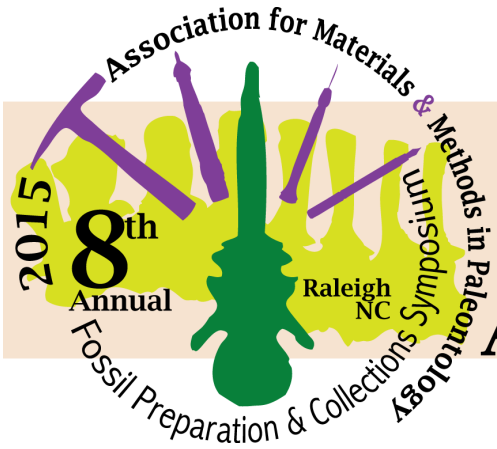


NORTH CAROLINA Museum of Natural Sciences

April 15
Chemistry Workshop

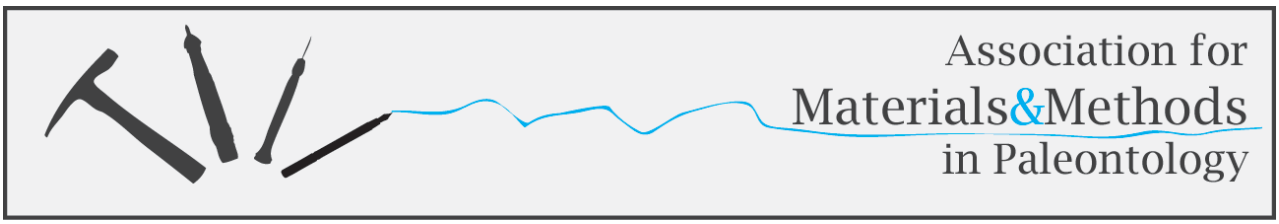
April 16-18

Host Committee Chair
Lisa L. Herzog

Host Committee
Lindsay E. Zanno
Terry "Bucky" Gates
Vincent P. Schneider
Victoria Arbour

Entertainment Pundit
Paul D. Brinkman

Innaugural Board of The AMMP
James McCabe, *President*
Marily Fox, *Vice President*
Gregory Brown, *Treasurer*
Lisa L. Herzog, *Secretary*
Matthew A. Brown, *Past President*



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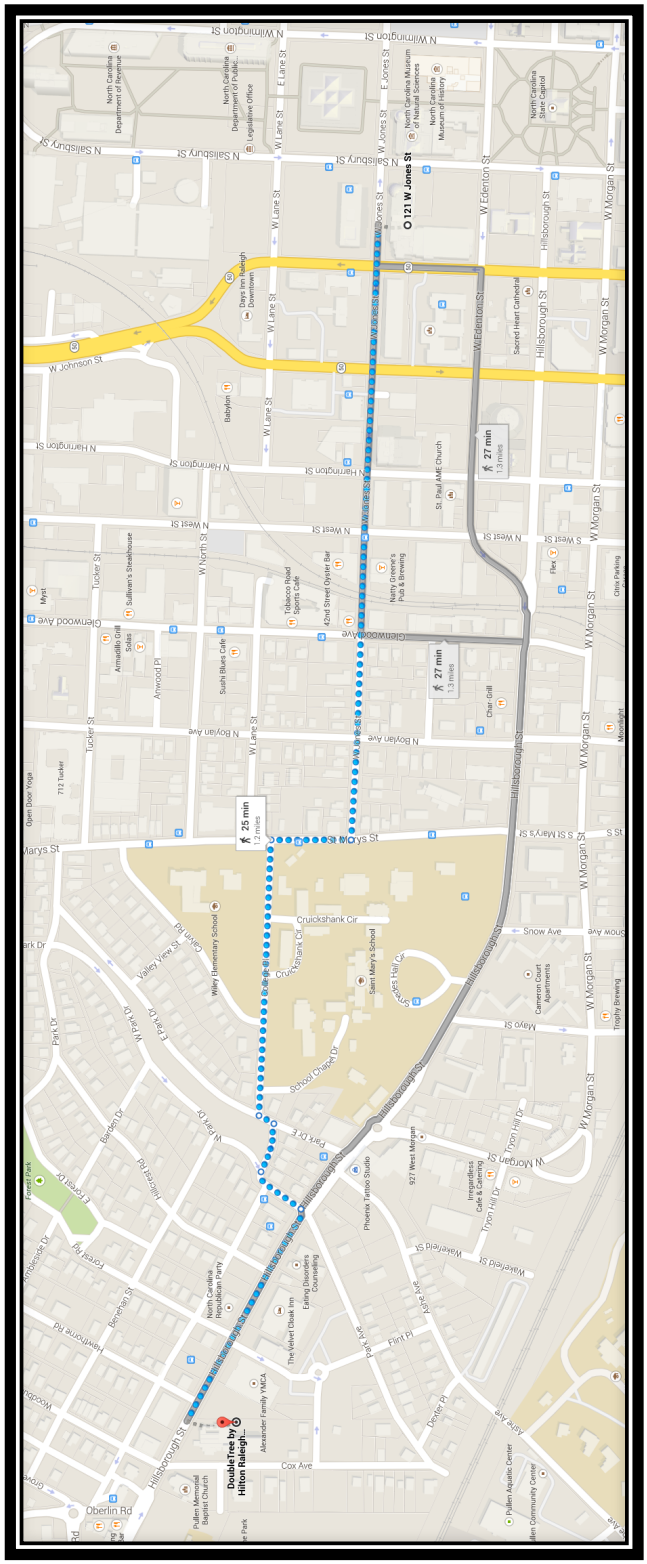
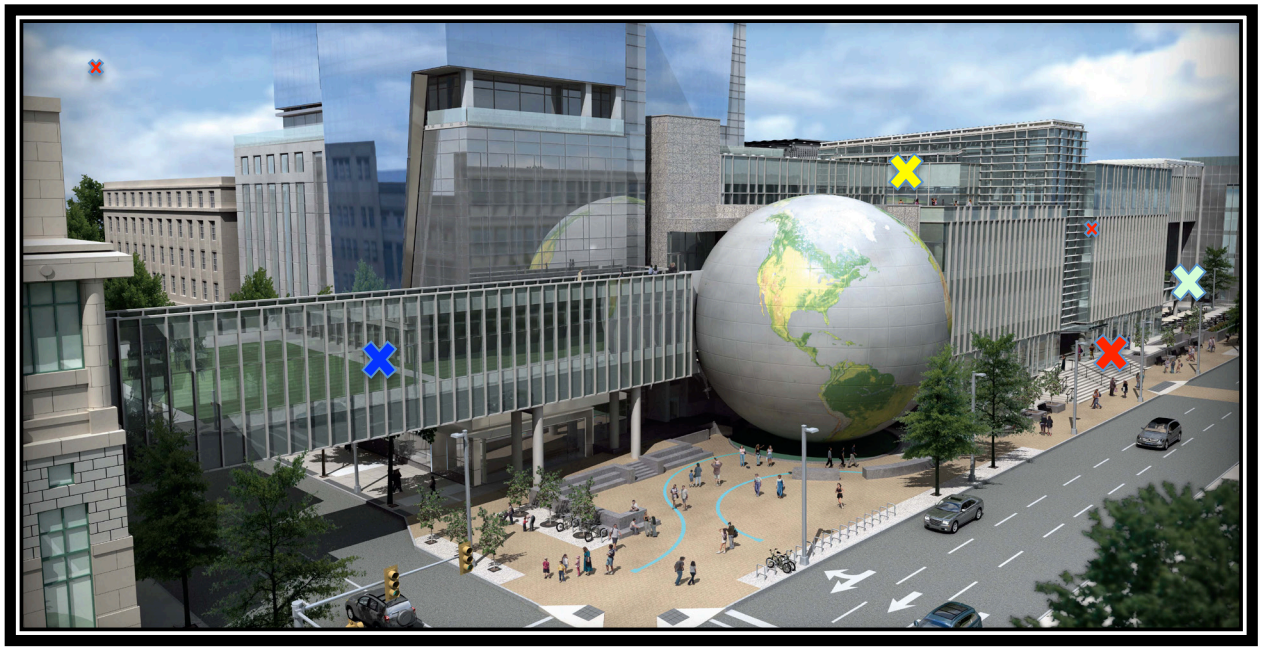
Maps and Location Guide





Rendered view looking SW at the intersection of Jones and Salisbury Sts.

- Registrants Enter Here; all events in this building "The Nature Research Center"
- Location of the Environmental Conservation Center; balcony adjacent to meeting space
- The Daily Planet Café; coffee, breakfast, lunch, dinner, beer, and wine
- Bridge to the main building dubbed the "Nature Exploration Center"; can be accessed on level 2 (covered), 3rd floor access currently closed.

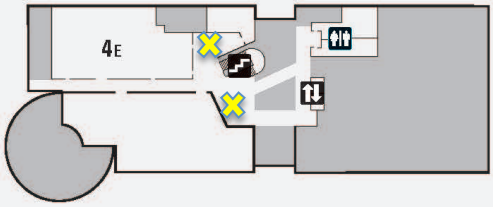
NATURE RESEARCH CENTER

4

FLOOR 4 *event guests only*

4E Environmental Conference Center

Registration, Coffee, Evening Reception Food and Drinks

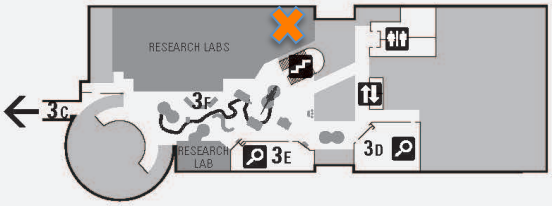


3

FLOOR 3 *bridge access*

3C Bridge to Main Building
3D Investigate Lab: Micro World
3E Investigate Lab: Visual World
3F Window on Research

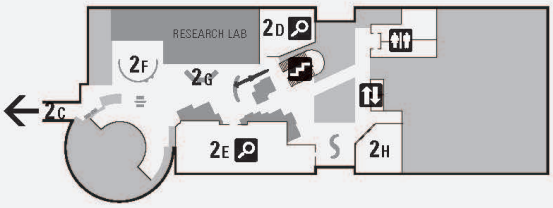
Paleontology & Geology Research Lab



2

FLOOR 2 *bridge access*

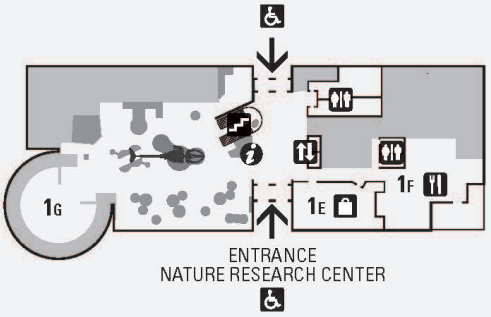
2C Bridge to Main Building
2D Investigate Lab: Natural World
2E Naturalist Center
2F Science Panorama
2G Window on Research
2H Window on Animal Health



1

FLOOR 1

1E Center Store
1F The Daily Planet Café
1G SECU Daily Planet



Info Desk | Restrooms | Food | Elevators | Stairs | Escalator | Public Programs *hours vary* | Store

MONDAY-SATURDAY | 9 AM – 5 PM
SUNDAY | 12 PM – 5 PM

NATURALSCIENCES.ORG

NORTH CAROLINA Museum *of* Natural Sciences

RESTAURANTS IN CAMERON VILLAGE SHOPPING CENTER (.5 miles north of hotel at oberlin/clark)

Faire Steak and Seafood $$$	919-307-3583	2130 Clark Avenue
Brixx Woodfired Pizza	919-723-9370	402 Oberlin Road
Ajisai Japanese Fusion	919-831-9907	427 Woodburn Road
Benelux Coffee	919-900-8294	402 Oberlin Road
Cantina 18	919-835-9911	433 Daniels St
Tazza Kitchen	919-835-9463	432 Woodburn Rd
Café Carolina & Bakery	919-821-7117	401 Daniels St
K&W Cafeteria	919-832-7505	511 Woodburn Rd
McDonalds	919-833-9101	416 Oberlin Rd
Moe's Southwest Grill	919-664-6637	506 Daniels St
*The Flying Biscuit	919-833-6924	2016 Clark Ave
The Village Deli & Grill	919-828-1428	500 Daniels St
Piccola Italia	919-833-6888	423 Woodburn Rd
The Village Draft House	919-833-1373	428 Daniels St
Noodles & Company	919-755-0282	403 Daniels St
Cameron Bar & Grill	919-755-2231	2018 Clark Ave
Starbucks (In Harris Teeter)	919-828-9216	501 Oberlin Rd
Baskin Robbins	919-828-1493	2018 Cameron Street
The Fresh Market (Grocery)	919-828-7888	400 Woodburn Rd
Harris Teeter (Grocery)	919-828-9216	500 Oberlin Rd
Goodberry's Creamery	919-833-9998	2042 Clark Ave
Chick-Fil-A	919-821-1155	2000 Cameron Street
Sugarland	919-835-2100	2031 Cameron Street
Which Wich	919-833-9424	413 Woodburn Road

*Great for breakfast

RESTAURANTS NEAR CONFERENCE HOTEL AND NOT IN CAMERON VILLAGE

David's Dumpling	919-239-4536	1900 Hillsborough St GO LEFT 1 BLOCK/ACROSS STREET
*Player's Retreat	919-755-9589	105 Oberlin Road GO LEFT 1 BLOCK/ACROSS STREET
Brueggers Bagels	919-828-7103	2302 Hillsborough St GO LEFT 5 BLOCKS/ACROSS ST
Chipotle	919-576-1894	2316 Hillsborough St GO LEFT 5 BLOCKS/ACROSS ST
Jimmy John's Subs	919-828-3278	2316 Hillsborough St GO LEFT 5 BLOCKS/ACROSS ST
La Rancherita	919-755-9697	2400 Hillsborough St GO LEFT 6 BLOCKS/ACROSS ST
McDaid's Irish Pub	919-821-2133	2412 Hillsborough St GO LEFT 6 BLOCKS/ACROSS ST
Mitch's Tavern	919-821-7771	2426 Hillsborough St GO LEFT 6 BLOCKS/ACROSS ST
Golden Dragon	919-834-2626	2402 Hillsborough St GO LEFT 6 BLOCKS/ACROSS ST
Jasmin Bistro	919-755-9991	2430 Hillsborough St GO LEFT 6 BLOCKS/ACROSS ST
IHOP (24 HR)	919-821-2242	1313 Hillsborough St GO *RIGHT* 3 BLOCKS
Irregardless Café	919-833-8898	901 West Morgan St GO *RIGHT* 4 BLOCKS/BEAR RIGHT

*Best burger in town (Bernie)

Paul D. Brinkman's Guide to Raleigh Restaurants Cont….

SELECTED **RESTAURANTS NEAR THE MUSEUM**

Daily Planet Cafe	121 W Jones St	*At museum
Crema	121 Fayetteville St	*Very close...excellent sandwiches, soup, salads
Café Carolina & Bakery	150 Fayetteville St	
Tasty 8 Hotdogs	121 Fayetteville St	
Raleigh Times	14 E Hargett St	*Third best burger in town
Morning Times	10 E Hargett St	
Busy Bee	225 S Wilmington St	*Nice outdoor eating space in back
Gravy	135 S Wilmington St	*Get the gnocchi
Sitti	137 S Wilmington St	
Tir na nOg	218 S Blount St	*Bar food
Bida Manda	222 S Blount St	*Outstanding
Chuck's	237 S Wilmington St	*Second best burger in town
Beasley's Chicken & Honey	237 S Wilmington St	
Poole's Diner	426 S McDowell St	*Also outstanding
Capital Club 16	16 W Martin St	
Sono	319 Fayetteville St	*Sushi
McDonald's	101 E South St	
The Fiction Kitchen	428 S. Dawson St	*Vegan and vegetarian
Mecca	13 E Martin St	*Diner food
Oakwood Cafe	300 E Edenton St	*Best Cuban pork sammy in town
Gringo	Across from Oakwood	*Best tacos downtown
Side Street	Lane and Bloodworth	*Avocado with bacon is best sandwich in town
Joule Cafe	223 S Wilmington St	
42nd Street Oyster Bar	508 W Jones St	*Great seafood
518 West Italian Cafe	518 W Jones St	*Might be closed by the time of the conference
The Big Easy	222 Fayetteville St	*Creole food
Bolt Bistro & Bar	219 Fayetteville St	
Buku	110 E Davie St	
Centro Mexican Restaurant	106 S Wilmington St	
Clyde Cooper's Barbecue	327 S Wilmington St	*Eastern NC style BBQ
Remedy Diner	137 E Hargett St	*Vegan and vegetarian friendly
The Pit Authentic BBQ	328 W. Davie St.	*Often considered Raleigh's best BBQ

Schedule of Events

Schedule of Events – Wednesday, April 15th

Pre-Meeting Workshop for Registered Participants

BASIC CHEMISTRY AND ADHESIVES FOR FOSSIL PREPARATORS

Led by
Sheila Siegler
Conservation Scientist
www.conservationomaha.com

9:00am-5:00pm
North Carolina Museum of Natural Sciences
Nature Research Center, 4th Floor
Environmental Conservation Center

This one-day workshop will start with an overview of essential chemistry basics including chemical names, symbols, and molecular bonding. No previous chemical knowledge is required. Because the majority of adhesives are polymers, we will then progress to an overview of polymers, and how they affect the working properties of various adhesives.

Basic principles of adhesion will be covered. Principal adhesives used in Fossil Preparation will be reviewed in more detail. This will include how they work, how they age, and how they can be removed. Published Material Safety Data Sheets (MSDS) for several adhesives will be analyzed and explained to glean information on application, use, removal, and safety concerns.

The final portion of the workshop will be an open Question and Answer session. Participants will have an opportunity to discuss specific materials, their use, potential solutions to enigmatic problems, or clarify any concepts.

Schedule of Events – Thursday Morning, April 16th

8:30 AM	Registration open: Nature Research Center 4th Floor Coffee and refreshments available
9:00AM	Opening Remarks: Lisa L. Herzog, Symposium Organizer **Welcome Address: Dr. Jason R. Cryan, Deputy Museum Director, Research & Collections** **Keynote Speaker: Dr. Lindsay Zanno, Director of Paleo & Geo Research Lab**
9:45	**Vicen Carrió** DEALING WITH 10 AGENTS OF DETERIORATION AT NATIONAL MUSEUMS SCOTLAND
10:00	**Michelle Pinsdorf, Steve Jabo and Pete Kroehler** RENOVATION OF THE VERTEBRATE PREPARATION LAB AT THE NATIONAL MUSEUM OF NATURAL HISTORY, SMITHSONIAN INSTITUTION
10:15	**Gregory Brown** THE USE OF CYCLODODECANE IN VERTEBRATE MICROFOSSIL PREPARATION
10:30	**Steven R. Clawson, Joseph Peterson and Celsea N. Vosters** CLOSE RANGE PHOTOGRAMMETRY OF THE UPPER JURASSIC CLEVELAND-LLOYD DINOSAUR QUARRY, EMERY COUNTY, UTAH
10:45	**Break: refreshments available in the Lobby**
11:00	**Robert L. Evander** THE ACID PREPARATION OF FOSSIL FISH: A TWENTY-YEAR RETROSPECTIVE
11:15	**Tylor Birthisel** JANKY JACKETS: AN EXAMINATION OF UNORTHODOX JACKETING MATERIALS
11:30	**Devin K. Hoffman, Andrew B. Heckert, Lindsay E. Zanno and Lisa L. Herzog** FOSSIL REPLICATION METHODS: MOLDING & CASTING VERSUS 3D SCANNING & PRINTING FROM THE VIEWPOINT OF AN UNDERGRADUATE INSTITUTION
11:45	**Victoria M. Arbour and Eva B. Koppelhus** CREATING AN INTERACTIVE DIGITAL SPECIMEN CABINET IN A MASSIVE OPEN ONLINE COURSE
12:00 PM	**Elizabeth A. Reinthal, Conni O'Connor, Herb Meyer and Greg McDonald** EXPLORING THE EFFECTS OF SOLVENTS AND CONSOLIDANTS ON THE PAPER SHALE OF FLORISSANT FOSSIL BEDS NATIONAL MONUMENT, CO
12:15	**Marilyn Fox and Alana Gishlick** HOW TO PACK FOSSILS FOR SHIPMENT BY COURIER* *Advanced packing workshop available in the afternoon
12:30-2:00	**LUNCH** See *Paul D. Brinkman's Guide to Raleigh Restaurants* on p.8

Schedule of Events – Thursday Afternoon, April 16th

2:00 PM — **WORKSHOPS – Registrants assigned to 1 of the 5 Options listed below.**

3 Dimensional (3D) Modeling, Scanning and Manipulations of Specimens
Organizer: Bucky Gates **Location**: Environmental Conference Center

Advanced Packing for Safely Shipping Specimens
Organizers: Marilyn Fox, Vanessa Rhue, and Vicen Carrió **Location**: 4th Floor NRC

Ultraviolet (UV) & Lighting Techniques for Specimen Diagnostics & Documentation
Organizer: Mike Eklund **Location:** Basement Level, Main Museum (NEC);
Registrants should meet in the Lobby of the Main Museum

Soft Tissue and Molecular Analysis: Basic Techniques for Field & Laboratory
Organizer: Alison Moyer
Location: Off site - Meet at Nature Research Center Main Entrance for Shuttle.

Paleontology & Geology Research Laboratory Tour; Collections Tour
Organizers: Lindsay Zanno and Vince Schneider
Location: Tour will start in the Paleontology & Geology Research Lab; 3rd Floor NRC

≈ 5:00 PM — Upon workshop dismissal, take a break, step outside, get some fresh air, visit the museum exhibits (museum is open until 9pm on Thursdays).

6:00 PM — **Poster Session: Environmental Conference Center**

Amy Davidson, Gregory Brown, Rachel Perkins Arenstein and Matthew Brown
CYCLODODECANE AND FOSSIL VERTEBRATES: SOME APPLICATIONS FOR MATRIX REMOVAL, MOLDING AND SHIPPING

Elizabeth Hall, Valery Monahan, Cathy Ritchie and Gisli Balzer
PACKING, SLACKING AND CRACKING: THE CASE OF THE SMUSHED-FACE BEAR SKULL

Verne Lee
CREATING A CASTING RESERVOIR FOR A PARTIAL SILICONE MOLD

Willow H. Nguy
REDISCOVERY, CURATION, AND CHARACTERIZATION OF A MIOCENE RHINOCEROS (PERISSODACTYLA: RHINOCEROTIDAE) HASH FROM AGATE SPRINGS, NEBBRASKA

Conni J. O'Connor, Kelly E. Hattori and Mariah Slovacek
THE LINDOE TECHNIQUE: AN IMPROVEMENT OF THE METHODS USED TO CREATE REALISTIC REPLICAS OF LOW- TO NO-RELIEF FOSSILS FROM THE FLORISSANT FORMATION

Reception – 4th Floor Lobby
Refreshments and dinner will be served

8:00 PM — **Form up teams for Paleo Trivia Night! Details at event**
Paul Brinkman Emcee: Trivia starts at 8:15 in the ECC
René Hernandez, Harmonica

9:00 PM — **Museum Closes – move on to the exit, you can't stay here…**

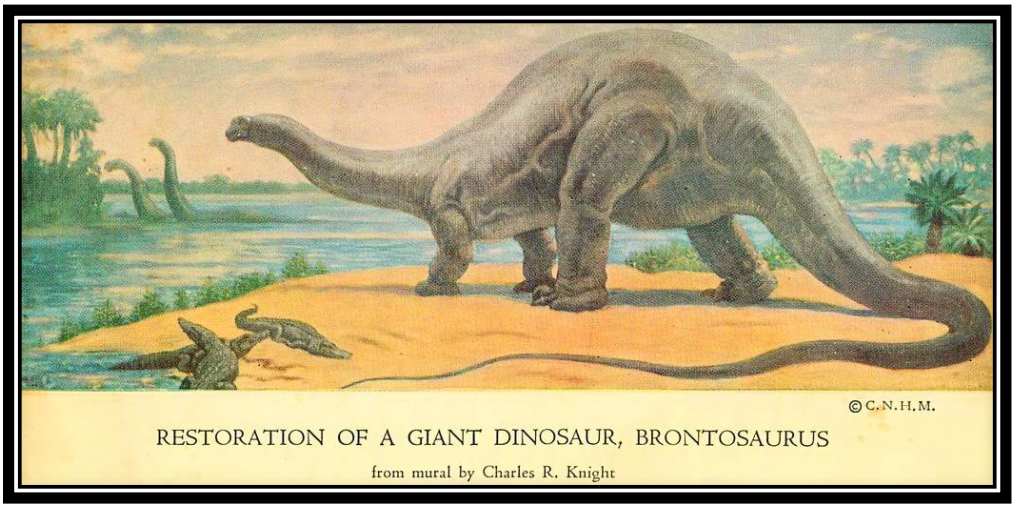
Schedule of Events – Friday Morning, April 17th

8:30 AM	**Pre-Presentation Refreshments, Q&A to Organizers** **Location:** Washington/Jefferson Room Lobby, DoubleTree Coffee, Orange, Cranberry and Apple Juices Assorted breakfast breads and Danishes, fruit and yogurt parfaits
9:00 AM	**Opening Remarks, Reminders and Announcements**
9:15	**Caitlin Wylie** ARE FOSSIL PREPARATORS BORN OR MADE? IDEAS OF SKILL AMONG LABORATORY TECHNICIANS
9:30	**Angella Thompson** COMPLETE THE WHEEL: MAKE PREPARATION AN INTEGRAL PART OF YOUR COLLECTION OBJECT
9:45	**Alan Zdinak** CONSERVATION COMBO PLATTER: A HOUSING METHODS TEACHING TOOL
10:00	**Carey Burke** HARD CORE PREPARATION TECHNIQUES: ACQUIRING AND PROCESSING FOSSIL BONE CORES ON A SLIM BUDGET
10:15	**Heather Falkner, Sally Shelton, Conni O'Connor, Herb Meyer and Greg McDonald** CONSERVATION OF PAPER SHALE FROM FLORISSANT FOSSIL BEDS NATIONAL MONUMENT, CO
10:30	**Jean-Pierre Cavigelli** PORTABLE AND INEXPENSIVE CUSTOM-MADE AIR ABRASIVE CHAMBERS FOR LARGE SPECIMENS
10:45	**Break: refreshments available in the Lobby**
11:00	**Vicki Yarborough** MULTI-PART, LEVEL STORAGE JACKET FOR LARGE VERTEBRATE FOSSILS
11:15	**Ana Balcarcel** USE OF EXPANDABLE FOAM AS AN ALTERNATE METHOD FOR COMPUTED TOMOGRAPHY (CT) MOUNT-MAKING AND UNUSUAL PACKING NEEDS
11:30	**Haviv Avrahami, Andrew B. Heckert and Larry Martin** COMPARISON OF NESTED SIEVES, TRADITIONAL SCREEN BOXES, AND PAINT SIEVES FOR THE RECOVERY OF MICROVERTEBRATE FOSSILS
11:45	**Jennifer Cavin** MAKING A PERMANENT BASE FOR A THIN FOSSIL USING EPOXY
12:00	**Patrick J. Kline, Margie V. Kline And Angela P. Osen** TECHNIQUES IN PREPARING AN OLIGOCENE TURTLE UTILIZING ULTRAVIOLET LIGHT DURING CLEANING AND PRESERVATION
12:15	**Closing Remarks: Announcements**
12:30-2:00	**LUNCH** See *Paul D. Brinkman's Guide to Raleigh Restaurants* on p.7

Schedule of Events – Friday Afternoon, April 17th

2:00 PM	**WORKSHOPS – Registrants assigned to 1 of the 5 Options listed below.**
	Basics of Mold Making & Casting by Reynolds Advanced Materials Organizer: Jared Hopkins **Location**: Washington Room, Host Hotel
	Printing *Parasaurolophus*: full-scale rapid prototyping of macrovertebrate fossil specimens by means of fused deposition modeling Organizer: Steven R. Clawson **Location**: TBA
	Integrating Computed Tomographic (CT) Imagery into the Preparation Process Organizer: Matthew A. Brown **Location:** TBA
	The Essence of the Association; Proper Material Usage and Paleontological Methodology for the developing Preparator Organizer: Lisa L. Herzog **Location:** 4th Floor Meeting Room NRC
	Paleontology & Geology Research Laboratory Tour; Collections Tour Organizers: Lindsay Zanno and Vince Schneider Location: Tour will start in the Paleontology & Geology Research Lab; 3rd Floor NRC
≈ 5:00 PM	Upon workshop dismissal, Participants are free for the evening. Anyone interested is welcome to attend the open meeting of the AMMP board.
6:00 PM	**AMMP Board Meeting – open to all members** (everyone who registered for the conference is a member) **Location TBA, likely over dinner**

Welcome Back Brontosaurus!



Schedule of Events – Saturday, April 18th

8:30 AM	**All field trips depart from Host Hotel at 8:30** Transportation will be waiting outside with Field Trip Organizers *Your Field Trip assignment is indicated in your registration packet* Lunch will be provided on all field trips FIELD TRIPS **1. Queen Anne's Revenge Conservation Laboratory, Aurora Fossil Museum, Green Mill Run Fossil Locality, Greenville NC** Field Trip Organizer: Bucky Gates **2. Newark Supergroup: Local fossil sites in the Triassic (Lake Jordan, Hanson Brick Quarry, Egypt Coal Mine)** Field Trip Organizers: Vince Schneider and Andrew Heckert **3. NC Museum of Art Conservation Center, Duke Lemur Center, Duke Division of Fossil Primates** Field Trip Organizer: Lisa Herzog
5:00 PM	**Approximate scheduled return from field trips. Actual time may vary slightly.**
6:00	**Evening Events Begin – Silent Auction Viewing and Bidding Open** **Beverages and Light Edibles available, Full Cash Bar Open**
7:15	**Silent Auction Officially Ends – Pens Down, Winning Bids to Cashier for Payment**
7:30	**Buffet-Style Dinner Options Available for Guests, Dining begins**
8:30-9:00	**Closing Remarks, Award Presentation, Silent Auction Total, Future Plans** René Hernandez, Harmonica
10:00 PM	**Banquet Hall Reservation Meter is Up, and we're out of quarters – move on to the exit, you can't stay here…**

Workshop Descriptions

3 DIMENSIONAL (3D) MODELING, SCANNING AND MANIPULATIONS OF SPECIMENS

Organizer: Terry "Bucky" Gates

Location: Environmental Conference Center (Rm 1)

Digital archival databasing of fossil specimens has become the new standard for 21st century collections. In this workshop participants will gain experience using a hand-held 3D surface scanner and associated software. Additionally, photogrammetry techniques will be used as a different means of producing 3D models of fossil specimens. Participants should come prepared to discuss prior experience with digitally archiving 3D models, collections policies for availability of the 3D data to outside researchers, and use of 3D models for morphometric data collection.

ADVANCED PACKING FOR SAFELY SHIPPING SPECIMENS

Organizers: Marilyn Fox, Vanessa Rhue, and Vicen Carrió

Location: Environmental Conference Center (Rm 2)

While many specimens can be shipped using basic specimen packing procedures, there are those special situations that require more complex techniques. This workshop will equip you with a broad knowledge of materials, methods, and strategies for handling, wrapping, and shipping fossils on institutional loan**.** It is an expansion to the 12:15 Oral Presentation "How to Pack Fossils for Shipment by Currier".

ULTRAVIOLET (UV) AND LIGHTING TECHNIQUES FOR SPECIMEN DIAGNOSTICS AND DOCUMENTATION

Organizer: Mike Eklund

Location: Basement of Main Building (NEC) of NCMNS

Description: UV photography and other simple lighting techniques are very powerful forensic tools to aid in specimen diagnosis and documentation. An array of inexpensive techniques can be applied universally to historic as well as modern specimens and help fulfill diagnostic needs in fossil preparation, collections management and scientific research alike. This workshop will introduce participants to the basic concepts and skills in using variable and alternative lighting to safely and efficiently document critical information on paleontological specimens. The opening discussion segment will address safety, basic lighting concepts, camera types/sensors, calibration, workstation ergonomics, documentation, record keeping, manmade versus natural artifacts, software and file storage choices. The hands-on lab portion will give participants a chance to work on several different types of workstations. A variety of large and small specimens as well as several different DSLR cameras and microscopes will be used. The final discussion portion will be on interpreting images, artifact diagnosis and implementation of learned concepts. Participants may bring cameras, iPads and SD media cards for "data" sets if time permits. **All participants are required to wear long sleeve shirts. UV safety glasses and gloves will be provided for all participants.**

SOFT TISSUE AND MOLECULAR ANALYSIS: BASIC REMEDIATION FOR FIELD AND LABORATORY

Organizer: Alison Moyer

Location: Offsite, NCSU campus

Typical fossil preservation and collection involves the stabilization and remediation of bony remains. Field methods are tailored to this type of collecting and many individuals are not prepared or aware of proper collecting strategies appropriate for encounters with soft tissue remains or sample purity for future molecular analysis. This workshop will be an overview of molecular-analysis techniques and strategies for fossil specimens. These types of methods are gaining ground in paleontological analysis and are part of an overall base knowledge in materials and methods in paleontology.

PALEONTOLOGY & GEOLOGY RESEARCH LABORATORY OPERATIONS OVERVIEW AND PALEONTOLOGICAL COLLECTIONS TOUR

Organizers: Lindsay Zanno and Vince Schneider

Location: Paleontology & Geology Research Lab., 3rd Floor Nature Research Center

The Nature Research Center opened in 2012 under the premise of "How Do We Know?" This new wing of the North Carolina Museum of Natural Sciences attempts to bring transparency to the process of scientific research with the four publicly viewable research labs housed within. The Paleontology & Geology Research Lab houses both the preparation process as well as the research personnel involved in this field. Director Lindsay Zanno has molded this novel space into a useful and functioning Research Lab that provides functionality to many different needs. Preparation is central, however, the functionality of the space requires modularity. Dr. Zanno will give a detailed summary of the activities that go on within this space, how various differing techniques are accommodated and what kinds of challenges this form of working environment produces.

Prior to the inauguration of the2012 Nature Research Center, Vertebrate Paleontology Collections and Research have both been an integral aspect of the museum since its inception in 1887. Curator of Paleontology, Vince Schneider has been with the museum for many years and has overseen the growth, curation and organization of the collections. He will lead participants on a tour of the collections space located in the basement level of the main building. The paleontology collection includes approximately 56,000 vertebrate, 55,000 invertebrate, 1,000 paleobotanical, and 34 type specimens. Two of the most notable specimens in the Museum's paleontological holdings are skeletons of *Acrocanthosaurus atokensis* and *Thescelosaurus*.

BASICS OF MOLD MAKING & CASTING BY REYNOLDS ADVANCED MATERIALS

Organizer: Jared Hopkins, Reynolds Advanced Materials

Location: Washington Room, Host Hotel

This workshop will cover the basics of moldmaking and casting with a demonstration of various techniques. Students will be introduced to a world of material possibility and how rubbers, plastics, foams, gypsums, etc. are used for a variety of applications. An assortment of materials will be discussed for maximum range of solutions to unique problems in paleontological applications. This workshop is run by Reynolds advanced materials and will feature molding and casting materials in their product lineup. The basic functionality of specific types of rubbers and epoxies is the main focus.

PRINTING *PARASAUROLOPHUS*: FULL-SCALE RAPID PROTOTYPING OF MACROVERTEBRATE FOSSIL SPECIMENS BY MEANS OF FUSED DEPOSITION MODELING

Organizer: Steven R. Clawson

Location:

Undergraduate and post-graduate programs in vertebrate paleontology and comparative anatomy require students to develop a tangible familiarity with fossil specimens. In many cases, important specimens (e.g. holotypes) and reference collections of common vertebrate fossil materials are not readily accessible to students in smaller colleges, and traditional injection-molded casts still remain relatively expensive to purchase and produce. While it remains difficult for affordable FDM (fused deposition modeling) printers, which can only produce z-axis layer heights of 50-100 µ at best, to resolve ultra-fine details such as fractures in tooth enamel, endochondral bone structures, and pathologies like osteoarthritis, details produced at a small scale such as cutting edges in teeth, foramen, and mastoid processes in mammals can be reproduced with precision. This workshop aims to demonstrate that while finite details cannot be rendered using these consumer desktop printers, nearly complete, education-grade models of fossil specimens can now be produced using fused deposition modeling at nearly 1/20th the standard production cost of traditional resin-casted models. As a demonstration, a full-scale rapid prototype of a juvenile *Parasaurolophus* skull (RAM 14000) has been produced by the author totaling $10 USD in material costs.

ROUNDTABLE DISCUSSION: THE ESSENCE OF THE ASSOCIATION; PROPER MATERIAL USAGE AND PALEONTOLOGICAL METHODOLOGY

Organizer: Lisa L. Herzog

Location: NCMNS Nature Research Center 4th Floor Meeting Room

With the incorporation of the Association of Materials & Methods in Paleontology in 2015 comes the responsibility of both the founding officers and the membership to adhere to and build on the concepts and goals that helped germinate the Association. The main focus of the Association predominate in its title; Materials & Methods as it best describes and encompasses what both professionals and volunteers encounter in our paleontological affiliations. Because the issue of training, accreditation, and universal standards proliferates in our field, continued discussions are warranted to continue the forward momentum.

All are welcome to join this Roundtable Discussion that is open for direction, and questioning. Specific lines of discourse will include a review of "Defining The Professional Vertebrate Fossil Preparator: Essential Competencies" (Brown, Davidson, Fox, Jabo and Smith 2/23/2012) as put forth to the Society for Vertebrate Paleontology. The highlight of this document is the list of 14 Essential Competencies. Participants will receive a copy prior to the Workshop. Additionally, Participants will be provided with a copy of the AMMP Charter and Bylaws as supplementary reading.

INTEGRATING CT IMAGERY INTO THE PREPARATION PROCESS

Organizer: Matthew Brown

Location:

The use of X-ray Computed Tomography (CT) in the study of fossil material has increased significantly in the last decade, and has augmented or even supplanted conventional mechanical preparation techniques in vertebrate paleontology laboratories. CT is dependent upon X-ray contrast between matrix and fossil material, and has traditionally allowed paleontologists to study otherwise unobservable morphological features in specimens. CT imaging has been integrated into the mechanical preparation workflow only recently, and allows the research team to target specific elements of anatomy for strategic preparation. CT datasets and three-dimensional digital models of specimens can be presented directly to the workbench, eliminating trips back and forth to offices or computer labs, as well as risks to laptop computers and other delicate equipment.

In addition to aiding an experienced individual preparator, these digital methods facilitate more precise instruction of new employees, ease and accuracy of record keeping, and provide exciting and engaging visual aids during education and outreach exercises. Most importantly, the complementary nature of CT and mechanical preparation techniques may increase specimen longevity and avoid destructive disarticulation of specimens that can involve the loss of valuable morphological and contextual information.

PALEONTOLOGY & GEOLOGY RESEARCH LABORATORY OPERATIONS OVERVIEW AND COLLECTIONS TOUR

Organizers: Lindsay Zanno and Vince Schneider

Location: Paleontology & Geology Research Lab., 3rd Floor Nature Research Center

The Nature Research Center opened in 2012 under the premise of “How Do We Know?” This new wing of the North Carolina Museum of Natural Sciences attempts to bring transparency to the process of scientific research with the four publicly viewable research labs housed within. The Paleontology & Geology Research Lab houses both the preparation process as well as the research personnel involved in this field. Director Lindsay Zanno has molded this novel space into a useful and functioning Research Lab that provides functionality to many different needs. Preparation is central, however, the functionality of the space requires modularity. Dr. Zanno will give a detailed summary of the activities that go on within this space, how various differing techniques are accommodated and what kinds of challenges this form of working environment produces.

Prior to the inauguration of the2012 Nature Research Center, Vertebrate Paleontology Collections and Research have both been an integral aspect of the museum since its inception in 1887. Curator of Paleontology, Vince Schneider has been with the museum for many years and has overseen the growth, curation and organization of the collections. He will lead participants on a tour of the collections space located in the basement level of the main building. The paleontology collection includes approximately 56,000 vertebrate, 55,000 invertebrate, 1,000 paleobotanical, and 34 type specimens. Two of the most notable specimens in the Museum's paleontological holdings are skeletons of *Acrocanthosaurus atokensis* and *Thescelosaurus*.

Field Trip Descriptions

Field Trip Descriptions

QAR CONSERVATION LABORATORY; AURORA FOSSIL MUSEUM, PIT OF THE PUNGO SPOILS PILE; GREEN MILL RUN FOSSIL LOCALITY, GREENVILLE NC

Field Trip Organizer: Terry "Bucky" Gates

★ First, participants visit The *Queen Anne's Revenge* (QAR) Conservation Laboratory for artifacts recovered from this flagship of the notorious 18th century pirate *Blackbeard*. This archaeological conservation and research project is a collaboration of scientists that use leading techniques in the science of preservation.

★ Next scheduled stop is the Aurora Fossil Museum. Aurora is the home of the PCS Phosphate quarry, which is the largest phosphate mine in the world. The sediment overlying the phosphate contains billions of Miocene-Pleistocene vertebrate fossils, the most famous of which are shark teeth. Participants will be able to prospect for fossils in a quarry spoils pile while at the Aurora Fossil Museum.

★ The Green Mill Run fossil locality in Greenville will be visited on the return trip if time allows. Fossiliferous sediments at this stop range from Late Cretaceous through Pliocene. Collecting fossils at this locality will likely require wading in a shallow creek.

NEWARK SUPERGROUP: LOCAL FOSSIL SITES IN THE TRIASSIC

Field Trip Organizers: Vince Schneider, Andrew Heckert

This field trip will take participants to several local sites where specimens have been collected for the museum. Vince Schneider, long time curator at the museum, has overseen many of the excavations.

★ Jordan Lake is a reservoir developed in the 1970s as a flood control facility run by the U.S. Army Corps of Engineers. Locally, the shoreline of the lake reveals extensive deposits of the Chatham Group 'undivided' in nearly 100 m of continuous section (Clark, 2012). During times of drought, outcrop exposure increases as the lake retreats from the shoreline. The North Carolina Museum of Natural Sciences has taken advantage of these times by prospecting the exposed shorelines. Several fossiliferous localities, predominantly mad up of indeterminate phytosaurs, have been developed.

★ Hanson Brick Quarry is a classic Triassic plant locality located in Chatham County, NC. The site exposes the Carnian age Pekin Formation, and the oldest of the Triassic formations exposed in North Carolina. There have been over 25 plant species identified from this site. This site has not been an active mine for several decades and has become overgrown with vegetation. However, there are several exposures, where one can access the wall and expose the plant layer. This site also produced a number of vertebrate fossils during the 1960's when the mine was still active. These included the remains of the dicynodont *Placerias*, the aetosaur *Lucasuchus*, as well as various phytosaur teeth and vertebrae.

★ The Egypt Coal mine (reclaimed site) closed in 1928 is located near Cumnock, Lee County, NC. It was a deep shaft mine that exposed the coals of the Norian age Cumnock Formation. The site consists of a number of spoil piles, now overgrown with vegetation, containing bulk shale that can be split to reveal fish scales, coprolites and an occasional phytosaur tooth. There were a number of coal mines in operation in the late 1800's, both in Lee and Chatham Counties. It was from one of these mines that AMNH vertebrate paleontology specimen number one, *Rutiodon carolinensis*, came from.

ART MUSEUM CONSERVATION FACILITY: DUKE LEMUR CENTER: DUKE DIVISION OF FOSSIL PRIMATES

Field Trip Organizer: Lisa Herzog

This field trip is a little bit 'outside the box' with three unique stops.

★ **North Carolina Museum of Art:** We will be given a tour of the Conservation Facility by the head of the division. This will be a great opportunity to compare techniques and materials shared between art and paleontology. We may also have time for a brief visit of the museum. Highlights include John James Audubon's The Birds of America, a treasure of art publishing that has belonged to the State of North Carolina for more than a century and a half is exhibited in its entirety at the North Carolina Museum of Art; additionally the most extensive Rodin collection between Philadelphia and the West Coast in the Museum's Iris and B. Gerald Cantor Court and Garden.

★ **The Duke Lemur Center (DLC)** was founded in 1966 on 80 wooded acres, two miles from the main Duke campus. It houses approximately 250 individual animals representing 23 species: from mouse lemurs (the world's smallest primate) and sifaka, to ring-tailed lemurs and the aye aye (the world's strangest primate), and everything in between. The scientific endeavors at the DLC span a remarkable array of disciplines, from behavior and genomics to physiology and paleontology. Conservation biology is also a major focus and provides the conceptual and operational bridge between the living collections of the DLC and its outreach activities in Madagascar.

★ **The Division of Fossil Primates (DFP)** houses over 27,000 specimens that range from 55-48 million years (Wyoming), 37-19 million years (Egypt), 18-7 million years (India), and 10,000-500 years (Madagascar). The primary focus of the DFP collections is on primates but many other mammals and vertebrates are also represented. Specimens range from nearly complete skeletons of subfossils from Madagascar, to skulls, dentitions, and isolated postcranial elements from Egypt, India and Wyoming. An extensive collection of comparative casts and recent primate skeletons is also included in the DFP Collections.

Photos: Coquerel's Sifaka (left), and sloth lemur Palaeopropithecus (right)

Alphabetical List of Oral Abstracts

CREATING AN INTERACTIVE DIGITAL SPECIMEN CABINET IN A MASSIVE OPEN ONLINE COURSE

Victoria M. Arbour[1,2*] and Eva B. Koppelhus[3]

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The University of Alberta launched their first Massive Open Online Course (MOOC), Dino 101: Dinosaur Paleobiology, in September 2013, and over 65 000 students have participated in this course over its four offerings. The course is delivered fully through online resources, which means that students do not have access to a traditional lab setting where they could observe fossils directly. One of the priorities we identified during the early development of the course was highlighting the role of museum collections in palaeontological research. We wanted students to see as many real fossils as possible in the lecture videos, but we also wanted to have a digital proxy for a hands-on fossil lab, and so our production team built a custom three-dimensional specimen viewer (in HTML) that would be embedded in the course. We created 30 models of fossils in our collections, primarily using computed-tomography scans and the software programs Mimics and Geomagic, that could be exported as stereolithography (STL) files and included in the viewer. Within the viewer, the specimen can be rotated by the student, and a 'specimen card' with information about the age, provenance, and classification of the specimen appears on screen. The models are revealed throughout the course where they are relevant to the learning outcomes, and serve as a way to 'gamify' the online lectures. The digital specimen cabinet proved to be very popular with students, and many commented that it had enhanced their understanding of the lecture material. Some students even tried their hand at creating their own 3D models using photogrammetry software and displays at their local museums. There are several challenges to displaying our collection online in this manner: because the models are displayed in custom-built software and embedded within a MOOC, it is not easy to expand the repository if we create new models. We also had to create relatively low-resolution models in order for the files to load easily across many different browsers and internet speeds. Nevertheless, there may be educational benefits to linking an online specimen cabinet with discrete learning objectives within a MOOC, versus posting 3D models on a museum or database website.

COMPARISON OF NESTED SIEVES, TRADITIONAL SCREEN BOXES, AND PAINT SIEVES FOR THE RECOVERY OF MICROVERTEBRATE FOSSILS

Haviv M. Avrahami[1*], Andrew B. Heckert[1], and Larry Martin[2]
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Traditionally, methods for screen washing sediment in order to recover microfossils involved the use of expensive, bulky, nested sieves, whether they are "screen boxes" or sedimentary sieves. Though nested sieves offer modular capability, size sorting of sediment and fossils, and other benefits, we have investigated using paint sieves. The paint sieves are lightweight and can be easily transported in the field. They are inexpensive and can be found at any local hardware store, whereas the nested sieves can cost more than $200 for a functional set and screen boxes have to be custom built. In initial tests, the 5-gallon paint sieves (Bluehawk® brand found at a local Lowe's Home Center) can hold a larger load (up to 2.5 kg of benonitic sediment) rather than the nested 8" (~20 cm) sieves, which quickly become clogged at just 1 kg. The paint sieves offer a continuous 3-dimensional surface area, compared to the nested sieves, which only filter on one side, and traditional boxes, which typically filter on 3–5 sides. Paint sieves are designed to handle heavy liquid loads such as viscous paint, whereas traditional sedimentary sieves are intended for dry sediment. The elastic band allows for a wide range adaptability. The fabric is soft and will not damage either delicate microfossils or skin. These paint sieves can be effectively labeled and used with desired sediments, but with nested sieves, there exists the risk of cross contamination between samples. Even with these benefits, the paint sieves have some drawbacks relative to the nested sieves. Nested sieves are standardized and can effectively sort sediment by size, and offer the ability to easily see what has been left after washing before removing the sediment and fossils from the mesh. They are durable and can be reused limitless times, while the paint sieves have a limited number of uses (but are surprisingly long-lasting). Microscopic analysis of the paint sieves indicates that "relaxed" they have irregular polygonal openings ranging from .07-.15 mm^2. With the fabric stretched (e.g., under load, the more relevant measure) the actual aperture remains small, due to how the sieves are designed, and increases to .12-.17mm^2. In practice, one of us (LM) reports finding fossils as small as 0.1 mm long, and frequently only 0.25 mm long, in concentrate from paint sieving.

USE OF EXPANDABLE FOAM AS AN ALTERNATE METHOD FOR COMPUTED TOMOGRAPHIC (CT) MOUNT-MAKING AND UNUSUAL PACKING NEEDS

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Computed Tomographic imaging (CT) of fossils requires that specimens are carefully and securely mounted in a way that inhibits movement for the duration of the scan. At the American Museum of Natural History (AMNH), preparators have developed in-house standards for CT mounts using shaped cavities in polyethylene foam. This procedure has been used with much success and we consider it the safest method for mounting most specimens. However, heavy, large, or awkwardly-shaped specimens provide challenges to mount-making and have been addressed in a variety of ways by our staff. One successful method tested by staff at the AMNH is the use of expandable foam.

Many factors must be considered for CT mount-making. For larger specimens, standard stock polyethylene foam planks are often too shallow for cradling. For a single specimen, hours may be spent adhering planks, measuring, cutting to size, and carving out the specimen shape with hot knives. Carving out this type of deep, complex cradle is cumbersome and time consuming. A two-part polyurethane expandable and flexible foam (Smooth-On Flex Foam) has been introduced, as an alternative, to quickly make cradles that contour and secure specimens in place. Mount setup time is reduced to just a few minutes, and other work can be done during the two-hour cure. A barrier layer is applied between the specimen and the foam application to allow for easy foam removal and an external rigid form for the CT mount is constructed using low-attenuation materials. This shape is critical to the safety of the specimen and the optimization of scan data. All products have been proven to cause minimal interference with X-ray signals.

We have also modified and implemented the use of expandable, flexible foam for fast packing of specimens for shipment. The procedure is adjusted so that multiple foam compartments are created. They are then safe for trouble-free removal by the addressee.

Expanding foam can save preparators time and effort; however, the use of expandable foam requires robust and stable specimens that can withstand the pressure of expansion and tension during foam removal. Not all specimens meet this requirement. For most specimens, traditional polyethylene cradles are still best. Both CT mount and shipping applications are currently in practice at AMNH.

JANKY JACKETS: AN EXAMINATION OF UNORTHODOX JACKETING MATERIALS

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Specimen jackets are created with burlap, water, and plaster. During remote field work however; these ingredients can occasionally be in short supply or absent and decisions need to be made on the viability of removing specimens. Several creative materials have been proposed and executed, to supplement any missing supplies keeping with best practice methods. Various cloths; such as cotton/polyester t-shirts, denim jeans, and cotton socks are typically found in abundance in most field camps, but are these materials suitable replacements for durable, easy-to-use burlap? Liquids, such as sports drinks or beer are familiar in many field packs or coolers, but can these liquids be substituted to form reliable plaster? If plaster is in short supply or unavailable, will paper towels soaked in consolidant, or mud that is impregnated with consolidant be a safe substitute for a plaster specimen jacket? Would layers of duct tape provide enough support and protection to safely transport specimens back to the lab? Since specimen jackets often reach large sizes, a jacket many require support braces made of tree branches, wood 2x4's, or fence posts, although other materials can be used for a support brace when those supplies are not available. This study examines past applications of various "quick fix" solutions, and determines the viability of each material in the creation of plaster specimen jackets to determine which solutions are safe for the fossils, versus when it is better to leave the specimen in the field and return with proper supplies.

THE USE OF CYCLODODECANE IN VERTEBRATE MICROFOSSIL PREPARATION

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Since 1995, cyclododecane (CDD), a waxy cyclic alkane hydrocarbon that sublimes at room temperature, has found increasing use by conservators as a temporary binder, facing, barrier coat, consolidant or mounting medium in the conservation of a range of fragile objects from ceramics and textiles to ancient paintings and frescos. Over the past decade, CDD's unique and advantageous properties have led to its adoption by vertebrate paleontology preparators for a variety of uses, including temporary fills during molding or reinforcing support during transportation, but its primarily use is as a temporary mount or "work-holder" for delicate microfossils during preparation. In addition to its support function, CDD can be used during micro-preparation to provide protection for fragile elements previously exposed, and can be used as a "warning-cushion" for edges of access while working inside enclosed cavities such as endocrania. CDD is also useful as a temporary consolidant of non-cohesive matrix in cases where removal of matrix might otherwise result in collapse of the enclosed specimen. Its function as a temporary gap filler is critical during preparation of microfossils in blocky matrix with open fissures. Since CDD is hydrophobic and insoluble in strong polar solvents, consolidation of otherwise porous matrix and specimen also allows use of the "water-bead" technique to enhance visual differentiation of matrix and bone. The proper use of special tools and the selective warming (or not) of specimens is key to the successful application and removal of CDD in these and other micro-prep procedures. Although the MSDS indicates that CDD has low toxicity, thorough safety studies have not been conducted. CDD is known to be a bioaccumulant with primary routes of entry through respiration and skin absorption. It is strongly recommended that heating, melting and application of CDD be done under a fume hood. Gloves and safety glasses should be worn and proper ventilation be provided during specimen preparation.

HARD CORE PREPARATION TECHNIQUES: ACQUIRING AND PROCESSING FOSSIL BONE CORES ON A SLIM BUDGET.

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Preparators are often asked to do unusual or unique jobs to assist researchers. Students often have lots to accomplish with little or no budget to work with. When these two factors combine, necessity becomes the mother of invention. I was recently approached by a student to assist in the recovery and stabilisation of fossil bone cores destined for histological study. The final result would show clearly either the presence or absence of medullary bone in several individuals of *Dromornis stirtoni*, a giant flightless bird. Naturally, time and money were both in short supply.

This presentation describes the methods and results that were generated using our limited access to technology, equipment, suitable fossil material and having no real idea regarding the correct or established process for extraction, embedding and slicing of the samples.

DEALING WITH 10 AGENTS OF DETERIORATION AT NATIONAL MUSEUMS SCOTLAND

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The Natural Sciences Department at the National Museums Scotland (NMS) has an extensive and diverse collection of specimens in its collections. The Palaeobiology section has a quarter of a million specimens that have been moved from old display cases in the galleries and wooden cupboards in cellars to roller-racking and metal cabinets in a custom-built store. The fact that fossils have survived for millions of years doesn't mean that they are indestructible. They are prone to damage and need to be looked after to ensure their longevity. The main problems in palaeontological collections are that some people consider them to be: "not affected by the same problems that affect other collections in museums", or "fossils are just rocks and, if we follow the conservation practices, researchers will not be able to study them".

Preventive conservation cares for specimens in good condition, or those which are prone to deterioration. There are 10 agents of deterioration and by controlling them; we are able to control deterioration. The control of these agents is the responsibility of the conservators and the preparators. The effectiveness of the methods applied depends on the knowledge of the staff regarding preventative conservation.

It doesn't matter about the size of the collection, all collections suffer deterioration due to the interaction with the environment and the other agents. In this presentation I will talk about how NMS has been dealing with the 10 agents of deterioration and how deterioration has decreased through time. NMS has moved sensitive collections away from exhibition areas and has implemented new storage with the use of archival materials and environmental controls. The control of the storage minimises the danger of deterioration both at the macro-level (in the room) and micro-level (cabinet, box, and drawer). Protocols and regulations helped to control the risks and are used all around the collections in NMS.

PORTABLE AND INEXPENSIVE CUSTOM-MADE AIR ABRASIVE CHAMBERS FOR LARGE SPECIMENS

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Air abrasive machines have become an integral part of many fossil preparation labs over the past few decades. While dust extraction systems are a necessity to remove particles from the air, most air abrasive work is done within a desktop work chamber directly connected to air extraction. This allows for far greater airborne particle containment. This is great for fossils that fit inside the chamber. But there are many fossils that are either too large, or part of an even larger whole, for such a chamber. A large, movable air abrasive chamber is commercially available as a potential solution for these oversized specimens. However, it is expensive and therefore out of reach for many (perhaps most) preparation labs. We have custom designed and implemented several homemade abrasive chambers at the Tate Geological Museum. This report will highlight what we did, and what lessons we have learned. Our first design was a large movable canopy anchored to the floor and ceiling of the lab that allowed access to large portions of an articulated hadrosaur specimen. It was cumbersome and awkward, but it worked. The second strategy was to make smaller movable air abrasive chambers out of cardboard box, a piece of glass, some old jeans and duct tape. The chambers can be laid directly on the specimen over the area that requires work. Several of these are currently being used at the Tate Museum for large dinosaur and turtle specimens.

MAKING A PERMANENT BASE FOR A THIN FOSSIL USING EPOXY

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JODA 4771, as collected, was a large block of Clarno Formation with only the hollow dentine of the upper tooth rows of a brontothere exposed. A huge amount of very hard rock was oriented over this thin, fragile specimen. As the rock was scribed away and the block got smaller, traditional plaster cradles were used to support it. Eventually, the block became extremely thin, and the plaster cradles were inadequate. In a few places the rock was only millimeters thick, and while uncovering the occlusal side of the teeth, a few holes were punched all the way through the matrix. Afraid to proceed any further for fear of losing the dimensions of the palate that had been preserved, it was decided to make a permanent base out of epoxy. Clear epoxy was chosen so the undersides of the teeth were still visible as originally preserved. The challenge now became how to construct this base without getting epoxy on the newly exposed occlusal surfaces. A number of trials were made using clay, carbowax, cyclododecane, and silicone. The best method was using brushable silicone employing a process much like molding the specimen. First, all undercuts and places where silicone could adhere were filled in with clay. Because the finished product is not being used to make a replica, claying can be done liberally without worry of masking features. Brushable silicone was applied to the dorsal surface until thick enough and completely set. A clay wall was constructed at the edge of the ventral surface. Then, the brushable silicone was extended up the wall to create a reservoir that was tightly sealed to the fossil. Finally, the clear epoxy was poured into this reservoir to form a solid, level, permanent base. Embedded in its new stable foundation, preparation resumed without fear of the specimen breaking apart.

CLOSE RANGE PHOTOGRAMMETRY OF THE UPPER JURASSIC CLEVELAND-LLOYD DINOSAUR QUARRY, EMERY COUNTY, UTAH

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In addition to morphometric data, research in vertebrate paleontology requires taphonomic interpretation to elucidate the paleoenvironment and highly variable postmortem conditions within the final burial zone of a target taxon. Precisely documenting the spatial distribution of bones in the field is fundamental to paleoenvironmental analysis, as bone orientation and accumulation rates are constrained under a handful of depositional and biogenic facies. In many cases, grid maps of bones that have been produced from productive quarries are quickly drafted and poorly resolved, offering little but generic 2-dimensional estimations of in situ bone orientations. Photogrammetry, a technique producing a surface model of the textures and topography of objects using an assemblage of digital photographs, offers an accurate means of resolving the relative positions of bone in a photorealistic environment in three dimensions. Mediated by a small number of important considerations, modern hardware and software distill the process of constructing a photogrammetric model of a quarry into three stages, rendering this technique time-efficient and relatively cost-efficient compared to laser/texture scanning. As a case study, a fully interactive 3-dimensional photogrammetric map of the bones currently exposed in the workable portion of the Cleveland-Lloyd Dinosaur Quarry (CLDQ) has been produced, in addition to a standard grid map for baseline comparison to constrain accuracy. The resulting digital package yields a detailed surface model of a bone assemblage in situ that can assist in environmental reconstructions.

THE ACID PREPARATION OF FOSSIL FISH: A TWENTY-YEAR RETROSPECTIVE

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A review of the condition of fossil fish acid-prepared twenty years ago reveals that the major goals of the preparation were met: fish skeletons were permanently transferred onto polyester resin, and the fish bones were freed from the surrounding matrix while preserving their articular relationships. The technique included the pre-embedding sacrifice of some fossil structures located on the hidden surface of the fish. A pre-embedding acid bath insured clean bone surfaces and good adherence of the fish bones to the plastic. The specimens were transferred to the bottom of polyester boxes, which were poured around them, and plexiglass lids were affixed. As judged by dust accumulation atop the lids, the closed boxes do seem to be preventing dust accumulation on the specimens. The B-72 consolidant was originally chosen for its low solubility in water, as the specimens were cycled back into acid and water baths following consolidation. Although many of the bones now appear dry, the B-12 continues to prevent the bones from deteriorating. Thin cynoacrylate glue was used as a consolidant for the prismatic calcium cartilage of the skate *Rhinobatos*. The prismatic surfaces still preserve the form of the long-gone cartilages. Our decision to grind the specimen number but not the specimen identification onto the side and lid each polyester box was fortunate. Several of the generic identities of these fish have changed in the intervening years. However, some problems are apparent. Sulfide minerals exposed during the course of preparation have suffered from pyrite disease since being placed in storage. Paper tags were adhered to the box lids to communicate taxonomic identification. The rubber cement used to adhere the paper labels to the plexiglass lids is failing. Those few specimens that were not housed in closed boxes are demonstrating that dust accumulation can significantly detract from the specimen. Breakage is also present in these unboxed specimens.

CONSERVATION OF PAPER SHALE FROM THE FLORISSANT FOSSIL BEDS NATIONAL MONUMENT, COLORADO

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Paper shale from the Florissant Formation is a combination of smectite clay weathered from volcanic ash interlayered with diatomite. Each layer is between 0.05 and 2 mm in thickness and contains carbonized fossils. These fragile fossils are susceptible to cracking and loss from even minor environmental changes, so stabilization is vital. A new method using Reemay, a stabilizing fabric, to add extra support to the paper shale was tested. Consolidants considered for adhering the fabric to the shale were Butvar B-76, Butvar B-98, Paraloid B-72, and Paleobond penetrating consolidant. The Butvars and Paraloid B-72 were dissolved into acetone and ethanol at concentrations of 2%, 5%, and 10% (weight/weight ratio) and their effects on application to shale were observed and measured. These effects included notable curling of the shale in some cases. Cyanoacrylates were also tested as a coating agent for the shale before application of the stabilizing fabric. The Paleobond penetrating consolidant was tested as a shale strengthener to keep it from curling during application of one of the other consolidants on the Reemay.

HOW TO PACK FOSSILS FOR SHIPMENT BY COURIER

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It is not possible for every researcher to visit every museum to see every specimen, so vertebrate paleontology collections regularly loan material to researchers in other institutions. This means that delicate, irreplaceable fossil specimens are shipped all over the world. It is easy to imagine a multitude of ways in which damage can occur; however, with a few simple steps most damage can be avoided. This presentation describes a basic packing procedure, consisting of three main components: plastic bag, inner box, and outer box, with appropriate padding added between the plastic bag and inner box, and between the inner and outer boxes to cushion the specimen and minimize movement and breakage. The plastic bag prevents contact of the specimen with packing materials, and if any breakage occurs, keeps all fragments together. Packing materials are important as well, although even less preferable materials can be used if not in direct contact with the specimen. Some preferable materials include Ethafoam, polyester fiberfill, crushed archival tissue paper, and stretch wrap, while materials to be avoided include cotton batting and inadequate boxes. Steps that should be taken before the specimen is packed include archival labeling and photography. A digital photograph provides documentation of the specimen and its condition when it left your institution. Examples are provided of checklists that can be used to standardize and streamline the packing and unpacking process for both the lending and receiving institutions. Checklists help to ensure that the same set of procedures is followed regardless of the person processing the loan. In addition to a packing list, specimen loan forms, and other documentation, a separate sheet should also be included that contains information to help the researcher return the loan safely. This sheet includes a brief outline of the appropriate packing procedure, as well as the address and contact information of the person to whom the loan should be returned. These simple steps help to maintain the level of access required for research and yet greatly reduce the loss of information inherent in any specimen breakage.

TECHNIQUES IN FOSSIL REPLICATION: A COMPARISON OF MOLDING AND CASTING VERSUS 3D SCANNING AND PRINTING FROM THE VIEWPOINT OF AN UNDERGRADUATE INSTITUTION

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Fossil replication is an important part of paleontology, whether it is used for research, museum displays, or other outreach. Traditionally, this process has been completed through making a rubber mold of a specimen and using the mold to pour casts in various media, including resin and plaster. However, recent developments in 3 Dimensional (3D) scanning and printing have opened new opportunities for sharing information about fossils. This study aims to compare the costs and benefits of both techniques so that preparators may make informed decisions when choosing how to invest resources in fossil replication. This comparison is made through the lens of an undergraduate with equal experience in both techniques and no bias toward either system. The molding and casting process is fairly inexpensive for large numbers of copies ($100 gallon silicone rubber, $50 gallon urethane rubber) and yields a highly detailed product (some features still visible under SEM). However, this process requires a physical mold to produce a cast, molds degrade over time, the chemicals involved can be mildly toxic, and there are issues with complex and/or delicate specimens. 3D scanning and printing is less invasive, allows scans to be transferred and downloaded digitally then printed anywhere in the world, and provides varying options in medium compared to plaster and resin. However, printinting equipment can suffer from technical issues, the quality of low cost prints does not meet the same standards as casts, and leaves visible artifacts (layers) when printing in plastic. Printing size limits (<12 inches/30 cm), upfront set up costs along with continued equipment maintenance costs is much higher ($3-4,000) than molding and casting supplies. This high set up cost is, however, offset by low-cost printing ($50 for hundreds of prints). 3D modeling has a time cost benefit over molding; specimens that can be scanned and edited in 3-4 hours require a 2-part mold that takes more than 2 days to complete. Printing 3D scans is basically automated and yields consistent results, whereas pouring molds is more time-intensive and subject to greater variability in output. These factors show that in cases where detailed replicas are needed molding and casting is preferable, though 3D scans are becoming increasingly useful for quickly sharing specimen information and producing rapid, lower detail copies.

TECHNIQUES IN PREPARING AN OLIGOCENE TURTLE UTILIZING ULTRAVIOLET LIGHT DURING CLEANING AND PRESERVATION OF THE FOSSIL.

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A nearly complete *Stylemys nebrascensis* turtle was recovered in 1994 by an amateur fossil hunter in the Nebraska Badlands, it was donated to the Heard Natural Science Museum in 2013 for preparation and display. The fossil had been preserved in the field using newsprint, white glue, and a partial plaster jacket. The turtle was encased in a three to five millimeter coating of aluminum silicate (Fullers Earth) and siltstone. Removing both the white glue and the newsprint from the carapace proved to be challenging, but the application of denatured alcohol reduced the mechanical labor somewhat. The space inside the turtle shell was filled with a combination of Fullers Earth, siltstone and volcanic ash deposits. The minerals contained in the interior space were utilized during the fossilization process to preserve the bones; within this enclosed environment the fossilized bones and matrix became the same color and were indistinguishable from each other. It was discovered during preparation that the use of Ultraviolet light would clearly illuminate and visually separate the fossil from the surrounding deposits, thus making matrix removal by hand or device easily achievable.

RENOVATION OF THE VERTEBRATE PREPARATION LAB AT THE NATIONAL MUSEUM OF NATURAL HISTORY, SMITHSONIAN INSTITUTION

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The East Wing of the Smithsonian Institution National Museum of Natural History (NMNH) was completed in 1964, and included the Paleobiology Department Vertebrate Paleontology Preparation Laboratory (VP Lab) on the ground floor. The VP Lab consisted of a series of rooms totaling over 3,000 square feet, including an acid preparation lab. Department research staff had a strong hand in laboratory design, and as a result the lab was spacious and well-equipped for the time. Except for a renovation of the acid lab in 1991 and the addition of a particulate extraction system in 2004, the infrastructure of the VP Lab has basically remained the same for five decades. An opportunity for complete renovation of the labs came with the related projects of renovating the NMNH Fossil Halls exhibits, and the HVAC systems in the NMNH East Wing. VP Lab staff worked with architects and the NMNH Office of Facilities, Engineering & Operations (OFEO) to incorporate needed lab functions with upgrades in building codes, equipment, and design standards. Construction spanned from mid-2013 to early 2015, with most high-impact work occurring on a very tight timetable.

The renovated labs incorporate many features for improved functionality and safety. These include chemical-resistant countertops and table surfaces, backsplashes which incorporate electricity and air connectors, protected housings for air line regulators and filters, textured resin flooring, microscope boom arms extending from walls, and LED microscope light sources. Improvements to the particulate extraction systems allow for full external exhausting of system intake, and welding capabilities. Sensors monitoring chemical leaks, chemical fumes, and particulate levels alert lab users to hazardous conditions. Light gray coloring of floors and countertops allow for errant fossil fragments to be more easily spotted and retrieved. Acid preparation facilities include acid-resistant piping and flooring, spill containment pits, stainless steel vented tanks, and fume hoods designed for work with hydrofluoric and acetic acids. Renovation of the VP Lab workspaces allows for improved research preparation function, and expands capabilities for mountmaking, molding and casting, and fabrication needed specifically for ongoing exhibit preparation.

EXPLORING THE EFFECTS OF SOLVENTS AND CONSOLIDANTS ON THE PAPER SHALE OF FLORISSANT FOSSIL BEDS NATIONAL MONUMENT, CO

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The Eocene fossils at Florissant Fossil Beds National Monument, CO, not only exhibit extraordinary preservation and diversity, but also present unique challenges in terms of stabilization and conservation. The lithology in which these specimens are found is alternating thin (<1mm) laminae of diatomite and smectite. When exposed to varying levels of humidity and temperature the shale undergoes various forms of deformation, such as delamination, crazing, and flaking, all of which compromise the overall stability of the fossils. To better develop methods for stabilizing the collections at Florissant, understanding the mechanics of the rock itself and how the shale responds to different solvents and consolidants is integral. While the application of any solvent will result in some amount of deformation, discovering which solvents cause the most instability will change the way the Florissant lab prepares and stabilizes fossils in the future. Solvents currently in use in the lab include technical grade acetone, ethanol, and isopropyl alcohol. Testing has shown that acetone, pure ethanol and pure isopropyl alcohol cause dramatic deformation in the paper shale. These solvents will no longer be used. Pure ethanol and isopropyl alcohol will be replaced with lower concentrations of the solvent, such as 90% and 75%. Although the addition of consolidants will temper the damaging effects of the solvent, the high evaporation rate of acetone in particular makes it harmful, and will be completely eliminated from use in the Florissant lab. Exploring the effects of these solvents and consolidants is critical to the preservation of the Florissant Collection so that future generations can continue to study and enjoy the specimens.

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COMPLETE THE WHEEL: MAKE PREPARATION AN INTEGRAL PART OF YOUR COLLECTION OBJECT RECORD

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Keeping accurate specimen preparation and conservation records is easily accomplished with modern databases. This is an important step forward, addressing the problems associated with written or typed paper records, while producing a more complete digital record of the specimen. The Non-vertebrate Paleontology Lab (NPL) at the University of Texas at Austin took advantage of the flexibility of the Specify database to create a Specimen Preparation record. By digitizing preparation records, we can now search them using standardized terms. Conservation was already well represented in the Specify structure, and therefore required less alteration.

Our first challenge was to delineate between preparation and conservation. Once our definitions were set, we altered an existing, but unused, data table and its associated form. Fields on this form were re-labeled, assigned controlled vocabulary in the form of drop down menus, and given new instructional hover text. Where material information is split, such as consolidant and solvent concentration, separate fields are used to record materials and material details. Access to Preparation and Conservation forms were embedded in the main specimen form, allowing this information to be seen in context.

Incorporating preparation data as part of our specimen record has given us a powerful tool for training, improved the quality of our record keeping, and given us a way to bring any historic prep records into a modern format. Names and dates are automatically recorded, and the addition of required fields ensure a thorough recording of information. Records can be searched and filtered using a variety of different criteria. For example, the use of controlled vocabulary has eliminated the possibility that a search for ‘B-72’ will omit records that use ‘B72’ or ‘b 72’. These drop down menus not only control spelling, but also reinforce lab policy on which consolidants are approved for use. For historic records, a ‘historic / unapproved’ entry was added.

With the technology available to us, paired with the hard-learned lessons about record keeping, it’s time for specimen record keeping to adapt. Hand writing prep records, or not keeping prep records at all, is akin to using nitrate lacquer as a consolidant— fine for an era where they didn't know better; but hopelessly dated today.

ARE FOSSIL PREPARATORS BORN OR MADE? IDEAS OF SKILL AMONG LABORATORY TECHNICIANS

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We often think of laboratory technicians as people who have specific training and credentials and who follow standard protocols to produce scientific data. There seems to be little room for skill or creativity in their work. In comparison, fossil preparators are skilled laboratory workers without formal training or standard methods. How then do preparators, as unusual lab technicians, define skill and good work, without universal ways of teaching and measuring the quality of fossil preparation? Based on interviews and observations from my sociological study of preparators since 2008, I investigate preparators' ideas about what it takes to be a preparator and what it means to be a *good* preparator. Specifically, many preparators believe that manual skill and patience cannot be learned. They consider these abilities to be innate. As a result, many labs require applicants for jobs and volunteer positions to first pass a "prep test" to assess their hand---eye coordination and ability to focus. But preparators also stress the importance of other skills that they believe *can* be learned, such as following directions, choosing appropriate tools and materials, knowing when to ask questions, problem---solving, and getting along with the members of a lab. Perhaps surprisingly, preparators did not mention strength as a skill required to prepare fossils. Thus preparators portray their skills as largely mental and emotional, as opposed to physical. I argue that this way of defining their skills separates preparators from the typical conception of rule---following, standardized technicians.

MULTI PART, LEVEL STORAGE JACKET FOR LARGE VERTEBRATE FOSSILS.

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Very large bones, such as sauropod limb bones, may be in several heavy pieces. This can make it difficult to maneuver the specimen. By following the Yale Peabody Museum Vertebrate Paleontology Lab's previously published protocol for making storage jackets using Hydrocal and Hydrocal FGR plasters, fiberglass, and medium density fiberboard (MDF) and adding a few new steps, a multi-part jacket is made that lines up exactly. Large bones supported in the jacket can be studied as if they were in one unbroken piece. Separations in the jacket are placed along pre-existing breaks in the element. Before anything else, the bone sections are lined up exactly in the sand box. A piece of 3/4" MDF cut to the size of the bone in the assumed single piece is then cut again at the separation points. "Feet" are added per our usual method. The cut MDF pieces are laid on a large flat surface and 2 X 4's running the full length of the entire base are attached onto the "feet" of the MDF base joining it together as if the base is one solid piece. The exact break is offset slightly so that the bone overhangs the jacket and the base by approximately 1/8th inch. A piece of cardboard fit closely to the plastic and clay covered bone acts as a separator between the parts and creates this space. The cardboard wall is coated with petroleum jelly to ensure the plaster from one section does not attach to another section. The jacket is then made using our usual method. Once the jacket is completed, the sections are removed, and each is treated as an individual base. All the completed bases will line up exactly. Aside from enabling easier and more accurate measurements, the individual bases can help when moving and storing the specimen.

CONSERVATION COMBO PLATTER: A HOUSING METHODS TEACHING TOOL

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The renovation of the NMNH fossil halls has pushed our public facing FossiLab into temporary quarters. With limited fossil preparation capabilities about half of our two dozen FossiLab volunteers are focusing on re-housing efforts. Some housing methods were familiar to the team, others newly introduced. But as the FossiLab is at the opposite end of the building from Paleobiology Department offices staff cannot be on hand to supervise at all times. So we created the Teaching Tray: A 14”x11” tray illustrates a variety of housing methods – cavity mounts, additive mounts, glass vials and polystyrene boxes – executed with archival materials: acid free trays, Ethafoam , Tyvek, polyester batting. Signage on the tray offers guidelines for the implementation of these methods. The tray resides in the FossiLab for easy reference as volunteers execute their assignments. The teaching tray helps keep our volunteers productive and informed and sets the bar for their already high standards of performance.

Alphabetical List of Poster Abstracts

CYCLODODECANE AND FOSSIL VERTEBRATES: SOME APPLICATIONS FOR MATRIX REMOVAL, MOLDING AND SHIPPING

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Over the past decade, cyclododododecane (CDD), a waxy hydrocarbon that sublimes at room temperature, has been increasingly adopted by vertebrate fossil preparators as a more effective and advantageous material for several standard treatments and for new applications borrowed from art and artifact conservation.

Some of the techniques in paleontology that utilize CDD's special properties include:
• Temporary embedding and support material to protect fragile specimens during removal of rock matrix with needles.
• Barrier layer to isolate areas from consolidation treatments or protect against inadvertent needle damage.
• Temporary consolidant, to saturate and to adhere paper separating layers between the specimen and a plaster working mount.
• Temporary filler to stabilize fractured specimens during airscribe preparation.
• Penetrating, acid resistant filler to protect fossil bone from damage during dissolution of limestone matrix with formic acid.
• Gap-filler for silicone rubber molding, to prevent undesirable penetration into the specimen.
• Sealant and separator for silicone rubber molding. A coating of CDD, applied in naptha, is an effective sealant for some porous fossil substrates.
• Protective coating for specimens otherwise too delicate to ship.

In several of these techniques CDD replaces materials traditionally used in preparation such as Carbowax ™ polyethylene glycol (PEG), microcrystalline wax or oil-based clay that subsequently must be laboriously melted, dissolved or mechanically removed.

CDD is not used in some fossil preparation laboratories due to health and safety concerns. It is hoped that continued exchange of information with art and artifact conservators will promote safe handling practices, encourage experimentation and spark new ideas.

PACKING, SLACKING AND CRACKING: THE CASE OF THE SMUSHED-FACE BEAR SKULL

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When a loaned specimen is returned not in its original packing materials and damaged as a result, two questions arise: 1)Did the original specimen loan agreement state that the specimen was to be returned in its original packing materials? and 2)Why did the original packing work and the return packing fail? Unfortunately, in the case of a short-faced bear skull (now called the “smushed”-face bear skull), the specimen loan agreement did not explicitly state that the loaned item be returned in the original materials. This left room for interpretation and substitution with unfortunate results.

This poster will present some recommendations for the secure packing and shipping of fragile specimens to assist other institutions in avoiding unhappy outcomes when undertaking loans. Safe shipping need not involve expensive or specialized materials or containers- readily accessible containers, materials and techniques are described in this poster, together with some basic principles of object protection. Fortunately for the Yukon Palaeontology Collection, our short-faced bear skull is being restored by the borrowing institution. And this time, very specific instructions on packing have been provided to the borrowing institution. No further damage occurred.

This poster was funded by Yukon Government.

CREATING A CASTING RESERVOIR FOR A PARTIAL SILICONE MOLD

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A large part of my work at the American Museum of Natural History consists of preparing and molding fossil mammal specimens from Chile that are primarily preserved in hard, volcaniclastic blocks. This very hard matrix requires pneumatic tools and hours of labor to remove. Specimens are often minimally prepared to reveal only certain aspects of morphology relevant for research and other fossil elements within the rock are left untouched. The silicone molding process targets only specific areas of the specimen. In turn, this often results in a partial mold in need of modification for easy casting.

A partial silicone mold is one without adequate walls to support casting material and is not considered a true reservoir. Partial molds must be shored up in some way, either with clay, tin foil, or other methods, to support materials used in the casting process. Building additional walls can be a lengthy and cumbersome task and may lead to mold distortion due to flexing. Nevertheless, making a partial mold is an efficient and time saving method that avoids complex design but involves specific approaches to ensure quality casts are produced.

Since silicone adheres to itself, additional walls can be added to an existing partial mold. This can be achieved by carefully placing the open side of a mold into a tin foil lined box containing newly prepared silicone. However, care must be taken not to obliterate any important details captured in the partial mold. Small chips of leftover silicone can be added to prop up and orientate the mold to ensure it is stable and does not flex in any way that might disrupt its original shape. Once the silicone mixture is cured this process can be repeated depending on the configuration of the mold.

Partial mold casting is approached in different ways to achieve quality results. This technique is cost-effective, time saving, and will ensure a partial mold will maintain its proper shape during the casting process and for years to come. Furthermore, this method can be applied to preexisting molds and remedy some oversights that often occur in the mold making process.

REDISCOVERY, CURATION, AND CHARACTERIZATION OF A MIOCENE RHINOCEROS (PERISSODACTYLA: RHINOCEROTIDAE) HASH FROM AGATE SPRINGS, NEBRASKA

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Rediscovery of a unique and exceptionally preserved chunk of the famous Agate Springs bone bed of Nebraska (Miocene) led to a collaborative conservation effort between paleontologists of the Department of Geology and Illinois Natural History Survey (INHS) at the University of Illinois. The chunk, comprising a large accumulation (or 'hash') of well-preserved bones collected by geologist Harold R. Wanless ca. 1950, was found in late 2014 during renovation of the Natural History Building on the Urbana-Champaign campus. This historically significant material was removed to the INHS paleontological laboratory where urgent conservation work is being undertaken to secure, identify and curate the specimens. More modern preparatory practices were used to hopefully extend the longevity of the specimen. The hash has been mechanically prepared using acetone and various hand tools to remove the aging shellac and matrix, and consolidated and repaired using Paleobond PB002 and PB100 to stabilize the bones. Preliminary study of the hash and its constituent skeletal elements has revealed the remains of two female rhinoceroses identified as the extinct *Menoceras arikarense* Barbour, 1906 (Mammalia: Perissodactyla: Rhinocerotidae). The remains include a near complete and fully articulated skull as well as a partial skull, several mandibular fragments and numerous postcranial elements. The goal of this study is to better understand the paleoecology of the Miocene Agate Springs community through a technical description of the nearly complete skull and partial cranium and its orientation within the bone bed.

Project made possible by funds from the Geology Department at University of Illinois and lab allocations from the Illinois Natural History Survey.

THE LINDOE TECHNIQUE: AN IMPROVEMENT OF THE METHODS USED TO CREATE REALISTIC REPLICAS OF LOW- TO NO-RELIEF FOSSILS FROM THE FLORISSANT FORMATION (AKA FLORISSANT'S FANTASTIC FAKE FOSSILS FOOL FELLOW FOSSILIST FANATICS)

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Many institutions have the luxury of being able to mold and cast large specimens for spectacular three-dimensional exhibition. Leaf and insect specimens from the Florissant Formation are difficult to replicate using conventional casting techniques because they are preserved as carbon imprints on a matrix with relatively non-existent physical relief. The Lindoe Technique introduced a creative method to mitigate those issues by using matte medium to transfer an image onto a plaster cast. This method has been adapted, improved, and refined for the reproduction of fossils from the Florissant Formation. Improvements include changes to medium used as the recipient for the transfer, layers of matte medium, and matte medium application techniques. The results of these modifications are realistic replicas of low- to no-relief specimens that can be used for exhibits, education, and outreach purposes.

REPURPOSING THE PURPOSEFUL: RE-TRAINING FOSSIL PREPARATORS IN VERTEBRATE MOUNT DISMANTLING AND CONSERVATION

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The Smithsonian Institution National Museum of Natural History (NMNH) is undergoing the renovation and redesign of its nearly 31,000 sq. ft. Fossil Halls. In addition to Smithsonian staff and contractors, museum volunteers serve an essential role in the dismantling and conservation of hundreds of mounted and bracketed vertebrate fossil specimens previously on exhibit. Specimens allotted for volunteer work are not slated to return to display. These specimens must be removed from their armature, repaired and conserved, and reincorporated into research collections both physically and in digital documentation.

NMNH Paleobiology volunteers have been trained in many aspects of general paleontology, fossil preparation, and collections work through the NMNH Paleontology Training Program and/or a specialized 11-day preparation training course. Most volunteers perform fossil preparation activities in the publicly-viewable preparation lab called the FossiLab. A group of approximately 20 FossiLab volunteers have shifted from research-driven preparation projects to assist with the fossil hall renovation. The adjustment was facilitated through a series of training sessions led by staff from the NMNH Paleobiology department and Vertebrate Paleontology Preparation Laboratory. This training incorporates hands-on specimen work with demonstrations in personal safety and protective equipment, documenting processes and materials used, and ways to resolve unique specimen issues through critical thinking. Volunteers work in a temporary FossiLab facility located in an interim NMNH paleontology exhibition, providing excellent opportunities to communicate with and educate public museum visitors. Content of training sessions was developed using professional fossil preparator core competencies as developed in 2012 through the Society of Vertebrate Paleontology Preparators Grant, as well as input and feedback from the participating volunteers. The materials and demonstrative setups produced for this training can be useful to other institutions training volunteers for similar tasks.

Training activities have resulted in the expansion of volunteer skill sets and competencies, allowing them to assist NMNH staff in the ongoing care of paleobiology collections and the Fossil Halls renovation.

STABILIZING THE PAPER SHALE AT FLORISSANT FOSSIL BEDS NATIONAL MONUMENT, CO: CONTROLLING RELATIVE HUMIDITY TO PRESERVE COLLECTIONS AND RECENTLY EXCAVATED SPECIMENS

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The delicate nature of the specimens at Florissant Fossil Beds National Monument, Colorado requires a constant monitoring of the collections. The overall stability of the fossils is greatly impacted by the abrupt change in humidity after the paper shale has been excavated, as well as the varying levels of humidity in the collections and display areas. Creating methods to effectively "acclimate" the shale's transition from the ground to the lab, and finding and maintaining the ideal humidity range to keep our collections room is integral to the collections management at Florissant. For these experiments, a controlled environment chamber was used, employing both humidification and dehumidification systems. The humidity is systematically lowered to slowly dry damp shale to safely lower it to the ambient relative humidity (RH) in the lab and collections areas. Tests have also been run to monitor damages the shale undergoes when it reaches a certain level of humidity. Below 25% RH, deformation occurs in the form of flaking and delamination. Initial data suggests that the ideal range to keep the collections area is between 30-35%. These tests will ultimately become the basis for a protocol that will outline how the paper shale will be handled once excavated, and how the collections area should be maintained.

Source of funding: Natural Resources Preservation Program

Notes