Peltopleurus, Luganoia, Eosemionotus, Habroichthys, Eoeugnathus, Peltoperleidus*, etc.) with some of the lower units of Monte San Giorgio and of the new sites in the Italian Prealps. It is also possible that the affinity could reach the specific level, but the scanty preservation of Spanish specimens prevents a detailed analysis. This faunal province can be extended as far as to the East: a few genera (*Guizhouniscus, Brachysomus, Guizhouamia*) recently described from the Ladinian and Carnian of the Guizhou Province (Southern China) appear very close to the European taxa (*Aneurolepis, Eosemionotus, "Caturus"*). Though, these Chinese fish faunas have a still insufficient stratigraphic support. It is worth pointed out also that most of these taxa are of very small size—less than 10 cm in standard length—and they all lived in coastal lagoons. The extension of the Tethys faunal province is further supported by the geographical distribution of shallow-water reptiles such as the nothosaurid *Lariosaurus*, which was also described for the first time in northern Italy and then studied in Spain and China.

Friday Fishes Symposium poster

INSIGHTS FROM MODULAR DISPARITY OF ACTINOPTERYGIAN PECTORAL FINS

TISSANDIER, Sylvie, LARSSON, Hans, McGill Univ. Redpath Museum, Montreal, QC, Canada

Disparity is the morphological distance between taxa. It is a useful metric, particularly when studied alongside other measures of diversity that can be independently derived from taxonomic or phylogenetic data. Disparity as a means of comparing taxa is more difficult and becomes less robust as the scale of the analysis increases and comparable homologies decrease. The paired fins of actinopterygians provide a useful example, as the fins are highly variable but within a generally conserved function. The phylogeny of actinopterygians is well known from morphological and molecular data, and is supported by many extinct taxa. Geometric morphometric analyses offer a means to quantitatively describe the progressive changes in size and shape of morphological features. Difficulties exist when selecting landmarks across phylogenetically diverse taxa that lack homologous fin structures. Teleosts have lost the metapterygium of the fin, and the existing structures have been highly modified between distantly related taxa such as palaeoniscoids and zebrafish. To avoid this problem, the fin was divided into discrete modules representing the basal elements, distal radials, and lepidotrichia. Landmarks were then selected outlining each module. Division of the fin into modular disparity offers a more general comparative framework to examine overall fin disparity within actinopterygian fishes without requiring homologous structures. Not surprisingly, inclusion of extinct taxa provided a more thorough examination of the changes in disparity, while also providing more statistically robust data for ancestral conditions.

Saturday 2:30

DENTAL MICROWEAR ANALYSIS OF THE EXTANT ELEPHANTS (*LOXODONTA AFRICANA*) AND (*ELEPHAS MAXIMUS*): A NEW QUANTIFICATION METHOD WITH IMPLICATIONS FOR PALEOECOLOGY AND DIETARY INTERPRETATION OF FRAGMENTARY FOSSIL SPECIMENS

TODD, Nancy, Manhattanville College, West Haven, CT; FALCO, Nicole, SILVA, Natalia, SANCHEZ, Chezdis, Manhattanville College, Purchase, NY

Studies of morphological specializations in teeth and jaws illuminate changes associated with shifting dietary preference. Analysis of dental microwear is providing additional insight and new methods for paleoecological reconstruction of diet.

No detailed microwear studies have been done on extant elephant teeth (Loxodonta africana and Elephas maximus), as their large size presents major logistical problems. Not only are the molars very large, but they consist of multiple molar plates (or lamellae) with complex enamel patterns. We have modified the new, low-magnification techniques that have been developed for larger mammalian teeth for application in elephants. Polyvinylsiloxane molds are made of enamel surfaces, from which clear epoxy resin casts are made. Using this clear resin allows for accurate molding of microwear, which is examined under a stereomicroscope (at 250X magnification) using light transmitted at an oblique angle from below. Images are captured via a digital camera and downloaded into digitizing software for analysis. The number of scratches and pits per image are counted, and scratch length and pit area are measured.

A wide range of variation is present on a single elephant molar. Anterior plates have more scratches and pits compared to more posterior plates, but mean scratch length is much longer

on the more posterior plates. Not only does microwear vary along the entire occlusal surface of the tooth, but varies within plate as well. More microwear occurs on the leading edge of enamel (anterior side) of each plate, compared to the posterior edge. There is also variation between buccal and lingual sides of each plate. Single plates of several fossil species (*Elephas planifrons*, *Amebelodon floridanus*, *Stegolophodon tsudai*, and *Gomphotherium* sp.) have higher frequency of scratches, somewhat surprising given that several are considered to be primarily browsers. These initial results indicate that complete elephant teeth need to be examined in order to quantify variation within species, and that fragmentary fossil specimens may not accurately represent the microwear on an entire proboscidean tooth.

Poster Session A

EVOLUTION AND DIVERSITY OF THE GENUS *PLIOPENTALAGUS* (LEPORIDAE, LAGOMORPHA) IN THE HOLARCTIC REGION

TOMIDA, Yukimitsu, National Science Museum Dept of Geology, Tokyo, Japan; JIN, Chang-zhu, Institute of Vertebrate Paleontology and Paleoanth, Beijing, China

The fossil record of the genus *Pliopentalagus* is poorly known. However, recent discoveries of abundant fossils from China and review of previously known fossil taxa from Asia, North America, and Europe clearly demonstrate that the genus *Pliopentalagus* actually display dynamic evolution and diversity in the Holarctic region. Our findings include:

Numerous specimens, including skulls, jaws, and post-cranial bones, of *Pliopentalagus* were excavated from Huainan, Anhui Province, China. They were discovered from four different cave and fissure deposits, representing three different geologic ages. We identified three different species: *P. huainanensis* (latest Miocene), *Pliopentalagus* sp. A (early Pliocene), and *Pliopentalagus* sp. B (late Pliocene), representing an evolutionary lineage well documented by a number of characters.

P. nihewanensis was described based on an isolated p3 and two lower molariform teeth from the basal ?Nihewan Beds? of the late Pliocene, as the first record of the genus in Asia in 1989. However, re-examination of the original specimens strongly suggests that the species belongs to the genus *Trischizolagus* rather than *Pliopentalagus*, because of the less complicated enamel crenulation of p3 and almost no enamel crenulations on lower molariform teeth. *P. progressivus* is known from the latest Pliocene or early Pleistocene of Henan, China. Re-examination of the original material (isolated p3 and lower molariform tooth) suggests that it is a valid species. It is uncertain, however, whether its direct ancestor is *Pliopentalagus* sp. B.

Aztranolagus agilis has been known from the late Blancan to late Wisconsinan in North America, and re-examination of the original specimens clearly indicates that this taxon represents a smaller species of *Pliopentalagus*, similar to the evolutionary stage of *P. huainanensis*. Two other species of the genus are known from the Ruscinian (MN15) of Moldavia (*P. moldaviensis*) and Czech (*P. dietrichi*) in Europe. They are similar to *Pliopentalagus* spp. A and B in terms of the general morphology but can be separated from the latter by other characters.

Poster Session B

PLEISTOCENE FAUNA FROM SANTA CRUZ NUEVO, PUEBLA, CENTRAL MEXICO

TOVAR-LICEAGA, Rosa, MONTELLANO-BALLESTEROS, Marisol, Instituto de Geologia, Mexico, Mexico

In Mexico, 779 localities bearing mammalian remains, mainly megafauna taxa, had been reported, but only in 29 have bird and herpetofaunas been mentioned. This gives an idea of the poor knowledge of the Pleistocene microvertebrates in Mexico.

Recently, in the state of Puebla, in the central part of Mexico, near the village of Santa Cruz Nuevo, vertebrate fossil remains were recovered from a sequence of fluvial sediments. The microvertebrate fauna includes: frogs, toads, plethodontids, turtles, snakes, scincids, lizards, rodents, lagomorphs, and procyonid. Among the megafauna taxa glyptodont, pampathere, bear, equid, proboscidean, antilocaprid and cervid were recognized. Bird remains were found but they had not yet been studied. The presence of *Peromyscus difficilis* and *Neotoma mexicana* suggests a late Rancholabrean age for the faunal association.

Comparing the fossil and extant faunas, 50% of the identified families continue in the study area; 32% had changed its geographic distribution and 18% went extinct in North America and mainly are the large-sized taxa (proboscideans, equid, and edentates). The families that had changed its distribution includes: Ambystomatidae, Plethodontidae, Bataguridae, Testudinidae, Scincidae, Ursidae and Antilocapridae. The families that continue in the estudy area are: Bufonidae, Ranidae, Scaphiopodidae, Phrynosomatidae, Colubridae, Viperidae, Kinosternidae, Leporidae, Muridae, Procyonidae, and Cervidae. None of the identified species of microfauna of Santa Cruz Nuevo went extinct at the end of the Pleistocene.

Based on the climatic ranges of the microvertebrate taxa, a template semi-arid shrubs is suggested, quite similar to that found today, so the environmental conditions practically had not changed since the Wisconsinian in the study area. However, in the fossil association there are some taxa that today inhabit subtropical to tropical conditions:*Bufo valliceps*, *Rhinoclemmys*, and the plethodontids, and one form that lives in the forest, confirming the proposed hypothesis of the coexistence of taxa with different ecological requirements during the ice-ages.

Friday 2:00

LOW-MAGNIFICATION MICROWEAR ANALYSES OF SOUTH AMERICAN ENDEMIC HERBIVORES

TOWNSEND, Kathryn, CROFT, Darin, Case Western Reserve Univ., Cleveland, OH

A key challenge for reconstructing diets of Tertiary South American mammals is the large proportion of taxa with few or no living descendants. Owing to this absence of close relatives, it is difficult to assess whether gross morphological characters useful for inferring diet in artiodactyls and perissodactyls (e.g., muzzle width) are equally effective for extinct South American endemics. Various 'taxon-free' methods (e.g., microwear, mesowear), may provide more reliable dietary reconstructions, as they rely on presumably universal properties of mammalian teeth rather than craniodental morphology (which has a strong phylogenetic signal). We here report preliminary results from a pilot study of enamel microwear in early Miocene notoungulates, astrapotheres, and xenarthrans, the first reported for Tertiary South American mammals. Microwear data from two to nine specimens from each of seven taxa from the Santa Cruz fauna of Argentina were recorded using a stereomicroscope. The diets of these taxa were estimated using a discriminant model derived from a published low-magnification microwear dataset of modern ungulates. The toxodontid notoungulates (*Nesodon* and *Adinotherium*), generally considered grazers due to their extreme hypsodonty, displayed microwear more typical of modern browsers. The same pattern was exhibited by the interatheriid *Protypotherium*, which is equally hypsodont. *Astrapotherium*, traditionally considered a browser, displayed the expected browser microwear. The tardigrade xenarthrans *Hapalops* was interpreted as a browser but *Pelecyodon* was reconstructed as a grazer. The lack of concordance between microwear-based and traditional dietary interpretations for these taxa may result from relatively small sample sizes for extinct taxa and/or the lack of a sufficiently broad extant comparative dataset. Alternatively, it may indicate that traditional methods of dietary interpretation are relatively inaccurate when applied to South American endemic herbivores.

Friday 2:30

PENGUIN ANKLES: SYSTEMATIC TREASURE OR MORPHOLOGIC CONVERGENCE?

TRICHE, Nina, The Univ. of Texas at Austin, Austin, TX

The tarsometatarsus, or ankle bone, of penguins (Aves: Spheniscidae) was traditionally the most systematically useful element of their osteology. However, this bone also has high preservation potential compared to other elements, and thus may be the best known bone, not the best indicator of phylogeny. It is also possible that penguin ankles are convergent owing to functional constraints imposed by similar lifestyles and conservative morphology. This morphology is well-described for some groups of fossil penguins, notably those from Antarctica, and consists of a short, broad, compact bone, as compared to other birds. There is much variation present between groups of fossil penguins, however, which has not yet been desribed or examined phylogenetically.

There are approximately fifty named fossil penguin species, many of which require revision, and at least thirty of which contain tarsometatarsal material in large samples. This abundance allows scoring of phylogenetic ankle characters over a broad sample of the penguin clade. However, no phylogenetic analysis has yet examined the utility of tarsometatarsal morphology for resolving penguin phylogeny, and no study has shown whether the extensive literature on penguin ankles reflects a strong phylogenetic signal or simply results from the fact that penguin tarsometatarsi are preferentially preserved.

Here, over thirty characters are proposed using fossil penguin tarsometatarsi, and a phylogenetic analysis of penguin species is performed to examine the utility of ankle characters and the possibility of convergence of this bone within penguins. Some of the characters address: relative size and shape of the bone, number and placement of the intermetatarsal grooves and foramina and of the calcaneal tubercular grooves and ridges, and orientation and size of the metatarsi. Preliminary results indicate that ankle morphology can be used to successfully recover penguin phylogeny. Homoplasy, although present, does not significantly increase the number of most parsimonious trees or decrease their level of support. These results show that penguin ankles, although more easily preserved than most other elements, are also strong indicators of phylogeny and should be investigated more fully in future analyses.

Poster Session B

TURTLES AND CROCODILIANS FROM THE LATE CRETACEOUS OF BIG BEND NATIONAL PARK, TEXAS

TROOP, Paul, TOVAR, Danny, CUMMINGS, Chris, HEGMAN, Kelly, MAMMINI, Janine, SMITH, Casey, California State Univ., Stanislaus, Turlock, CA

Big Bend National Park, Texas contains a distinctive Late Cretaceous vertebrate fauna from the southern part of North America. The Big Bend fauna is less well known compared to northern areas. Microfossils were collected from the inland floodplain facies of the upper Aguja Formation (latest Campanian-early Maastrichtian) at the Rattlesnake Mountains, and have increased the vertebrate record from Big Bend. The vertebrates include fish (lepisosteid) scales and teeth; a partially complete salamander skeleton; trionychid turtle carapace fragments; and crocodilian teeth and scutes. Most important was the discovery of three vertebrae from a possible champsosaur. Champsosaurs are commonly found north of 55 degrees paleolatitude; this is the first record from Big Bend. If this is correct, then this both extends the distribution of champsosaurs to the south and increases the diversity of the Big Bend fauna.

Poster Session B

REPORT ON A COMPREHENSIVE PALEONTOLOGICAL SURVEY OF COLORADO NATIONAL MONUMENT

TRUJILLO, Kelli, Univ. of Wyoming, Laramie, WY; IMHOF, Margaret, Northern Arizona Univ., Flagstaff, AZ; WALKE, Zachary, Southern Oregon Univ., Ashland, OR

Colorado National Monument (COLM), located in western Colorado near Fruita, sits in an area rich in fossils. Although surveys of the Morrison Fm. and the trails of COLM previously had been done, this park unit had never been systematically surveyed for actual or potential fossil resources.

During the early summer of 2004, we began a paleontological survey of COLM. In addition to surveying new areas, we also re-surveyed and assessed previously reported localities. All localities were located using GPS, and all data was then compiled into a GIS database.

We reported 75 paleontological localities within COLM. From the Chinle Fm., our findings included numerous trace fossils as well as a report of previously collected teeth and scutes of a metoposaur. From the overlying Wingate Ss., we reported several localities with numerous theropod tracks on fallen blocks along the canyon floors. The Kayenta Fm. proved to be largely unfossiliferous within COLM, although we did report a fragment of a reptilian rib from this unit. The overlying Wanakah Fm. yielded a few invertebrate trace fossils.

The most fossiliferous unit within COLM was the Upper Jurassic Morrison Fm. Each member of this unit yielded fossils, including an isolated lungfish tooth plate from the Tidwell Member, theropod and sauropod tracks and bone from the Salt Wash Member, and dinosaur bone and turtle shell from the Brushy Basin Member. The Early Cretaceous Burro Canyon Fm. also yielded a large amount of dinosaur material in fallen blocks sitting on the Morrison Fm.

The data collected in this survey will assist park service personnel in managing the fossil resources of COLM and will also aid interested scientists in planning future fieldwork within this park unit.

Friday 11:15

CAN MODERN HETEROMYID SPECIES BE IDENTIFIED USING ONLY DENTAL MEASUREMENTS? A TEST USING EXTANT SPECIES WITH IMPLICATIONS FOR FOSSIL IDENTIFICATION

TSENG, Jack, Univ. of California, Berkeley, San Jose, CA

Identification of fossil micromammals is often based on isolated teeth, although the robustness of individual tooth characters in species identification has only rarely been quantified. Species identification of extant small mammals often relies on pelage characteristics and/or molecular techniques, not with dental morphology, thereby complicating comparison of fossil and modern species. However, application of dental morphological methods commonly used in mammalian paleontology to extant species defined on non-dental characters provides an independent test of the efficacy of dental morphology in distinguishing taxa. I examined specimens of extant species of *Perognathus* and *Chaetodipus* (Rodentia: Heteromyidae), whose cheek tooth morphologies closely resemble those of fossil *Perognathus*.

I took length, width, and crown height measurements of all cheek teeth from recent museum specimens for analysis as a "best-case" scenario of morphological data available for identification of fossil forms. I conducted multivariate discriminant analyses to identify single measurements useful in distinguishing species within and across genera. Results showed that species were identified correctly more than 95% of the time in all analyses using 56 tooth measurements per specimen. In *Perognathus*, the single tooth measurement accounting for the highest percentage of correctly identified specimens was the transverse width of the posterior loph (TP) of p4. In *Chaetodipus*, the single most useful measurement for identifying species was TP of m1. Overall, no single tooth measurement was able to identify species with more than 30% consistency. The morphological similarity of species of *Perognathus* corresponded with sister-group relationships established by molecular data. The results suggest that overall quantitative dental morphology provides more consistent identification than any single measurement, but certain isolated measurements are more consistent than others. These measurements hold promise for identifying fossil heteromyid taxa in light of their species resolving power in morphologically similar extant taxa.

Friday 2:15

A REVIEW OF MIDDLE EOCENE UNGULATE MAMMALS FROM THE PONDAUNG FORMATION, MYANMAR

TSUBAMOTO, Takehisa, EGI, Naoko, TAKAI, Masanaru, Kyoto Univ., Inuyama, Aichi, Japan

We review an ungulate mammalian fauna of the upper middle Eocene Pondaung Formation, central Myanmar. The Pondaung ungulate fauna consists of 29 species (14 families and 18 genera): one species of an indeterminate small ungulate (*Hsanotherium parvum*), 12 species (six genera in six families) of artiodactyls (cetartiodactyls), and 16 species (11 genera in seven families) of perissodactyls. Although both Pondaung artiodactyls and perissodactyls are abundant and taxonomically diverse, the former is less diversified in generic numbers than the latter, but is nearly equal to the latter in abundance. Anthracotheriid artiodactyls and brontotheriid and amynodontid perissodactyls are the most abundant elements in the fauna. The estimated paleoecologies of the included taxa, the geologic and geographic evidence, and cenogram analysis suggest that the paleoenvironment of the Pondaung fauna is forested/woodland vegetation with humid/subhumid moisture and large rivers, which were located not far from seashore. The age of the Pondaung fauna is independently correlated with the late middle Eocene only on the basis of the stratigraphic, microfossil, and radiometric evidence, yielding a result consistent with mammalian faunal correlations. On the other hand, the Pondaung fauna includes many artiodactyl taxa compared to other middle Eocene faunas of East Asia and shows relatively high endemism at the generic level.

Romer Prize Session, 11:45

PRIMARY HOMOLOGIES OF THE DORSAL AND CERVICAL AXIAL MUSCLES IN SAURIA (CROWN DIAPSIDA) AND THEIR EVOLUTIONARY IMPLICATIONS

TSUIHIJI, Takanobu, Field Museum of Natural History, Chicago, IL

As a basis for understanding musculoskeletal evolution of the archosaurian neck and trunk, primary homologies of the axial muscles in these regions among lepidosaurs, crocodylians, and birds were established based on gross morphology and innervation patterns. One of the most significant findings is that the *mm. intertransversarii* complex in the avian cervical region is actually a "composite" of the two epaxial muscles, *m. longissimus* and *m. iliocostalis*, in other saurians.

Based on such homology assessments, evolutionary changes in presacral muscular morphology in Sauria can be inferred. Archosaurs have the cervical *transversospinalis* system that is more distinctly different from its dorsal counterpart than the one in lepidosaurs. Within Archosauria, many apomorphies further separate birds from crocodylians. In the avian trunk, the *longissimus* and *iliocostalis* systems are severely reduced while the *transversospinalis* system expands onto the transverse process. This is in contrast to the crocodylian condition in which the long transverse process is occupied by a well-developed *longissimus* system. In non-avian saurians, *m. spinalis cervicis* and *m. semispinalis cervicis* comprise an integrated, multipennate muscular complex. In contrast, their avian homologs are differentiated and form discrete muscles, such as *m. ascendens cervicalis*, consisting of short slips. This avian configuration apparently enables different actions among the muscles and allows independent mobility at each vertebral articulation. In addition, the avian homolog of *m. spinalis capitis*, the long muscle connecting the trunk with the head and neck, has extended significantly caudally. Some of these myological apomorphies in Aves are correlated with a sharp morphological contrast between a long and flexible neck and a short and rigid trunk in this clade. Osteological modifications relating this cervico-dorsal contrast are already noticeable in basal dinosauriforms and continue along the saurischian lineage toward Aves. Acquisitions of some of the "avian" myological apomorphies may have accompanied such osteological changes, and therefore preceded the origin of the crown clade.

Wednesday 10:15

PARAREPTILIAN PHYLOGENY IN LIGHT OF THE POSTCRANIAL ANATOMY OF *MACROLETER* (AMNIOTA: REPTILIA) FROM THE UPPER PERMIAN OF RUSSIA

TSUJI, Linda, REISZ, Robert, Univ. of Toronto at Mississauga, Mississauga, ON, Canada

The phylogeny of the Parareptilia has recently come under intense scrutiny due to spirited debate regarding turtle origins. However, many poorly described members of the clade need to be reevaluated in order to obtain a more complete picture of the evolution of the group as a whole. *Macroleter poezicus* is purportedly a close relative of the nyctiphruretids, a clade of parareptiles primarily restricted to the Upper Permian sediments of the Russian Mezen River Basin. The nyctiphruretids are characterized by, among other features, large temporal emarginations, and distinctive dermal sculpturing. The recent collection and preparation of a number of new specimens of *Macroleter poezicus* from Russia provides an opportunity to fully describe the postcranium of this taxon for the first time, which is crucial for the clarification of its phylogenetic position. The skull and the vertebral column of *Macroleter* are quite massive, with the neural arches of the vertebrae displaying a swollen morphology. By contrast, the morphology of the limbs is in fact quite gracile, with a long and slender shaft and widely-flaring proximal and distal ends. A highly interesting feature recently revealed in the postcranial skeleton of the new specimens of *Macroleter* is the fusion of the astragalus and calcaneum in adult individuals, whereas these elements remain unfused in the subadult condition. While this fusion is not present in known procolophonids, it is in the owenettid *Barasaurus*, and is a character also present in pareiasaurs. Other features of *Macroleter* comparable to those found in pareiasaurs include the presence of a shortened tail and a reduced vertebral count.

This new evidence from the postcranial skeleton of *Macroleter* is incorporated into an analysis of parareptilian relationships. Numerous features found in the new specimens of *Macroleter* suggest a close affinity to the more basal pareiasaurs. Phylogenetic analysis of this rather poorly known clade will contribute to a resolution of relationships within the Parareptilia.

Poster Session A

A DIVERSE LATE MIOCENE (HEMPHILLIAN) INSECTIVORE FAUNA FROM NORTH-CENTRAL NEBRASKA

TUCKER, Shane, VOORHIES, Michael, Univ. of Nebraska State Museum, Lincoln, NE

At least 15 species of Insectivora are represented by fragmentary jaws and isolated teeth in the Wyman Creek local fauna recovered from a fluvial channel deposit near the top of the Ash Hollow Formation in Keya Paha County, Nebraska. Previously reported rodent and carnivore taxa establish the biochronologic age of the fauna as late Hemphillian (He3). Volcanic ash clasts associated with the fossils were chemically matched by Dr. Michael Perkins to the

Blacktail Creek Ash (6.62 ± 0.03 Ma), supplying a maximum geochronologic age for the fauna.

Moles (Talpidae) belonging to at least 5 species are the most frequently found insectivores in the assemblage (NISP=310). A highly fossorial scalopine (Scalopus (Hesperoscalops) sp.) is most abundant, followed by a very large (M1: 4.6 x 3.8 mm) new species of *Domninoides* and a desman-like mole with resemblances to both *Lemoynea* and *Gaillardia*. One undetermined genus and species is represented by a very small dentary fragment bearing a moderately high-crowned m2 and a larger undetermined talpid is represented by two isolated upper molars.

Remains of shrews (Soricidae) are less abundant (NISP=50) but are more diverse taxonomically than talpids with at least eight distinct species present. Four of the species appear to resemble their counterparts in the early Hemphillian Lemoyne l.f.: *Anouroneomys* (or *Crusafontina*) *magnus, Sorex edwardsi, S. yatkolai*, and *Alluvisorex* sp. The most abundant shrew is a somewhat *Cryptotis*-like blarinine. A large, probably new neomyine (?) having low-crowned molars with blunt, inflated cusps, is known from a single specimen, as are a tiny (m1-3 = 2.6 mm) soricine, and a large blarinine possibly related to *Paracryptotis*. A partial dentary is clearly assignable to the Heterosoricidae, a group otherwise confined to deposits of Barstovian and older age in North America.

The extinct Family Plesiosoricidae is represented by ten teeth and jaw fragments identified as an unnamed species of *Meterix*. The Wyman Creek plesiosoricid (and heterosoricid if not reworked) are among the biochronologically youngest occurrences of their respective families in North America.

Poster Session B

A NEW LOOK AT OLD FACES: REVISITING *MONOCLONIUS* AND *BRACHYCERATOPS*

TUMARKIN-DERATZIAN, Allison, Vassar College, Poughkeepsie, NY; DODSON, Peter, Univ. of Pennsylvania, Philadelphia, PA

The ceratopsid dinosaurs are a group of animals rich in diversity, with cranial ornamentation exhibiting a high degree of both inter- and intraspecific variability. Previous examination of ontogenetic change among the "short-frilled" centrosaurines has led to recognition of a distinctive suite of immature cranial characters that crosses generic lines. The existence of this common immature morphology is in striking contrast to the complex cranial ornamentation displayed by adults, which are readily distinguishable by species-specific characters of the frill, nasal and orbital regions. Previous studies further demonstrate that cranial ornamentation develops relatively late in ontogeny, and hypothesize that specimens lacking adult cranial ornamentation are juveniles or subadults of other adult forms, and thus should probably be regarded as taxonomically indeterminate.

The centrosaurine genera *Monoclonius* and *Brachyceratops* lack strongly developed cranial ornamentation, and were both originally erected based on taxonomically indeterminate juvenile or subadult material. Each of these problematic genera, however, also includes referred cranial material of much larger individuals—the Canadian Museum of Nature's *Monoclonius lowei*, and the Smithsonian's large *Brachyceratops*. With their retention of selected subadult characters at larger-than-expected size, these two individuals appear to follow ontogenetic courses distinct from those of other centrosaurines. Observations of bone surface textures indicate that, although the large *Brachyceratops* is possibly a subadult, *M. lowei* is more likely an adult. Regardless, neither of these animals would be ontogenetically transformed into any other known centrosaurine from the same deposits. We propose that these two specimens likely represent valid taxa, which fail to develop the distinctive cranial characteristics of other adult centrosaurines. By considering both size and morphology, and applying the evolutionary concept of heterochrony, we conclude that *M. lowei* and the large *Brachyceratops* may represent paedomorphic centrosaurines retaining immature cranial morphology at large adult body sizes.

Friday 11:00

ANATOMY AND RELATIONSHIPS OF *SHAMOSUCHUS DJADOCHTAENSIS* (CROCODYLIFORMES, NEOSUCHIA) FROM THE LATE CRETACEOUS OF MONGOLIA

TURNER, Alan, NORELL, Mark, American Museum of Natural History, New York, NY; POL, Diego, Ohio State Univ., Columbus, OH

The Central Gobi locality Ukhaa Tolgod has yielded abundant tetrapod remains including thousands of small mammals and lizards as well as abundant dromaeosaurid, alvarezsaurid, troodontid, ceratopsian, and ankylosaur dinosaurs. Until now, a crocodyliform component to the locality?s fauna has been lacking. Here, we describe the first crocodyliform found in the Ukhaa Tolgod locality (Djadokhta Formation), referring it to the type species *Shamosuchus djadochtaensis*. The specimen preserves an almost complete skull in association with postcranial remains and is considerably more complete than the holotype (AMNH 6412). The material, including a diverse array of dermal armor, offers new information not preserved in previous specimens and coupled with CT imaging of the skull contributes to a better understanding of this taxon.

The specimen offers new information to explore the phylogenetic relationships of *Shamosuchus djadochtaensis* and bears important information for understanding the evolutionary history of advanced neosuchians related to the origin of Eusuchia. Like most advanced neosuchians, *Shamosuchus* does not possess antorbital fenestrae, but unlike advanced neosuchians *Shamosuchus* lacks two waves of maxillary tooth size variation (festooning). Moreover, *Shamosuchus* shares a number of derived similarities with *Rugosuchus nonganensis* from Early Cretaceous of China, *Bernissartia fagesii* from the Early Cretaceous of Europe, and the "Glen Rose Form" from the Early Cretaceous of North America. *Shamosuchus* and *Rugosuchus* share a ventrally located ridge along the lateral margin of the angular and longitudinal keels restricted to the dorsal osteoderms' posterior margins. *Shamosuchus*, *Rugosuchus*, *Bernissartia*, and the "Glen Rose Form" all lack external mandibular fenestrae. *Shamosuchus* is more similar to *Rugosuchus* than to *Bernissartia* and the "Glen Rose Form", however, in that the internal choana, while formed almost entirely by the pterygoids, has a rather anterior location with the posterolateral end of the palatines not reaching the posterior margin of the suborbital fenestra.

Poster Session B

AN ANALYSIS OF POSSIBLE GUT CONTENTS IN A HADROSAURID DINOSAUR FROM THE UPPER CRETACEOUS (LATE CAMPANIAN) JUDITH RIVER FORMATION OF MONTANA

TWEET, Justin, CHIN, Karen, Univ. of Colorado at Boulder, Boulder, CO; MURPHY, Nate, Judith River Dinosaur Institute, Malta, MT

An exceptionally well-preserved subadult specimen (JRF-115-H) of a hadrosaurid, *Brachylophosaurus canadensis*, from the Judith River Formation near Malta, Montana, was found to include dark, organic-rich, fine-grained material within the body cavity. This material is mostly composed of small leafy fragments, and in the past has been interpreted as possible gut contents. To determine what the material represents, we examined its physical and chemical characteristics, along with the taphonomy of the host carcass and surrounding rocks.

The material in the body cavity consists of layered leaf fragments lying flat with respect to the body's orientation on its side. This included mass is now exposed in several places, and does not appear to extend beyond the carcass. Surface exposures indicate that the material occupies an area at least 1.15 by 0.25 meters, and one to at least two centimeters thick. Its matrix is made up of clay with scattered clasts of coarse silt to very fine sand particles. The sediments encasing the host skeleton include virtually no plant material and are made up of clean fine sand with no apparent temporal hiatuses. Sedimentary structures indicate that the body was buried in a channel by a current moving from the feet toward the head, with the belly facing into the current at a shallow angle.

The data indicate that the organic material most likely represents gut contents, but with some post-mortem disruption. Current disruption through openings in the decaying carcass might account for some of the clasts, and could have influenced the orientation of the plant matter.

This study provides baseline information for analyzing other cases of putative gut contents in herbivorous dinosaurs. As only two other cases of possible herbivorous dinosaur gut contents have been reported within the last forty years, this study makes an important contribution to understanding examples of unusually well-preserved dinosaur carcasses. The findings also have dietary implications, suggesting that this hadrosaurid had been eating significant amounts of leaves at the time of death.

Wednesday 9:15

A NEW *XENOROPHUS*-LIKE ODONTOCETE CETACEAN FROM THE OLIGOCENE OF NORTH CAROLINA

UHEN, Mark, Cranbrook Institute of Science, Bloomfield Hills, MI

Oligocene cetaceans in eastern North American are currently only known from around Charleston, South Carolina, despite the relative abundance of Oligocene nearshore marine rocks from Mississippi across the gulf coast into Florida and the Carolinas. A new skull from Onslow Beach, North Carolina represents the first discovery of an Oligocene cetacean from the Gulf or East Coast of North America outside the Charleston area. Outcrops of Oligocene age rocks are rare in North Carolina, but where they occur, they have been assigned to the River Bend Formation, part of which is lower Oligocene (Rupelian) and part of which is upper Oligocene (Chattian). Offshore, the rocks are lumped into an undifferentiated Oligocene age unit. Since this skull was found in the surf zone, and has clear evidence of having been under the present day ocean for a period of time, it is assigned to the undifferentiated Oligocene until further evidence of its age can be determined.

The skull is similar in size to *Xenorophus sloani* and *Archaeodelphis patrius*, but is more complete than the type specimen of either. The specimen is missing the anterior end of the snout, and does not include any teeth. Both auditory bullae and periotics are present and in place on the specimen. Portions of both lower jaws are crushed up onto the ventral palate. The anterior borders of the nasals are posterior to the antorbital notches. The nasals, premaxillae, and frontals are posteriorly telescoped over the frontals, which are only visible in dorsal view just posterior to the nasals and at the dorsal borders of the orbits. Much of the orbits are formed by the greatly enlarged lacrimals, a characteristic of *Xenorophus* and its close relatives. The intertemporal region includes a sagittal crest formed by the parietals, and is bounded posteriorly by a nuchal crest formed by the parietals, squamosals, and supraoccipitals.

This specimen represents the first extension of the range of Oligocene cetaceans of the east coast outside of South Carolina, and will help resolve some of the outstanding questions regarding the early diversification of Odontoceti and the origins of modern odontocete clades.

Saturday 9:30

THE PHYLOGENETIC RELATIONSHIPS OF BASAL SAUROPODOMORPHS: IMPLICATIONS FOR THE ORIGINS OF SAUROPODS

UPCHURCH, Paul, Univ. College London, London, United Kingdom; BARRETT, Paul, The Natural History Museum, London, United Kingdom; GALTON, Peter, Univ. of Bridgeport, Bridgeport, CT

Phylogenetic relationships of early sauropodomorphs are poorly understood: recent cladistic analyses have produced radically divergent results. This study tackles this problem using a data-matrix consisting of 291 characters for one outgroup and 27 ingroup basal sauropodomorphs. The outgroup ('ancestor') has been given all plesiomorphic states based on the anatomy of neotheropods, *Herrerasaurus* and basal Ornithischia. Application of the heuristic search in PAUP 4 generated three most parsimonious trees of length 645 steps (CI = 0.485, RI = 0.667, RCI = 0.331). These trees are identical in topology except for the positions of *Mussaurus* and *Yunnanosaurus*. The common topology indicates that *Saturnalia*, *Thecodontosaurus* and *Efraasia* are the most basal sauropodomorphs and lie outside of a clade containing prosauropods and sauropods. The prosauropod clade contains two major monophyletic groups: Melanorosauridae (*Riojasaurus*, *Melanorosaurus*, *Camelotia*, and *Lessemsaurus*) and Plateosauria (*Plateosaurus*, *Coloradisaurus*, *Lufengosaurus*, *Massospondylus*, *Yunnanosaurus* and others). The sauropod clade includes (in order of increasing closeness to the Eusauropoda): *Anchisaurus*, *Blikanasaurus*, *Jingshanosaurus*, *Antetonitrus*, *Chinshakiangosaurus*, *Kotasaurus*, and *Vulcanodon*. The suggestion that *Jingshanosaurus* is a basal sauropod is important because it has a virtually complete skeleton and can therefore provide important insights into the earliest stages of the evolution of the group. Many changes occur in the early sauropod skull (e.g. reduction of the external mandibular fenestra, onset of narial retraction, loss of the medial wall of the antorbital fossa, broadening of the snout and wrinkled tooth enamel) and the locomotor system (e.g. increased width of scapular acromion, shortening of the manus, loss of the 'twist thumb' and features that presumably improve the femur for weight-bearing). Character mapping identifies several convergences between basal sauropods and melanorosaurids, and it is conceivable that the discovery of more material will cause the latter clade to shift to a new position within sauropods.

Friday 11:30

USING AN EXCEPTIONAL FOSSIL RECORD TO TEST AND CALIBRATE RODENT MOLECULAR CLOCKS

VAN TUINEN, Marcel, Stanford Univ., Palo Alto, CA; BELL, Chris, Univ. of Texas, Austin, TX; CONROY, Chris, Univ. of California, Berkeley, CA; HADLY, Elizabeth, Stanford Univ., Stanford, CA

The applicability and accuracy of molecular clocks continue to be much-debated topics. In part, the debate derives from the frequent incongruence between molecular and fossil divergence time estimates. Bias in the fossil record typically is inferred to explain this incongruence. However, molecular time estimation can be inaccurate when a molecular clock is falsely assumed and through over-reliance on few fossil anchorpoints for rate calibration. Unfortunately, few studies yet exist that account for uncertainties in both molecular and paleontological time estimation. By focusing on arvicoline rodents, we explore how the fossil record can be used most efficiently and reliably to calibrate molecular trees, and to reveal variation in rates of molecular evolution. Arvicoline rodents comprise a model system for several reasons. This group has an excellent fossil record, is well studied genetically, and shows phylogenetic consistency between molecules and fossils. Thus, both molecular and fossil uncertainties can readily be quantified in this group. We explore novel techniques for combining molecular and paleontological data and evaluate the precision of internal (arvicoline) fossil calibration points relative to external calibration points (e.g. *Mus-Rattus*). We use relative estimates of both genes and fossils to bracket the timing and branching patterns of the clade. By comparing the two data sets we determined: (1) error bars associated with estimates of divergence times from molecules and morphology; (2) that internal calibration is less error-prone due to a significant increase in molecular rate from murid ancestors leading to arvicolines; (3) most significantly, we show that the iterative use of fossils and molecular data significantly increases our understanding of the cadence of evolution in this group.

Wednesday 4:00

THREE-DIMENSIONAL PREPARATION OF A LATE CRETACEOUS STURGEON FROM MONTANA

VANBEEK, Constance, Field Museum of Natural History, Chicago, IL

The Cretaceous fossil record of sturgeons (Acipenseridae), while plentiful, has not been known for well-preserved or complete specimens. The poor quality and fragmentary nature of the known material have made them of limited value to studies on the comparative anatomy and phylogenetic significance of fossil sturgeons. When an unusually well-preserved specimen of a new, undescribed taxon arrived at the Field Museum on loan from the Museum of the Rockies, it presented an opportunity to fully prepare the most complete fossil sturgeon yet known.

Because the specimen was so unique in its completeness, it was necessary to fully expose and then disarticulate all elements for research. This entailed removing previous consolidants that had been applied for stabilization of the fossil; and preparing elements in such a way that high-resolution images, both photographic and illustrative, would reveal the fine details. An important consideration was strengthening the fragile bones yet still being able to disarticulate them while undergoing this very thorough and detailed preparation. That dichotomy proved to be a persistent theme throughout the preparation of this remarkable specimen.

Poster Session B

THE PARTIAL PRESSURE OF OXYGEN AS A FACTOR IN VERTEBRATE DEVELOPMENT AND EVOLUTION

VANDEN BROOKS, John, Yale Univ., New Haven, CT

Understanding the environment?s effect on vertebrate evolution and development is essential to the study of ecology, paleontology and evolutionary theory. The Berner oxygen curve indicates a marked increase in the partial pressure of oxygen (pO_2) from the Late Carboniferous through the Permian with an upper value of 31% and a sharp decline at the Permo-Triassic boundary. Large-scale changes in pO_2 in the atmosphere would have had wide-ranging effects on vertebrate ecology and development.

Preliminary results pointed to a correlation between pO_2 and developmental rate in the embryonic stages of development in *Alligator mississippiensis*. To further examine the effects of varying pO_2 on vertebrate development, I carried out two experiments. The first was a more detailed study of the effect of varying oxygen levels on *Alligator mississippiensis* development. *Alligator* eggs were raised under two hypoxic and five hyperoxic levels of pO_2. In addition, sampling was weighted towards the earlier stages of development to determine the timing of cartilage formation and ossifications more carefully. I carried out the second experiment on *Poecilia reticulata* (the common guppy fish). This experiment was conducted under similar oxygen levels to the *Alligator* experiment, but allowed for the examination of the effects of high oxygen over the entire lifespan of an organism. Their short generation time allowed for a multi-generational experiment to test the effects of stepwise increases in oxygen as well as the plasticity of the observed changes.

The results of these experiments further strengthened the correlation between oxygen content and development. I then used the data to begin to examine changes in the fossil record during the hypothesized oxygen spike. This fossil data was used as a test of the Berner curve, as well as a first step in developing a possible paleo-proxy for oxygen within the vertebrate fossil record.

Wednesday 9:45

DON'T HAVE A COW, MAN! IT'S ONLY ACTUALISTIC TAPHONOMY ON THE YELLOWSTONE RIVER OF MONTANA

VARRICCHIO, David, JACKSON, Frankie, SCHERZEER, Benjamin, SHELTON, Jessica, Montana State Univ., Bozeman, MT

Catastrophic mass drownings have been inferred for a wide variety of vertebrates from titanotheres to hadrosaur dinosaurs, but relatively little modern data exists for taphonomic comparison. Late in the winter of 2003-04, a Montana rancher lost roughly 40 cattle to the Yellowstone River. These cows attempted to cross the frozen edge of the river to drink at a still open stretch. The herd broke through the ice, drowned, and became entrapped beneath the ice. Here they remained for over a month until the spring melt, when the river, freed of its ice jam, distributed the carcasses downstream. The simultaneous drowning of these cows provided a unique opportunity to examine the hydrodynamic consequences of mass death within a fluvial system. Carcasses were located, described and tagged in two canoe trips. The first trip in May 2004 located 33 cows spread over 40 km downriver from the initial drowning site. After two months nearly all the cows remained virtually intact and severely bloated. In several specimens, unborn calves protruded through the pelvic canal or were partially scattered outside the cow. This likely resulted from a combination of gas build-up and scavenger activity. Significantly, groups of two to five cows occurred at distances from 1 to over 30 km downstream. Although only 17 carcasses remained in late September, after the peak summer flow, several groups still persisted. The two most complete carcasses had only rigid upper skins holding the skeletons together. These specimens have implications for the occurrence of dinosaur 'mummies' in paleochannel deposits. Most cows were now fully disarticulated and poorly represented. The total remaining bone assemblage differed significantly from classic Voorhies Groups II and III for poorly transported and lag elements. While skulls were underrepresented, ribs and scapulas occurred with much higher frequency than expected. The occurrence of multi-individual groups with a uniform taphonomic signature supports the interpretation of similar fossil assemblages in fluvial deposits as representative of mass mortality.

Wednesday 11:00

BLEEDING KANSAS IN THE EVOLUTION DEBATE

VLAMIS, Ted, Wichita, KS

Confronting challenges to the inclusion on evolution as an integral part of K-12 curricula is and will continue to be not primarily a national issue, but rather it involves a series of political battles fought largely at state and local levels. As such, scientists will need to understand not only the scientific arguments, but also the political context in which these individual debates occur.

This presentation focuses on the past several years of political maneuvering in the evolution debate in Kansas. Particular attention is given to how this debate is shaped by the struggles between the moderate and social conservative wings of the Kansas Republican Party and the importance of voter mobilization/turnout. Detailed precinct by precinct voting results of

State BOE races and other contested primaries are compared as are general election results.

Because both pro-evolution and anti-evolution forces have prevailed at different times an analysis of successful strategies can help scientists in understanding how to confront this issue in the political arena. Education of the public must be accompanied by sound political strategies in order to ensure K-12 curricula which include evolution as a key component of biological science.

Poster Session A

THE TERRESTRIAL MAMMALIAN ASSEMBLAGE OF THE MARINE PLIOCENE AGE SAN DIEGO FORMATION, SAN DIEGO COUNTY, CALIFORNIA

WAGNER, Hugh, San Diego Natural History Museum, San Diego, CA

The San Diego Formation contains one of the most diverse assemblages of Pliocene age organisms in the world including terrestrial plants, marine invertebrates, marine vertebrates, terrestrial vertbrates and birds. The known recovered diversity of terrestrial mammals from this unit is remarkable and provides significant information regarding the age of the unit, its possible physical location at the time of deposition, the composition of the terrestrial mammal fauna during middle and late Blancan time including interesting implications about the habitat or habits of some terrestrial mammals. A terrestrial mammalian assemblage recovered from a very limitied terrestrial facies, the Poggi Canyon local fauna, contains a limited representation of the total terrestrial mammalian taxa recovered from the marine deposits of the San Diego Formation. A total of eighteen families including twenty-eight species of terrestrial mammals from insectivores to proboscideans have been identified from this rock unit. A majority of these specimens were recovered from deposits in the vicinity of Chula Vista in southern San Diego County; however, others have appeared mixed with marine vertebrate and invertebrate assemblages in south-central San Diego County. The oldest terrestrial assemblage appears to be middle Blancan in age, approximately 3.5 Ma, in the southern portion of the county. The middle to late Blancan taxa represented are correlative with taxa in Blancan faunas from other locations in the United States. What appear to be latitudinal and climatic differences are especially evident in the rodent and carnivore taxa. The felids are the most abundant carnivores both in number of taxa and individuals represented. The interval of time represented may be as much as 1.5 Ma. The stratigraphic control on some occurrences can not be well integrated into the Chula Vista section.

Poster Session A

MORPHOLOGY AND SYSTEMATICS OF THE HEMPHILLIAN (MIOCENE) GRAY FOSSIL SITE TAPIR

WALLACE, Steven, East Tennessee State Univ., Johnson City, TN; HULBERT, Richard, Univ. of Florida, Gainesville, FL

The most abundant mammal at the Hemphillian Gray site in eastern Tennessee is a small-sized tapir (10-15 percent smaller than *Tapirus terrestris* in linear skeletal dimensions). The recovered sample, which appears to represent a single species, includes over 12 skulls, most with associated or articulated mandibles and postcranial skeletons, and hundreds of isolated bones and teeth. The deposit reflects a sinkhole-derived pond that was surrounded by a dense oak/hickory forest. Tapirs prefer such closed canopy systems today, which may have contributed to their high concentration within the site. Only a small portion of the deposit has been excavated, consequently the MNI is expected to grow substantially, making the Gray sample the largest and most completely known population of a Neogene tapirid.

The Gray tapir is most similar in size and morphology to *"Tapiravus" polkensis* from the late early and late Hemphillian of Florida, and is here referred to that species. However, the Gray sample is much larger and more complete than the combined sample from Florida, demonstrating many previously unknown character states for this species and affording a closer look at its generic status. The cheek teeth have the characteristic morphology of *Tapirus*, and its overall skull proportions are similar to those of *Tapirus veroensis* or *Tapirus pinchaque*. Phylogenetically, the most important morphologic features are: large, triangular interparietal; temporal crests approach one another through ontogeny but do not unite to form a single sagittal crest; groove for meatal diverticulum on frontals and nasals is extensive, moderately deep, and has distinct anterior and posterior margins; mental foramen located ventral to p2; i1 much larger than i2 and procumbent; caniniform I3; reduced upper canine; and strong parastyles on upper molars. These characters support referral of this species to *Tapirus*, and provide new insight into the evolution of the genus during the late Miocene.

Poster Session A

REVISION OF *SIMIMERYX* (ARTIODACTYLA, HYPERTRAGULIDAE)

WALSH, Steve, San Diego Natural History Museum, San Diego, CA

Simimeryx was named by Chester Stock in 1934 from the Sespe Formation of Ventura County, California. Numerous additional specimens of *S. hudsoni* (including deciduous premolars and isolated postcrania) are present in LACM collections from the early Duchesnean (late middle Eocene) Pearson Ranch local fauna, curated by D.J. Golz in the 1970s. The species was originally described as lacking a diastema between p2-3, but some mandibles of *S. hudsoni* do have such a diastema (e.g., LACM 52927), foreshadowing the condition in *Hypertragulus*. An isolated cubonavicular (LACM 53509) shows that *S. hudsoni* had the diagnostic ruminant character of the fusion of these two bones. Available specimens are inadequate to test a recent proposal of I. Vislobokova that *Simimeryx* had lost p1 and that its caniniform lower tooth is c1.

Simimeryx is rare in the Eocene strata of San Diego County. A few upper molars from UCMP V-72088 (member C of Santiago Fm.) have a continuous lingual cingulum and may be conspecific with an unnamed species of *Simimeryx* from the late Uintan Tapo Canyon local fauna, described by M. Mason in an unpublished thesis.

"Hypertragulus" heikeni was named by I. Ferrusquia-Villafranca from the early Chadronian of Chihuahua, Mexico on the basis of paired mandibles with low-crowned teeth. The presence of a short diastema between p2-3 and a more complex p3 was thought to exclude the species from *Simimeryx*, but these characters are sometimes present in *S. hudsoni* (e.g., LACM 53437). *"H." heikeni* is similar to *S. hudsoni* in having low-crowned molars without fossettids, in having the cristid obliqua of m1-3 contact the posterior wall of the trigonid (rather than joining the crest between the metaconid and entoconid as in *Hypertragulus*), and in having an m3 hypoconulid with the primitive selenodont condition of a simple U-shaped basin (not the derived crescentic or cloven condition found in *Hypertragulus*). *"H." heikeni* is here regarded as the youngest known species of *Simimeryx*, and is similar in size and morphology to the poorly known *S. minutus* from the later Duchesnean of Utah.

Wednesday 9:15

A CTENOCHASMATID FLYING REPTILE (ARCHAEOPTERODACTYLOIDEA, PTEROSAURIA) FROM THE LIAONING DEPOSITS, LOWER CRETACEOUS, CHINA

WANG, Xiaolin, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; KELLNER, Alexander, Museu Nacional/UFRJ, Rio de Janeiro, Brazil; ZHOU, Zhongue, Institute Vertebrate Paleontology and Paleoanth., Beijing, China; CAMPOS, Diogenes, Departamento Nacional de Producao Mineral, Rio de Janeiro, Brazil

A new pterosaur specimen (IVPP V 11981) from the lower Yixian Formation (125 Ma) at the Sihetun locality is reported. Several elements (cranial bones, carpals scapula-coracoid) are unfused, suggesting that it represents a subadult. Soft tissue is concentrated near the posterior part of the skull (preserved length: 140mm, estimated length: ca.165mm) and consists of small dark fibers that lack any symmetric branching, consistent with the hair-like structures reported in other pterosaurs. A second kind of soft tissue is formed by a mass of dark substance surrounded by the sclerotic ring and possible represents the remains of the eye ball, reported for the first time in a pterosaur. IVPP V 11981 shows the following synapomorphies of the Archaeopterodactyloidea: elongated mid-cervical vertebrae, with low and blade like neural spine, and strongly inclined quadrate. The dorsal margin of the skull is concave, a feature shared by Gallodactylidae + Ctenochasmatidae. It further shows two synapomorfies of the Ctenochasmatidae *sensu* Kellner: long rostral part (anterior to the nasoantorbital fenestra) reaching around 60% of the skull length and dentition formed by an estimated number of over 150 thin needle-like teeth. The nasoantorbital fenestra is low and comparatively small (ca. 16% of the skull length) similar to *Ctenochasma* and larger than in *Pterodaustro*. At least one cervical vertebra has a small lateral pneumatic foramen, reported for the first time in the Ctenochasmatidae. Cervical ribs were observed in some mid-cervicals, an unusual feature within archaeopterodactyloids. From the 10 pterosaur taxa from the Jehol Biota described so far, three are members of the Archaeopterodactyloidea, all of uncertain systematic position within that clade. The first one, *Haopterus gracilis* is not a member of the Ctenochasmatidae, having lesser teeth and a shorter rostrum. The two others, *Eosipterus yangi* and *Beipiaopterus chenianus* are known by incomplete material that lack cranial elements, making the comparisons with IVPP V 11981 difficult. The new specimen is the first uncontroversial member of the Ctenochasmatidae from the Jehol Biota.

Wednesday 11:30

A NEW SPECIES OF *MARTINOGALE* (CARNIVORA, MEPHITINAE) FROM THE DOVE SPRING FORMATION (UPPER MIOCENE) OF SOUTHERN CALIFORNIA AND ITS IMPLICATIONS FOR THE ORIGIN OF NEW WORLD SKUNKS

WANG, Xiaoming, WHISTLER, David, TAKEUCHI, Gary, Natural History Museum of Los Angeles County, Los Angeles, CA

The late Miocene *Martinogale* has long been suspected to be the earliest and most primitive skunk (Carnivora, Mephitinae) in the New World. Presumably an immigrant from Eurasia, this taxon was previously poorly known by a few fragments of jaws from the central Great Plains and New Mexico. A nearly complete skull and associated lower jaws of *Martinogale* was recovered from the upper section (late Clarendonian) of the Dove Spring Formation, Kern County, California. The new specimen is among the best preserved primitive fossil skunks and represents one of the earliest members of the New World mephitines. As the smallest skunk so far known, the new *Martinogale* features some of the most primitive cranial and dental morphologies in mephitines. Belonging to a new species of *Martinogale*, the new specimen is also the first occurrence of this genus in the West Coast of North America.

Phylogenetic analysis suggests a New World clade of mephitines for all known fossil and living taxa from North and South America. We place them in a new tribe Mephitini to be distinguished from Old World mephitines. New World mephitines share the following derived characters: presence of a P4 parastyle, m1 hypoconid dominant in talonid, and presence of a lingual cingulum on lower canines. We further postulate that New World skunks are the result of a single immigration event, and the new California skunk is close to the origin of the New World skunks.

Poster Session B

WARM SPRINGS RANCH DINOSAUR QUARRIES FROM THE UPPER MORRISON FORMATION OF NORTH CENTRAL WYOMING

WATKINS, Pamela, GRAY, David, Wyoming Dinosaur Center, Thermopolis, WY; IKEJIRI, Takehito, Fort Hays State Univ., Hays, KS; POHL, Burkhard, Wyoming Dinosaur Center, Thermopolis, WY

The Warm Spring Ranch dinosaur quarries are located in Hot Springs county near the town of Thermopolis on the southern shoulder of the Big Horn Basin in north central Wyoming. The quarries date to the Upper Morrison Formation (Late Jurassic). Since 1993, approximately sixty individual sites, including three major quarries, have been discovered on approximately 700 acres of the ranch. Three major quarries, Bone Bed (BB), Beside Sauropod (BS), and Something Interesting (SI), are discussed relative to lithology, dinosaur taxa, and taphonomy. The predominant dinosaur remains found on the ranch are sauropods, including up to six fairly complete skeletons of *Camarasaurus*, *Apatosaurus*, and *Diplodocus*. Partial theropod remains (cf. *Allosaurus*) are present at one site. Although theropod shed teeth are found in several sites, no strong evidence of scavenging is recognized. Fragmentary remains of *Stegosaurus* are also found at another site. Generally, the majority of bones are found in a disarticulated state but well preserved. There is a paucity of non-dinosaurian vertebrate fossils (e.g., fish, turtles, crocodilians) on the ranch. Stratigraphically, the three quarries lie within a 10 to 12 m vertical span relative to each other. The lithology of each quarry exhibits slightly different facies, including various types of mudstone, fine to medium grain-sized sandstone, and thin lenses of carbonate nodules. The amount of plant material varies throughout each quarry and consists mainly of lignite. Abiotic and biotic factors of the quarries suggest various depositional environments ranging between fluvial and lacustrine systems in the Thermopolis area during this time.

Saturday 8:15

WHAT PNEUMATICITY TELLS US ABOUT "PROSAUROPODS", AND VICE VERSA

WEDEL, Mathew, UCMP, Berkeley, CA

Diverticula of the lungs and air sacs pneumatize parts of the postcranial skeleton in most birds. Birds are the only extant vertebrates with postcranial skeletal pneumaticity (PSP). PSP is also present in most other theropods, sauropods, and pterosaurs, but absent in ornithischians and most "prosauropods" (non-sauropod sauropodomorphs).

What "prosauropods" tell us about pneumaticity: 1. PSP originated in sauropodomorphs in the Late Triassic, at about the same time that it appeared in theropods. 2. The only "prosauropod" with pneumatic cavities in its vertebral centra is *Thecodontosaurus caducus*, one of the earliest and smallest sauropodomorphs. All "prosauropods" have vertebral laminae, but it is not clear whether these laminae were associated with pneumatic diverticula. 3. Pneumatic cavities are confined to the cervical vertebrae in *T. caducus*, basal sauropods, and basal theropods, and in the earliest ontogenetic stages of pneumatization in extant birds. 4. *T. caducus* was small and only pneumatized a few elements. The same is true of the earliest theropods with PSP. Pneumaticity probably did not evolve to lighten the skeleton (although it became important in that regard later in the evolution of sauropods and theropods).

What pneumaticity tells us about "prosauropods": 1. The pattern of pneumatization in *T. caducus* indicates the presence of a diverticular lung and cervical air sacs similar to those of birds. The same holds for basal sauropods, basal theropods, and pterosaurs. 2. In terms of evolutionary change, respiratory mechanisms are highly conserved, PSP is highly labile, and diverticula seem to be somewhere in between. In the case of dinosaurs without PSP, such as ornithischians and most "prosauropods", our null hypothesis should be that they had air sacs (since they are bracketed by taxa with PSP) but lacked either PSP or diverticula, not that they lacked air sacs.

Wednesday, Preparator Poster

PREPARATION OF UNIQUELY PRESERVED VERTEBRATE FOSSILS FROM THE BIG PIG DIG QUARRY IN BADLANDS NATIONAL PARK, SOUTH DAKOTA

WEILER, Matthew, JOHNSON, Shawna, SHELDON, Matthew, TATE, Allen, HERBEL, Carrie, South Dakota School of Mines & Technology, Rapid City, SD

Fossil preservation from the Pig Dig varies widely within a 36 square meter area. Thus the variable preservation (well-indurated to friable matrix) presents problems that are not commonly seen with other Badlands fossil beds. Pig Dig bones are collected from a damp environment that dries quickly and flakes apart. This is problematic as the matrix varies from one extreme to another throughout the quarry. Preparation using water as a solvent cannot be used on these clay-covered specimens as the smectite swells, thus making bone preservation unstable. The best tool for the loose friable clay is a pick and brush to remove matrix, followed by consolidation using thin Butvar B-76 to permeate the bone. Consolidating with thin Butvar first over the entire bone surface followed by medium Butvar within the cracks is critical. Later applications of Butvar glue can be used to repair large broken areas. However, when working with well-indurated matrix, the process changes, even though the fossils are as fragile as those within friable matrix. We recommend an airscribe, usually a Microjack 2 or 5, to cut through matrix with minimal vibration, minimizing bone breakage. Repeated applications of thin Butvar during airscribing aid in keeping bones intact. Many stages of bedding jackets are used with Pig Dig specimens to maintain the original position as collected. With a combination of finesse and modern tools, these preservational differences within the same site, or even the same jacket can be overcome, so that each fossil can be prepared so that the specimen is preserved beautifully.

Poster Session B

R. W. WHIPPLE'S SPECIMENS REFERABLE TO *MEGAMOLGOPHIS AGOSTINI* ROMER, 1952 (AMPHIBIA: LEPOSPONDYLI)

WELLSTEAD, Carl, WVU Tech, Montgomery, WV

In the early 1930s R. W. Whipple of Marietta College (Ohio) collected two series of lepospondylous vertebrae from the Ninevah Limestone (Greene Formation, Dunkard Group, Permian) at Limestone Hill, WV. One specimen consists of an articulated series of approximately 17 dorsal and six caudal vertebrae. The dorsal centra are large for a lepospondyl (1.6 cm long). The caudal centra, seemingly from tail's end, are smaller, approximately 0.5 cm long. The second specimen consists of two articulated, but fragmentary, caudal vertebrae whose centra are about 1.5 cm long. The vertebrae are similar to those found in lepospondyls such as *Megamolgophis* and *Brachydectes* in that the centra are hourglass-shaped, amphicoelous, and bear longitudinal carinae. Similarly, the left and right halves of the neural arches are sutured, not fused, to one another. Likewise, neural arches are sutured, not fused, to their centra. However, the large size of the vertebrae and morphological details of the carinae suggest assignment of the specimens to *Megamolgophis* (estimated body length, one meter), rather than to *Brachydectes* (maximum length, approx. 50 cm) whose vertebrae are generally smaller and bear simpler carinae. Whipple's specimens represent only the second- and third-known articulated series of vertebrae of *M. agostini* and contribute significantly to knowledge of the species in that the short caudal series bears haemal arches.

Student Poster Session

EGGSHELLS AND BABY DINOSAURS IN THE UPPER AGUJA FORMATION OF BIG BEND NATIONAL PARK, TEXAS

WELSH, Edward, Chadron State College, Chadron, NE

Surface collecting within the inland floodplain deposits of the upper Aguja Formation (upper Campanian to lower Maastrichtian) in Big Bend National Park, Texas has produced a rich abundance of fossil remains representing the Late Cretaceous of this area. The sites in this region are important in providing one of the southernmost terrestrial records at this time in North American natural history. Fossilized eggshells are present within these deposits, located around the Rattlesnake Mountain area. Specimens were collected in May of 2002 during a field course in the park. Another trip to the park was made in January of 2005 and more fragments were discovered and collected, more than tripling the size of the 2002 eggshell collection. This trip in 2005 also provided a yield of small teeth from hatchling and/or juvenile hadrosaurs and theropods (tyrannosaurs and cf. *Saurornitholestes*). This is the southernmost record of fossil eggshell remains in the United States, which is what makes this site unique. The occurrence of fossilized eggs, especially with associated animal material, is rare, which makes true taxonomic identification and correlation difficult. Fossil eggshell remains as well as material from young dinosaurs are present within the same sediments of the upper Aguja. No nests have been discovered in this area, which denies direct correlation. The specimens of the Big Bend Aguja sites reveal a variety of microstructures which resemble dinosauroid prismatic, dinosauroid spherulitic, and ornithoid eggshell microstructures, structures commonly seen in dinosaurs and birds.

These sites in Texas are beginning to reveal that animals were nesting in Big Bend, and it appears that these animals preferred this area as a nesting ground. The collective material gained will help provide a clearer picture into this nesting environment as well as the overall viewpoint of the local paleoecology. Along with the abundance and variety of specimens found in deposits such as this, this research must calls other researchers to pay closer attention to similar microsites, because valuable material such as the eggshells found in Big Bend may be seriously overlooked.

Saturday 3:30

ONTOGENY AND OSTEOHISTOLOGY OF THE ORNITHOPOD DINOSAUR *TENONTOSAURUS TILLETTI* (CRETACEOUS, NORTH AMERICA)

WERNING, Sarah, Sam Noble Oklahoma Museum of Natural History, Norman, OK

The ornithopod dinosaur *Tenontosaurus tilletti* is represented by a large number of specimens from several North American formations of Aptian-Albian age. The Antlers Formation of Oklahoma and the Cloverly Formation of Montana and Wyoming have each yielded excellent specimens representing two nearly complete ontogenetic growth series. Areas where these formations now outcrop were separated geographically by approximately twelve degrees of paleolatitude, and were deposited on different sides of the Hadley cell boundary. Paleoecological data suggest differences in both aridity and seasonality between the two formations. In addition to these factors, *T. tilletti* is ideal for a comparative growth study because it is has been better sampled than most dinosaurian taxa.

I performed an ontogenetic study of this species using histological methods, and observed variation in bone histology and growth rate at the individual, population and species levels. This variation may be explained in part by differences in paleoclimate between the two populations. Additionally, the results of this study are compared to previously published growth curves and histological data for other dinosaurian taxa. Because of the systematic placement

of this basal iguanodontian, as well as the broad ontogenetic and populational sampling, this study provides improved basis for evaluating variation in other, more advanced ornithopods.

Poster Session A

NEW RODENT FAUNAS SPANNING SEVERAL SALMAS FROM THE LAGUNA DEL LAJA REGION, ANDEAN MAIN RANGE, CENTRAL CHILE

WERTHEIM, Jill, UC Santa Barbara, Santa Barbara, CA; CROFT, Darin, Case Western Reserve Univ. School of Medicine, Cleveland, OH; FLYNN, John, American Musem of Natural History, New York, NY; WYSS, Andre, Univ. of California, Santa Barbara, Santa Barbara, CA

Most South American Land Mammal "Ages" (SALMAs) are based on well-sampled but geographically restricted faunas from the high latitudes, or less well known temporal "snapshot" localities from elsewhere on the continent. Abundant fossils have recently been recovered from a previously unsampled region, the primarily volcanic and volcaniclastic Cura-Mallín Formation (CMF) near Laguna del Laja (LdL) in the Andean Main Range of central Chile. Preliminary $^{40}Ar/^{39}Ar$ dates spanning the unit's entire thickness at LdL and the base of the overlying Trapa-Trapa Formation (TTF) indicate ages ranging from ~21-9 Ma, potentially spanning five SALMAs. LdL thus represents one of very few examples of superposed mammal faunas in South America.

The extra-Patagonian location of LdL is reflected in the strong dissimilarity of the rodents to all known coeval species, with the exception of those from the geographically near Cañadon del Tordillo (CdT) fauna of Neuquén, Argentina (middle Miocene Colloncuran SALMA). Although some LdL rodents exhibit generic affinities to Patagonian taxa, most are new at the species level, and several likely represent new genera. The degree of distinctiveness of the LdL rodents relative to Patagonian contemporaries is notable given the proximity of LdL to the northern edge of Patagonia, undoubtedly reflecting differences in age, habitat, topographic isolation, paleoenvironment, and depositional setting. In contrast, the similarities between the LdL and CdT rodents demonstrate the strong effect of geography, potentially even stronger than age, on taxonomic composition and morphology.

The broad temporal range of the LdL deposits is reflected in associated changes in composition of the rodent fauna. Forms closely related to taxa typical of at least four different SALMAs appear sequentially; a Colhuehuapian aff. *Neoreomys* n.sp. is overlain by taxa of Santacrucian aspect (*Steiromys*, cf. *Acarechimys*, aff. *Stichomys* n. sp., cf. *Scleromys*, aff. *Eocardia* n. sp.) Taxa typical of the Colloncuran (e.g. *Prolagostomus*, *Maruchito*) occur highest in the CMF and a remarkably high-crowned ?*Alloiomys* has been recovered from the overlying TTF.

Wednesday 1:45

ECOMORPHOLOGICAL STRUCTURE OF MODERN CARNIVORAN DIVERSITY AND THE IMPACT OF ENVIRONMENT

WESLEY-HUNT, Gina, WERDELIN, Lars, Swedish Museum of Natural History, Stockholm, Sweden

We test the hypothesis that the ecomorphological structure of carnivoran diversity is not significantly different among a set of environmental categories regardless of taxonomic make-up. Similar structure would infer that the ecological structure of modern carnivoran diversity is constant and not dependent on the environment. To test this, we compiled a database of morphologic information for 217 fissiped carnivorans (91% of known species). Characters used to calculate a distance matrix describe the entire dentition and capture the variety of functional units found within the carnivoran tooth row. Diversity and environmental data from 197 localities worldwide were obtained from a database of modern mammal communities, compiled by a working group at NCEAS. Morphologic disparity was calculated among the taxa found in each of seven environmental categories: Bushland, Grassland, Temperate Forest, Tropical Forest, Wooded Grassland, and Woodland.

We found that only Temperate Forest can be distinguished from other environments by average disparity. Average and maximum disparity is lower in this category than in all others. Therefore, maximum distance between any two taxa is less, and taxa are generally more tightly packed. However, the structure of the taxonomic morphospace distribution in Temperate Forest is very similar to that in other categories; this is especially evident when individual localities are compared. To further explore the structure of morphospace we used the minimum spanning tree (MST). We found that the MST and its descriptive statistics provide a useful compliment to average disparity in describing the morphologic distribution of a group. Knowledge of how modern carnivoran diversity is organized in different environments allows for a better understanding of the structure of fossil carnivoran diversity and the diversification of carnivorans into new environments and ecological roles.

Friday Fishes Symposium poster

PRELIMINARY SURVEY FOR *CARCHARODON MEGALODON* AND OTHER FISHES FROM THE MIOCENE OF PANAMA

WESTGATE, James, Lamar Univ., Beaumont, TX; BROWN, R., Instituto Nacional de Antropologia E Historia, Chihuahua, Mexico; COPE, Dana, College of Charleston, Charleston, SC; STRINGER, Gary, Univ. of Louisiana-Monroe, Monroe, LA

Recent field surveys near the Canal Zone and in the Darien Province of Panama have yielded new evidence of the Miocene ichthyological community that inhabited the region prior to the closing of the Straits of Panama. A diverse assemblage of chondrichthyan teeth and teleost otoliths was collected from the Miocene Gatun Formation at two localities near Barriada San Pedro, between Colon and Sabanitas. Specimens from these localities comprise the Cervesa local fauna. *Carcharhinus* sp., *Hemispristis serra*, *Myliobatis* sp., *Rhinoptera* sp., and *Sphyreana* sp. are represented by teeth. An otolith assemblage is dominated by sciaenids (drums) with 53% of the total taxa and 51% of the total specimens. A sciaenid, *Equetus* aff. *davidandrewi*, is the dominant taxon based on otoliths, comprising almost 24% of the otoliths. Three species of ariids (marine catfish) constitute 24% of the total specimens. The otoliths represent forms that are found mainly in the present-day Caribbean Sea and Gulf of Mexico. The presence of at least one Pacific form is interpreted as a relict of the Western Tethys fauna prior to the closure of the Isthmus of Panama. The paleowater depth probably ranged from 0-25 m. The community represented by otoliths is comprised of species which prefer tropical and subtropical climatic conditions, normal marine salinity (with some indications of reduced salinities), and soft, muddy bottoms.

Two teeth of the great white shark *Carcharodon megalodon* represent the first records of this species from the Darien Province. One tooth was discovered on the Membrillo River near the village of Membrillo in outcrops of the uppermost Oligocene/ lowermost Miocene Topalizo Formation. The other specimen was collected in the Tuira River drainage basin, probably from the upper Miocene Tuira Formation, Gatun Group, near the Colombian border.

Wednesday 9:00

PHYLOGENY OF THE RHYNCHOSAURIA

WHATLEY, Robin, Smithsonian Institution, Washington, DC

Rhynchosaurs are a group of Triassic, terrestrial archosauromorphs that developed a mosaic of increasingly distinctive cranial features over their ~40 million year long history. Previous analyses of this group have treated Early, Middle, or Late Triassic taxa in isolation such that no single unified phylogeny was available. Morphologic characters based upon first-hand examination of all taxa and most specimens known worldwide inform a comprehensive phylogenetic hypothesis for the Rhynchosauria, including basal members *Mesosuchus browni* and *Howesia browni* and all species of the Late Triassic genus *Hyperodapedon*. This study provides the first well-supported phylogenetic placements of *Stenaulorhynchus stockleyi* (Manda Formation, Tanzania) and *Isalorhynchus genovefae* (basal Isalo II unit, southwestern Madagascar). *Stenaulorhynchus* is distinct from *Rhynchosaurus articeps* in possessing a number of derived postcranial features shared with other large-bodied rhynchosaurs. The relationship between *'Rhynchosaurus' spenceri* and *'Rinchossauro mariante'* remains unresolved, but these two taxa together herald major changes in the skull and dentition, an evolutionary trend that is continued in later-diverging rhynchosaurs.

Isalorhynchus does not belong to the Late Triassic clade *Hyperodapedon* as previously proposed, but instead possesses a mosaic of plesiomorphic and derived cranial features supporting its position basal to all species of *Hyperodapedon*, including *H. huenei* + *'Scaphonyx' sulcognathus*. Many features shared by *Isalorhynchus* and *Hyperodapedon* are plesiomorphic for the latter. Resolution is lacking among the Late Triassic taxa *H. gordoni, H. huxleyi, H. sanjuanensis*, and other species of *Hyperodapedon*, and placement of the closely related taxa *H. huenei* and *'S.' sulcognathus* differs from that in previous analyses. The phylogenetic position of *Isalorhynchus* indicates that its lineage must have diverged by the earliest Late Triassic, prior to the diversification of *Hyperodapedon*.

Wednesday 11:45

TABULATION AND SIGNIFICANCE OF LIMB PROPORTIONS OF *PANTHERA ATROX* FROM THE LATE PLEISTOCENE OF NORTH AMERICA

WHEELER, H. Todd, George C. Page Museum, Los Angeles, CA; JEFFERSON, George, Colorado Desert District Stout Research Center, Borrego Springs, CA

The long-limbed cursorial proportions of late Pleistocene *Panthera atrox* were first presented in detail by Merriam and Stock in the form of limb proportions based upon the sample of 90 some individuals from Rancho La Brea, California. That these observations apply to a contiguous species of *P. atrox* throughout the Americas, south of the Laurentide and Cordilleran Ice sheets, has not been seriously challenged, since assignment of all lions to *P. atrox, P. leo,* and *P. spelaea*, with allowance for the pronounced sexual dimorphism. This seemingly obvious conclusion however should have evidence.

Identification of individual large *Panthera* without soft tissue is a difficult and subjective process; but distinguishing populations of the different lion species can be accomplished by objective criteria such as limb proportions. The other population of *Panthera atrox* is from Natural Trap Cave (NTC), Wyoming, with a sample of five or six individuals. The *P. atrox* from (NTC) have the following limb ratios: radius/humerus .93, metacarpal III/humerus .36, tibia/femur .88, metatarsal III/femur .34, and humerus/femur .86; very similar proportions to the Rancho La Brea sample. The (NTC) lions are smaller, with the males being about the same in size, and limb length, to the Rancho La Brea females; but similar size variations are seen in separate populations of both living and fossil *Panthera*.

The shorter limbed extant *Panthera leo* is described as having the limb proportions of a forest felid, which it is. Since it is also the top predator of the woodlands surrounding the savanna, its limb proportions reflect the compromise between habitats. *Panthera atrox* developed in North America. Here, *Smilodon* was the top predator of the woodlands and heavy cover habitats, conditions where *P. atrox* could not compete. Northern forests as preferred habitat for

Smilodon may have become as effective a barrier inhibiting contact between *P. atrox* and *P. spelaea* as the Glacial Maximum ice sheets of Beringa. As an uncompromised open terrain lion, *P. atrox* may have developed an even more structured form of prides than exhibited by extant *P. leo.*

Poster Session A

OLD TEETH, NEW INTERPRETATIONS: A FUNCTIONAL ANALYSIS OF THE MOLAR MORPHOLOGY OF THE QUERCY ADAPIDS

WHITE, Jessica, Univ. of Iowa, Iowa City, IA

As a part of a larger paleoecological analysis of adapiforms, this study explores the utility of two methodologies for identifying functional morphotypes in molar anatomy among the adapids from the Quercy fauna. Results of an ANOVA analysis reveal that of the 15 dimensions collected here on the lower first molars, *Leptadapis* and *Palaeolemur* differ significantly at the .05 level in 13 comparisons, whereas *Adapis* and *Leptadapis* differ in 7. However, in no cases do data collected on *Adapis* differ significantly from those of *Palaeolemur*.

Following Canonical Variate Analysis and Thin Plate Splines Analysis, preliminary data suggest functional differences reflect variable lingual and buccal "flexing" of the molars. Interestingly, MANOVA testing of the partial warps demonstrated differences between all 3 genera. Functional interpretations of this were substantiated through relative warps analysis. Although inclusion of additional adapid genera and supplementation of sample sizes is needed to further support this preliminary work, it is reasonable to suggest that different functional morphotypes do exist among the Quercy adapids. Further, it may be possible that this variation may correspond to different patterns of dietary behavior among adapids.

Student Poster Session

FOSSIL MOLES OF THE SANTA FE RIVER 1B, FLORIDA

WILLIAMS, Daniel, Univ. of Kansas, Lawrence, KS

The Santa Fe River site (SF1B) in Gilchrist County, Florida is a sinkhole deposit of debated Pliocene, mixed Pliocene/Pleistocene age. Fossils from SF1B include a wide variety of small mammals. Mole elements found in the deposit include 14 humeri, two ulnae, and a right m2. Analysis of extant and fossil comparative specimens suggests the humeri belong to the extant genus *Scalopus*. The two ulnae and the right m2 are classified as *Scalopus aquaticus* based on characters and size. An initial principal components analysis revealed no recognizable pattern among the fossil humeri. A further statistical analysis of modern *S. aquaticus* humeri is used to determine the significance of the variation observed in the fossil group.

Student Poster Session

A NEW LATE MIOCENE (LATE BARSTOVIAN) HERPETOFAUNA FROM FORT POLK, LA

WILLIAMS, Michael, Louisiana State Univ., Baton Rouge, LA

With the exception of isolated Pleistocene turtle and crocodilian elements, fossil herpetofaunas are unknown from the state of Louisiana. Microvertebrate screenwashing of Fort Polk sediments has yielded abundant remains of fossil anurans, salamanders, and snakes. Thus far, 52 anuran postcranial elements, five salamander vertebrae, and 86 snake vertebrae have been identified from four out of nine fossil reptile and amphibian bearing sites on Fort Polk.

Since reptiles and amphibians are good indicators of paleoenvironments, the taxonomic composition of this fauna will allow basic paleoenvironmental determinations to be made. Bufonid toads and non-natricine colubrid snakes are normally found associated with upland sites, while ranid frogs and natricine colubrid snakes are commonly associated with permanent freshwater sources. Because of these habitat preferences, the calculation of bufonid:ranid and natricine:non-natricine colubrid indices will further constrain the paleoenvironments.

Wednesday, Preparator Poster

THE LITTLE MUSEUM THAT COULD: HOW THE BURPEE MUSEUM OF NATURAL HISTORY PREPARED A JUVENILE TYRANNOSAUR

WILLIAMS, Scott, Burpee Museum of Natural History, Rockford, IL

During the summer of 2002, a volunteer field crew from the Burpee Museum of Natural History excavated the rare, partially articulated skeleton of a juvenile tyrannosaur from the Hell Creek Formation (late Maastrichtian) of Carter County, Montana. The subsequent preparation of the specimen, nicknamed 'Jane', presented several challenges. While Burpee Museum had adequate space for housing and displaying the tyrannosaur, it did not have an established fossil prep lab. Therefore Burpee Museum immediately set about to correct this situation. Initially, the museum sought assistance from institutions with established fossil prep labs including the Black Hills Institute for Geologic Research, the Field Museum of Natural History, and Paul Sereno's Dinosaur Lab at the Univ. of Chicago. These institutions were very generous with advice on fossil preparation and molding and casting of fossil vertebrates. They also provided suggestions for equipment purchases, molding and casting material and made several trips to Burpee to consult with staff. Preparation of 'Jane' the tyrannosaur was accomplished by a small crew of fossil enthusiasts, supplemented by experienced contract preparators from the Field Museum. While waiting for new prep equipment to arrive and upgrades to the lab to be implemented, Burpee's prep staff utilized several innovative and inexpensive techniques for continuing the preparation of the tyrannosaur. These included simple modifications to engraving tools and the construction of portable air abrasion chamber utilizing PVC piping, a simple shower curtain, and Plexiglas. The upgraded Burpee prep lab contains a ComCo Air Abrasion unit, homemade stationary and portable abrasion chambers, a dedicated air compressor unit, air powered Micro-Jack tools, and an assortment of fossil adhesives and stabilizers. The Burpee prep lab was designed to be a 'living exhibit'; viewable to the general public who can ask the preparators questions about the preparation process. To date, the preparation, molding and casting of 'Jane' has involved over 10,000 hours of work. The result can be seen in Burpee Museum's new exhibit, *Jane: Diary of a Dinosaur*.

Friday 2:30

A PHYLOGENY OF THE MIOCLAENINAE

WILLIAMSON, Thomas, New Mexico Museum of Natural History, Albuquerque, NM;
CARR, Thomas, Carthage College, Kenosha, WI

Mioclaeninae Osborn and Earle, 1895, originally established upon the early Paleocene *Mioclaenus*, has since been expanded by some workers to include many Paleogene ungulates of North and South America, Europe, and North Africa. We conducted two phylogenetic analyses of 52 dental characters for 28 taxa, which included selected "zhelestids," South American Kollpaniinae, European Pleuraspithotheriinae, African *Abdounodus*, and numerous North American Hyopsodontinae and Mioclaeninae. In these analyses *Bomburia* and *Ellipsodon* were run as separate taxa rather than as synonyms. In addition, the analyses included new morphological data for *Bomburia*, *Ellipsodon* and other taxa. Also, a new specimen referable to *Platymastus palantir* (USNM 12911)—a partial maxilla with M1-3—added characters that indicates it is a hyopsodontid instead of a loxolophine arctocyonid, which supports its synonymy with *Bomburia prisca*.

Two analyses were conducted; the first with *Bomburia prisca* and *Platymastus palantir* included as separate taxa; and the second with *P. palantir* as a junior synonym of *B. prisca*. The first analysis resulted in 959 trees of 185 steps, with a C.I. of 0.42, and an H. I. of 0.60. The second analysis resulted in only 6 trees, of 186 steps each, with a C.I. of 0.42, and an H.I. of 0.59. Both analyses indicate that the Mioclaeninae is monophyletic and includes only North American taxa. Kollpaniinae, Pleuraspidotheriinae, and *Abdounodus* fall outside of a clade consisting of "basal" ungulates including *Protungulatum*, *Oxyprimus*, and *Baioconodon* + (Hyopsodontinae + Mioclaeninae).

Saturday 11:45

ESTIMATING EARLY SAUROPOD DINOSAUR LOCOMOTOR POSTURE AND SPATIOTEMPORAL DISTRIBUTION WITH ICHNOFOSSILS AND BODY FOSSILS: A STRATOCLADISTIC APPROACH

WILSON, Jeffrey, Univ.of Michigan, Ann Arbor, MI

Fossil vertebrate distributions are typically based on body fossils, which are often poorly sampled at the margins of their true temporal and spatial ranges. Because vertebrate ichnofossils can be preserved in great abundance and often in different environments than vertebrate body fossils, ichnofossil data may improve estimated ranges. If ichnofossils are used to estimate distributions, however, their attribution to body fossil groups (i.e., trackmaker identification) must be temporally and spatially independent of body fossil distributions. Ichnofossils identified by synapomorphies present in body fossil clades can extend pre-existing distributions and inform character distributions, which in turn may influence hypotheses of locomotor evolution.

Spatiotemporal distributions of sauropod ichnofossils and body fossils overlap, but some strata and areas are recorded by only one of these sources. This partial disjunction between ichnofossil and body fossil datasets indicates that no one source provides the best estimate of sauropod distributions. In addition to spatiotemporal information, early sauropod ichnofossils provide information about locomotor posture that often cannot be discerned from the earliest body fossils, which rarely preserve manual and pedal remains. The presence of derived locomotor features in early-appearing sauropod ichnofossils challenges previous hypotheses of character transformation, implying parallelism, reversal, or ghost lineages.

Stratocladistics can be used to resolve these conflicting character and temporal distributions. Stratocladistic analysis of a combined ichnofossil and body fossil dataset suggests a richer, more widely distributed diversity of early sauropods than currently recognized in body fossils and suggests that several signature locomotor features evolved during the 10-15 million-year interval preceding the appearance of *Tetrasauropus* and *Isanosaurus* in the fossil record. These results underscore the importance of ichnofossils to understanding vertebrate distribution and locomotor evolution.

Friday Fishes Symposium poster

ANATOMY OF THE SILURIAN THELODONT *PHLEBOLEPIS ELEGANS* PANDER

WILSON, Mark, Univ.of Alberta, Edmonton, AB, Canada; MARSS, Tiiu, Tallinn Technical Univ., Tallinn, Estonia

Among the most-often illustrated of fossil jawless vertebrates is the Late Silurian thelodont *Phlebolepis elegans* Pander, 1856, yet details of its anatomy remain controversial. The last detailed study of the body morphology of this species was that by Ritchie in 1968, but reconstructions by many authors before and since reveal fundamental differences of interpretation. Problematic aspects include the shape and position of the mouth, the branchial openings, the sizes of the dorsal and anal fins, and the shape and size of the caudal fin. Nevertheless, *P. elegans* is the best-known member of the family Phlebolepididae, and among the best-known

members of the Thelodonti, a group that has been suggested to be close to the ancestry of several major clades of early vertebrates.

We present here the preliminary results of our examination of thousands of specimens of *Phlebolepis elegans* from the collections of Tartu Univ., Estonia. Collected in 1929 by Artur Luha from the Himmiste quarry on the island of Saaremaa (formerly known as Oesel), the specimens are arranged by the dozens in part and counterpart on thick slabs of dolostone. The corresponding sediments were deposited during the Ludlovian Age in a shallow marine environment.

Study of the specimens confirms that the mouth was somewhat ventral, rather than terminal, that the pectoral fin originated close behind the orbit, that the dorsal fin is slightly in advance of the anal fin, and that the dorsal lobe of the caudal fin is more extensive than previously thought, although the ventral lobe contains the body axis. Scale patterns on the head show the probable location of the pineal macula. The arrangement of the branchial openings remains somewhat doubtful, but new evidence on this point has also come to light. Of the previous reconstructions, that by Ritchie is the most faithful to the evidence, although several details can now be improved upon.

Saturday 1:45

TAPHONOMY, GASTROLITHS, AND THE LITHOPHAGIC BEHAVIOR OF SAUROPODOMORPH DINOSAURS

WINGS, Oliver, Nds. Landesmuseum Hannover-Naturkundeabt, Hannover, Germany

Gastroliths (stomach stones) have been traditionally interpreted as essential for the trituration of ingesta in prosauropod and sauropod dinosaurs. While recent research has shown that the amounts of gastroliths in sauropods do not correspond to the amounts within avian gastric mills, a patchy occurrence of gastroliths within the fossil record of sauropodomorphs may give further evidence.

Occurrences of suspected sauropod gastroliths and exotic clasts (exoliths) in several Upper Jurassic sauropod localities from western USA are compared with authentic finds of sauropod gastroliths (e.g., *Cedarosaurus*, *Seismosaurus*) as well as with other Mesozoic dinosaur sites. As taphonomic experiments with ostrich chick carcasses have demonstrated, the release of gastroliths from the body cavity can occur within a few days and is likely to happen in an aquatic environment because of prolonged floating of the carcass. This may be an explanation for the absence of gastroliths from most sauropodomorph carcasses in fluvial depositional environments, but not for their absence within autochthonous finds. Other reasons for post-mortem separation of bones and gastroliths, such as scavenging, also cannot explain the frequent absence of gastroliths satisfactorily.

The results of this investigation show that there are indeed very few prosauropod and sauropod finds with unambiguous gastroliths. The scarcity of pebbles in the fine-grained sediments of most fossil localities indicates that only a small number of sauropodomorphs possessed gastroliths. The existence of a gastric mill in all sauropodomorphs is not supported by the taphonomic evidence. Exoliths, which are abundant in the Lower Cretaceous of the western USA, are virtually absent in Upper Jurassic sediments. Without association with fossil bone, there is no convincing evidence that these exoliths represent former gastroliths. It is more plausible that most of the surface-collected stones are weathering relicts of former conglomerate layers or represent clasts associated with hyperconcentrated-flow deposits.

Poster Session A

PLIOCENE LAGOMORPHS AND MACROSCELIDIDS RECENTLY RECOVERED FROM LAETOLI, NORTHERN TANZANIA

WINKLER, Alisa, Southern Methodist Univ., Dallas, TX; HARRISON, Terry, New York Univ., New York, NY

Laetoli (circa 4.5-2.6 Ma) is one of the most important paleontological and paleoanthropological localities in Africa. The Laetoli sites were first worked in the 1930s, and they continue to produce a spectacular fauna including mammals, birds, reptiles, invertebrates, plants, and ichnofossils. Collections from 1998-2004 include more than 15,000 specimens, of which about 27% are lagomorphs. As from prior collecting, macroscelidids are extremely rare. Only four specimens, an isolated P4 and three incomplete mandibles of *Rhynchocyon pliocaenicus* were recovered. The lagomorph remains are isolated crania and postcrania, as well as partial skeletons, of the extinct taxon *Serengetilagus praecapensis*. The specimens of *Serengetilagus* from Laetoli are the most numerous and complete of any known fossil lagomorph from Africa. The large sample of *Serengetilagus* from Laetoli documents the range of morphological variation within this genus. This clarifies the taxonomic assignment of other poorly represented African and Asian specimens that have been assigned to *Serengetilagus*. It also clarifies the relationship between *Serengetilagus* and the contemporaneous morphologically similar primarily European fossil taxon *Trischizolagus*.

Thursday 1:30

TYRANNOSAUR BRAIN AND EAR STRUCTURE: ONTOGENY AND IMPLICATIONS FOR SENSORY FUNCTION AND BEHAVIOR

WITMER, Lawrence, RIDGELY, Ryan, Ohio Univ., Athens, OH

The ear regions and cerebral endocasts of tyrannosaurids were investigated using CT scanning of the bony braincase and 3D visualization. Adult and subadult specimens of *Tyrannosaurus rex* included AMNH 5029, AMNH 5117, FMNH PR 2081, among others. The controversial juvenile Cleveland skull (CMNH 7541) was also scanned. CMNH 7541 has been regarded as representing either a separate taxon (*Nanotyrannus*) or a juvenile *T. rex*. The braincase of the Cleveland skull was digitally extracted for more direct comparisons with more mature specimens. Pneumaticity of the braincase is extensive in all specimens, with clear communications among the caudal tympanic, basisphenoid, and subcondylar recesses. Most of the pneumatic features can be attributed to pneumatization from diverticula from the middle ear, but some may derive from a median pharyngeal diverticulum and others from the pulmonary system associated with the cervical air sacs. The cerebral endocasts of adult specimens are grossly similar to those of other large-bodied theropods, but that of the Cleveland skull is different in that the cerebral region is relatively more rounded and the dural pineal peak observed in adults is almost absent, suggesting potentially considerable ontogenetic changes in brain structure or at least endocranial cavity structure. The identification of presumptive olfactory turbinates in the Cleveland skull allows discrimination of neural components (olfactory bulb) from sensory epithelial components; the olfactory apparatus is well developed. The osseous labyrinth of the inner ear is organized much like that of other nonavian coelurosaurs but has particularly long delicate canals consistent with a well developed vestibulo-ocular reflex and reliance on the visual system. Moreover, the structure housing the cochlear duct is long, consistent with reliance on auditory cues and perhaps even emphasis on low frequencies given the effects of extensive tympanic pneumaticity on middle ear impedance. Orientation of the head when alert can be reconstructed based on labyrinth orientation, and the alert posture of the juvenile was strongly down-turned.

Friday 8:30

MANIPULATING DINOSAURIAN SOFT TISSUE: METHODS FOR HANDLING SOFT TISSUES, VESSELS AND CELLS IN FOSSIL SPECIMENS

WITTMEYER, Jennifer, SCHWEITZER, Mary, North Carolina State Univ., Raleigh, NC

We previously announced the discovery of vessels and microsctructures with cell-like morphology preserved in hindlimb elements of *Tyrannosaurus rex* (MOR 1125), showing that soft tissues could be preserved in the fossil record, not just by replacement or replication, but as intact structures retaining flexibility and resilience. Investigation of additional fossil material, including other tyrannosaurs, hadrosaurs, and more recent specimens, indicates that this is not an isolated phenomenon.

The challenge of trying to manipulate, process and analyze vessels and cellular structures millions of years old is not a minor one. Applying techniques designed for modern tissues to fossils has serious limitations, as methodologies for handling extant bone-derived vessels and cells are not well defined. We have tested a variety of methods for isolating, imaging, fixing, embedding and extracting soft tissue and cellular structures, to gain the greatest quantity of information from limited fossil materials in order to characterize preservation at cellular and sub-cellular levels.

Here, we detail methodologies designed to isolate these components from fossil bone and prepare them for detailed microscopic and molecular analyses. We discuss methods for removal of mineral matrix, isolation and preparation of microscopic structures, fixation and TEM preparation; and various means of molecular analyses.

Poster Session B

ZOOLOGICAL PALEOPATHOLOGY AND THE CASE OF THE *TYRANNOSAURUS* JAW: INTEGRATING PHYLOGENY AND THE STUDY OF ANCIENT DISEASE

WOLFF, Ewan, VARRICCHIO, David, Montana State Univ., Bozeman, MT

The analysis of diseases by veterinary pathologists relies on gross observation, serology, bacteriology, histopathology and clinical history. Paleopathologists are left with a fraction of that information from which to draw conclusions. Paleopathology has disregarded microbial evolution, and falls within the Victorian mindset that views the human model of disease as the arbiter of diagnosis. Although human pathology research is extensive, disease comparisons taken outside of phylogenetic context must be questioned. Therefore, the author proposes a new approach, here termed *zoological paleopathology*, that allies this field with zoological medicine. Zoological paleopathology accepts that pathogens evolve, and that susceptibility to non-transmissible conditions may also evolve, such that patterns can only be distinguished by inter-clade investigation. This method draws upon a history of zoological pathology research on numerous taxa, deferring to human pathology only in those mammalian cases that justify direct comparison. It is also pattern-based, preferring differential diagnosis of well-defined broad-scale trends to peremptory diagnosis of individuals.

As a test case for zoological paleopathology, the author studied oral pathology in tyrannosaurids. Of fifty-six individuals examined, one fourth of the mandibles displayed some form of anomaly, typically of the surangular or dentary. The dentaries had abnormalities classified as tooth traces from scavenging, an isolated bite wound, and idiopathic periosteal reactive ridges, which are observed on some specimens to display cranial curvature and overlap between the lingual and labial aspects. The surangulars often display resorptive fenestrae that are random in distribution. The fenestrae are ovate, ringed by normal periosteum, and generally lie proximal to other abnormal fenestrae. The tentative differentials for this condition are developmental abnormality, bite trauma, osteomyelitis, fibriscess, idiopathic neoplasia and metastatic carcinoma. Preliminary results indicate that these abnormalities more closely resemble those found in crocodilians than ratites.

Poster Session A

MULTIVARIATE TESTS OF EVOLUTIONARY MODE IN *ECTOCION* TEETH

WOOD, Aaron, DESILVA, Jeremy, EITING, Thomas, ROUNTREY, Adam, WHITLOCK, John, ZELDITCH, Miriam, Univ. of Michigan, Ann Arbor, MI

Tooth proportions are often used to study the tempo and mode of evolution in mammalian lineages. In 1943 Simpson cited the Paleocene/Eocene "condylarth" genus *Ectocion* from the Bighorn Basin of Wyoming as an example of a chronocline in which m1 length increased over time. Sixty years later, using larger samples with higher stratigraphic resolution, Gingerich showed that m1 crown areas of *Ectocion osbornianus* exhibit stasis rather than directional change. However, both tooth shape and cusp configuration are important for fossil mammal classification, and studying these as well as size should provide a more complete understanding of the evolutionary processes affecting mammalian lineages.

We analyzed size and shape of the lower dentition (p4, m1, m3) of *E. osbornianus* sampled across ~1000 meters of stratigraphic section, representing over 2 million years. Teeth with little or no wear were cast, photographed in occlusal view, and digitized. The landmarks comprise cusp points and the intersection of the cristid obliqua and trigonid; semi-landmarks were also digitized along tooth margins. Multivariate analytical methods were used to determine whether tooth shape follows a random walk, sustained directional change, dynamic equilibrium or stasis. Additionally, principal components analyses (PCA) were conducted for each tooth type.

Preliminary univariate analyses indicate centroid size may follow a random walk whereas multivariate tests indicate that shape exhibits stasis in all 3 tooth types. Stasis of shape is further supported by the distribution of shapes along PCs; nearly all tooth shapes lie within the range of variation found at a single stratigraphic interval. Results are similar whether or not semi-landmarks are used in the analyses. Simulations of shape evolution offer further criteria for distinguishing the evolutionary mode acting on *E. osbornianus* tooth shape.

Saturday 1:45

"GIGANTOPRISMATIC" ENAMEL MICROSTRUCTURE IS NOT PLESIOMORPHIC FOR MULTITUBERCULATA

WOOD, C.B., Providence College, Providence, RI; ROUGIER, Guillermo, Univ. of Louisville, Louisville, KY

A recently prepared molar of *Glirodon grandis* from the Morrison Formation (Upper Jurassic) reveals no prismatic microstructure in its enamel, which is contrary to earlier (unillustrated) reports that the taxon displays "gigantoprismatic" structure. Furthermore, the new specimen shows abundant tubules in the inner enamel yet no trace of planar discontinuities, more or less perpendicular to the dentine-enamel junction, that would define "Synapsid Columnar Enamel" (or SCE), which is thought to be plesiomorphic for cynodonts and non-cynodont synapsids. A stratigraphically earliest gigantoprismatic structure is therefore not demonstrated in multituberculates, and the presence of ancestral SCE in other "plagiaulacids" is not clearly established in the few specimens that have been examined. A case of "mixed preprismatic enamel" in a "plagiaulacid" from the Purbeck Limestone remains something of a mystery because the enamel has been viewed and photographed only by visible light, not by scanning electron microscopy. Several competing hypotheses for multituberculate relationships with other mammals and mammaliaforms have been advanced recently, but we have rescored enamel characters with new data and some corrected data such that our trees—combining five enamel characters and more than 270 standard, non-enamel characters from recent matrices—indicate that multituberculates are bracketed by taxa with prismatic enamel having small or "normal" prisms and center-to-center distances. Gigantoprismatic enamel is thus autapomorphically distributed in one or more clades of derived Cimolodonta within Multituberculata, and evidence for independent origin of enamel prisms in multituberculates appears to be weak. The biology of giant prisms (mean diameter = 8.2 ?m) also remains a mystery because no extant mammals are known to have them, and no living ameloblasts large enough to form them have ever been observed.

Student Poster Session

BONE HISTOLOGY OF THE TITANOSAURID SAUROPOD *ALAMOSAURUS SANJUANENSIS* FROM THE JAVELINA FORMATION, TEXAS

WOODWARD, Holly, Lubbock, TX

Bone samples of the titanosaurid sauropod *Alamosaurus sanjuanensis* were collected from the Upper Cretaceous Javelina Formation in Big Bend National Park, Texas, for use in a histological analysis. Parts of two dorsal vertebrae, two caudal vertebrae, twelve ribs, two tibiae, three humeri, one scapula, two fibulae, three femora, one pubis, one ulna, one metacarpal, and one metatarsal were examined. The dorsal vertebral centra and neural arches possess the camellate cavities typical of titanosaurids, though much smaller than those described for *Saltasaurus loricatus*. An unusually thick internal trabecular plate parallels the posterior articulation surface within dorsal vertebral centra. Camellae are not found in the caudal vertebrae. However, similar cavities extend from the rib heads to well below the middle part of the shafts in dorsal ribs. The camellate cavities result in an average of 52 and 67 percent open space within the ribs and vertebrae, respectively. The distal ends of the dorsal ribs retain calcified cartilage, possibly reflecting their connection to cartilaginous sternal ribs. The primary cortical tissue in appendicular elements is typically woven to fibro-lamellar. Some elements (e.g., humerus, ulna, fibula) exhibit growth rings produced by cyclic alternation of woven and fibro-lamellar tissue, from about 58 up to 79 percent adult length, but no arrested growth lines. Lamellar-zonal tissue is found in the peripheral cortex of appendicular elements and ribs greater than about 75 percent adult length, and elements of this size and larger are extensively remodeled. However, limb girdle elements (e.g., pubis, scapula) underwent complete remodeling earlier in ontogeny, after attaining about 50 percent adult length. Growth ring data, transformed to body length and mass estimates, result in a best fit growth curve that indicates adult body mass (32 metric tons) was approached at an age of about 60 years.

Friday 2:45

NEW NOTOHIPPIDS (NOTOUNGULATA, EUTHERIA) FROM THE CENTRAL CHILEAN ANDES

WYSS, Andre, Univ.of California Santa Barbara Dept of Geological Sciences, Santa Barbara, CA; FLYNN, John, American Museum of Natural History, New York, NY; CROFT, Darin, Case Western Reserve Univ. School of Medicine, Clevland, OH

The two most diverse groups at the reference locality of the Tinguiririan South American Land Mammal "Age" are archaeohyracids and notohippids. The taxonomy of the species belonging to the former group has recently been clarified. We here consider the notohippids from Tinguiririca as well as one from the Las Leñas Fauna, roughly 0.5& deg to the north.

The Tinguiririca Fauna includes four notohippids, two fairly large and two small. One of the larger forms is quite hypsodont (incisors included) and represents a new species of *Eomorphippus*; it is known from the anterior portion of a skull bearing a nearly complete upper dentition. Referred specimens document nearly all elements of the lower dentition. This Chilean taxon resembles *E. obscurus* Ameghino 1901, but is ~20% larger and differs in incisor and canine proportions. The other large form is known only from a partial upper incisor battery and possibly two upper cheek teeth. Although about the same size as *Eomorphippus* n. sp., this taxon differs in having incisor enamel restricted to the tooth tips (not extending to the roots), and in having incisors and canines of uniform size and shape.

One of the two smaller notohippids from the Tinguiririca Fauna, represented by fragmentary upper and lower dental remains, is low crowned, and compares closely to *"Eomorphippus pascuali"* (a likely synonym of *Puelia*). The other small-bodied taxon is hypsodont (incisors included), and is represented by a well-preserved pair of mandibles lacking only p1. This taxon is essentially a half-sized version of *Eomorphippus* n. sp. (above), warranting recognition as a second new species of *Eomorphippus*. Collectively these taxa facilitate biochronologic comparisons of the Tinguiririca Fauna to the "Partie la plus superieure de couches à *Astraponotus*" of the Gran Barranca; Roth's mysterious Cañadon Blanco (also in Patagonia); and other recently uncovered central Chilean Andean faunas. In the latter regard, we describe a hypsodont notohippid palate from the Las Leñas Fauna, an assemblage notable for including the only primate so far recovered from the extensive volcaniclastic deposits of the central Chilean Andes.

Saturday 10:45

THE SKULL OF THE TRIASSIC SAUROPODOMORPH, *MELANOROSAURUS READI*, FROM SOUTH AFRICA AND THE DEFINITION OF SAUROPODA

YATES, Adam, Univ. of the Witwatersrand, Johannesburg, South Africa

An almost complete skeleton of a sauropodomorph dinosaur was excavated from the lower Elliot Formation of the Ladybrand district, Free State, South Africa by a team from the National Museum, Bloemfontein. It was tentatively identified as *Euskelosaurus* sp. but it shares autapomorphies with *Melanorosaurus readi* and it is reassigned to this taxon here. The skull and neck are remarkably similar to those of Plateosauridae and Massospondylidae (a group of taxa sometimes refered to as core prosauropods). Derived characteristics that it shares with some, or all, core prosauropods include: a median nasal depression, a posteriorly enlarged prefrontal that restricts the frontal contribution to the orbit, an elongate ventral ramus of the squamosal, an inset first dentary tooth and axial postzygapophyses that are level with the posterior centrum face. The lack of several trophic adaptations seen in eusauropods (e.g. broad jaws, tooth-tooth occulsion), indicate feeding mechanisms were similar to those of the core prosauropods. Nevertheless some derived character states suggest an affinity to sauropods. These include: incipient projecting premaxillary muzzle, absence of the antorbital fossa on the ventral end of the lacrimal, a raised parasphenoid rostrum relative to the basipterygoid processes and sculpted tooth enamel. The postcranial anatomy also reveals a number of apomorphies shared with sauropods including more than three sacral vertebrae, caudal hyposphenal ridges and a large anterolateral process on the ulna defining a deep radial fossa.

When the new data are combined in a phylogenetic analysis of basal sauropodomorph relationships, *Melanorosaurus* is found to share a more recent common ancestor with eusauropods than with *Plateosaurus*, and so is a sauropod according to the current definition. However the presence of characteristics thought to diagnose Prosauropoda in *Melanorosaurus* causes the core prosauropods to break into a paraphyletic array on the stem of Eusauropoda. In this situation many taxa such as *Riojasaurus, Anchisaurus, Jingshanosaurus, Yunnanosaurus* and Massospondylidae are also captured by the current definition of Sauropoda. In this situation a new definition for Sauropoda may be required.

Friday 11:45

THE ISOTOPIC ECOLOGY OF AFRICAN MOLE-RATS: IMPLICATIONS FOR HOMININ EVOLUTION

YEAKEL, Justin, DOMINY, Nathaniel, Univ. of California, Santa Cruz, Santa Cruz, CA; BENNETT, Nigel, Univ. of Pretoria, Pretoria, South Africa; KOCH, Paul, Univ. of California, Santa Cruz, Santa Cruz, CA

Underground Storage Organs (USOs), including tubers, grass rhizomes, corms, and bulbs, are a source of nutrition for some animals in xeric regions. Plants living in these arid environments store nutrients and water in USOs for use during the long dry seasons. Modern African mole-rats (family Bathyerigidae) are known to utilize this resource. Faunal analyses show that mole-rats co-occur with ancient hominins in late Miocene sub-Saharan Africa, possibly indicating similar dietary reliance on USOs. Isotopic studies of fossil hominins have been interpreted by some authors to indicate USO utilization. Our ultimate goal is to use stable isotope analysis of fossil mole-rats to test this conjecture. As a prelude to this study, we measured the isotopic composition of bone collagen from six species of bathyergids distributed across a broad range of habitats; each species relies on USOs to a different extent. The different species of mole-rats have distinct $\delta^{13}C$ values, with a total range among all specimens of -25 to -10 per mil. Our data suggest a broad range of dietary specialization along the C3/C4 vegetation axis. Some species have $\delta^{13}C$ values suggesting narrow dietary preferences; values for others indicate broader diets. Some of the $\delta^{13}C$ values from mole-rats overlap isotope data for hominin species, perhaps signifying a similar reliance on USOs. Further isotopic study of modern mole-rats should present a more complete picture of the ecology of these intriguing mammals in different habitats. These studies will also be the basis for interpretation of isotope data from fossil mole-rats at hominin sites, allowing us to test the hypothesis of USO use by these extinct human relatives.

Thursday 1:30

TRANSPARENCY AND MINIMALISM: ECOLOGICAL MODELING OF LATE PLEISTOCENE EXTINCTIONS

YULE, Jeffrey, GINZBURG, Lev, Stony Brook Univ., Stony Brook, NY

Late Pleistocene extinctions occurred over a period of about 50 ky, primarily affecting mammal species of ≥44 kg body mass. Polarized debate about the cause(s) of the extinction has centered on two factors: anthropogenic effects (especially hunting) and climate change. While our limited understanding of earlier extinction events and the species they affected necessitates generalized models, we can assess Late Pleistocene events more conventionally, via ecological equations (e.g., Lotka-Volterra-like model of predation). Since the 1960s, models have been used as one tool in resolving the debate, but recent models and computer simulations have become opaque and/or excessively over parameterized, tending to confuse rather than clarify discussion. These "black boxes" also rely on problematic assumptions. A review of late Pleistocene extinction models and of modeling philosophy remedies that confusion and suggests that leaner, more transparent mathematical models can help to avoid similar problems in the future. Based on these findings, we propose a new model that uses fewer parameters. It avoids prey-dependent assumptions (which do not coincide with observed data on extant vertebrate predator-prey systems), relying instead on ratio-dependent assumptions (which better agree with observed data). Extinction can be predicted mainly on the basis of three parameters: intrinsic rate of growth of human populations, intrinsic rate of growth of prey populations, and hunting offtake. Results from this new model are consistent with those of more complex alternatives, and the system of differential equations that constitute the model has the important advantages of being accessible, transparent, and easily modified.

Friday 3:00

POSTCRANIAL MORPHOLOGY AND THE PHYLOGENY OF "CONDYLARTHRA"

ZACK, Shawn, Johns Hopkins Univ.Sch of Medicine, Baltimore, MD

"Condylarths" are an abundant and diverse grade of Paleocene and Eocene mammals known primarily from the Holarctic. Although "condylarths" last appear in the late Eocene, the order has been implicated in the ancestry of numerous later mammalian clades, including artiodactyls, perissodactyls, paenungulates, macroscelideans, and South American ungulates. Affinities within "Condylarthra" have proven difficult to assess, however, complicating efforts to assess these potential relationships. While there is general agreement on some aspects of "condylarth"supergeneric classification, other areas (particularly interfamilial relationships) have been more problematic. Additionally, the families Hyopsodontidae and Arctocyonidae are probably polyphyletic. Most studies of phylogenetic relationships within "Condylarthra" have focused (by necessity) on the comparatively rich dental record of the order. Although reasonably complete postcranial material has long been known for a few taxa, they account for only a small fraction of "condylarth"diversity. As a result, postcranial morphology has been of limited use in disentangling "condylarth"interrelationships. With continuing addition of new specimens, however, sufficient postcranial material is now available to assess the impact of postcranial data on "condylarth"phylogeny.

Postcranial morphology supports the monophyly of several "condylarth" clades, including Phenacodontidae and Mesonychidae. While there is support for the monophyly of some arctocyonid and hyopsodontid subclades, there is less support for monophyly of either family, strengthening previous suggestions that Arctocyonidae and Hyopsodontidae are artificial groups. There is also little postcranial support for Periptychidae, but the strength of dental support for this grouping, combined with the lack of strong postcranial evidence for alternative relationships, favors periptychid monophyly and implies that locomotor diversification within the family occurred after the acquisition of key dental features. Finally, the postcrania of *Desmatoclaenus* support a relationship of this genus to phenacodontids, and show fewer similarities to loxolophine arctocyonids.

Poster Session A

MICROTIDS FROM THE FIENE LOCAL FAUNA (IRVINGTONIAN), SMITH COUNTY, KANSAS

ZAKRZEWSKI, Richard, Fort Hays State Univ., Hays, KS; BEVER, Gabe, Univ. of Texas-Austin, Austin, TX

Based on the occlusal pattern of the lower first molar (m1), microtids are represented in the Fiene local fauna(l.f.) by five species; *Allophaiomys pliocaenicus*, a 5-triangled species of *Microtus, M. paroperarius, M. meadensis*, and *M. llanensis*. In addition to the variation seen in triangle (T), re-entrant, and cementum development on the anteroconid complex, two m1s of *M. meadensis* exhibit a pattern of two confluent fields (T4-5, T6-7)and two of the *Microtus* sp. exhibit a prism fold on T6. Eight of 54 (15%) upper second molars (M2s) exhibit a well-developed posterolingual dentine field, and eight have this character slightly developed. This field is typically found in *M. pennsylvanicus, M. californicus*, and in other species of *Microtus* at lower frequencies. The M2s could not be assigned to a particular species. Thirty-six M3s pertain to either *M.* sp. or *M. paroperarus*. Of these, eight (22%) have a confluent T1-2. Four of the five species from the Fiene l.f. are found in the Cudahy l.f. of Kansas and Porcupine Cave and Hansen Bluff in Colorado. *Allophaiomys* is not present in the Cudahy and *M. llanensis* has not been reported from the Colorado sites. The Fiene l.f. is the third site, but first on the Plains, wherein *Allophaiomys* occurs with its presumed descendants. Based on radiometric dates and paleomagnetic data from other sites, *Allophaiomys* is thought to have existed from slightly less than 2.1 Ma to about 840 Ka; the 5-T *Microtus* from 1.4Ma? to the present; *M. paroperarius* from about 840 Ka to 252 Ka, and *M. meadensis* from 820 Ka to 252 Ka. *Allophaiomys* is the defining taxon for the Irvingtonian I microtine stage east of the Rocky Mountains. *M. meadensis* defines the Irvingtonian II and *M. llanensis* helps characterize the stage. The co-occurrence of *Allophaiomys* and *M. meadensis* suggests that the age of the Fiene l.f. may be about 840 to 820 Ka.

Friday 9:45

EOCENE SIRENIA OF EGYPTIAN TETHYS: AQUATIC ADAPTATIONS

ZALMOUT, Iyad, GINGERICH, Philip, Univ.of Michigan Museum of Paleontology, Ann Arbor, MI

University of Michigan field parties working in the Gehannam and Birket Qarun formations of Wadi Hitan, western Fayum, Egypt, have made a diverse collection of Bartonian-to-Priabonian (middle to late Eocene) sea cows transitional between those previously known from the Mokattam and Qasr el-Sagha formations of Egypt. Three contemporary genera, *Protosiren, Eotheroides*, and *Eosiren*, are known from associated skulls and postcranial skeletons that include substantial pectoral and pelvic girdles. These display considerable morphological disparity within the general sirenian body plan, and thus, by inference, represent a range of adaptive behaviors.

Rostral deflection and tooth wear vary among the genera studied here: Eotheroides and Eosiren have greater rostral deflection than does *Protosiren*, while *Protosiren* has greater tooth wear (suggesting a substantially different diet). Vertebral morphology shows that *Eotheroides* and *Eosiren* were very similar in trunk and tail morphology to the living dugong, with well-formed vertebral epiphyses and rib articulations like those of Dugong. *Protosiren* is unusual in retaining cartilaginous vertebral epiphyses and rib articulations. All three genera have hind limbs reduced in comparison to those of land mammals, but this reduction is much greater in *Eotheroides* and *Eosiren*. Such differences clearly reflect dietary and environmental specialization and niche partitioning even at this early stage of sirenian evolution.

Associated remains of sea grasses (*Thalassodendron*) provide new information about Tethyan shallow water habitats and local substrate coherence, and enhance comparisons with contemporary biogeographic provinces elsewhere.

Poster Session B

LATE CAMPANIAN NON-AVIAN THEROPOD DIVERSITY ACROSS THE WESTERN INTERIOR BASIN

ZANNO, Lindsay, SAMPSON, Scott, Univ.of Utah Utah Museum of Natural History, Salt Lake City, UT; ROBERTS, Eric, Idaho State Univ., Pocatello, ID; GATES, Terry, Univ.of Utah Utah Museum of Natural History, Salt Lake City, UT

Four years of intensive collection of vertebrate fossils conducted by Univ. of Utah crews within the Kaiparowits Formation of Grand Staircase-Escalante National Monument, southern Utah, has added substantially to our understanding of the diversity of theropods across the Western Interior Basin (WIB) during the late Campanian. Recently identified taxa include a new genus of North American oviraptorosaur, an undescribed tyrannosaurid, and the dromaeosaurid Saurornitholestes. Radiometric dates establish the Kaiparowits Formation as time correlative with fossiliferous portions of the Dinosaur Park, Judith River, Two Medicine, Fruitland, and Aguja Formations. This new information, together with previous work by other institutions, documents an increasing ecological similarity between the Kaiparowits Formation

and other stratigraphically correlative faunas across the Western Interior in terms of mid-clade theropod diversity. Paleoenviromental interpretations of upper Campanian WIB formations suggest a span of habitats, from wet alluvial to arid coastal plain settings. Yet despite this substantial environmental variation, four out of five theropod clades have been documented in well-sampled parts of the basin. More specifically, it appears that tyrannosaurids, oviraptorosaurs, *Saurornitholestes-type* dromaeosaurs, troodontids, and ornithomimosaurids were able to invade or persist within a wide range of late Campanian environments. In contrast, although higher level composition of late Campanian ecosystems appears consistent across the basin, current evidence from well sampled formations such as the Kaiparowits increasingly supports the notion that theropod genera and species exhibited provincialism, with comparably limited geographic ranges.

Friday 11:45

AN ONYCHODONT-LIKE SARCOPTERYGIAN FISH FROM THE MIDDLE DEVONIAN OF YUNNAN, SOUTHWESTERN CHINA

ZHU, Min, ZHAO, Wenjin, IVPP Chinese Academy of Sciences, Beijing, Peoples Republic of China

An onychodont-like sarcopterygian fish was found from the Middle Devonian (Zhaotong Formation, late Eifelian-early Givetian) of Yunnan, southwestern China. The specimens come from the muddy limestones in which they are associated with *Bothriolepis*, a basal tetrapodomorph fish and a lungfish under study. The fish-bearing horizon is about 90 meters below the stratigraphic unit bearing *Stringocephalus*. The new form is comparable to *Psarolepis* and onychodonts in its short parietal shield, large and deep internasal cavities receiving parasymphysial dental plate, and the lower jaw with an ascending profile. Its coronoid series of lower jaw consists of five bones with fangs in coronoids 2-4 and only denticles in coronoids 1 and 5, corroborating the hypothesis on the transition from the 5-coronoid condition to the 3-coronoid condition in the lineage of sarcopterygians. Other features resembling *Psarolepis* and other primitive sarcopterygians include three infradentary foramina on the lower jaw and the shape of maxillary. The parasymphysial dental plate with a row of fangs occupies a deep groove in front of coronoid 1, representing a unique feature distinct from other forms (e.g. *Psarolepis, Achoania, Onychodus, Styloichthys, Youngolepis*) where the tooth whorl attaches to a raised structure formed by the Mechkelian bone and/or the dentary. The parasphenoid bears both fangs and denticles but it is not clear whether the bone includes any components of the vomer. The combination of characters in this new cosmine-bearing fish provides unique insight on the relationship and diversification of *Psarolepis, Onychodu*s and other early sarcopterygian forms.

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