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George Corner
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UNIVERSITY OF NEBRASKA
STATE MUSEUM

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This event is #AMMP11

UNIVERSITY OF NEBRASKA STATE MUSEUM

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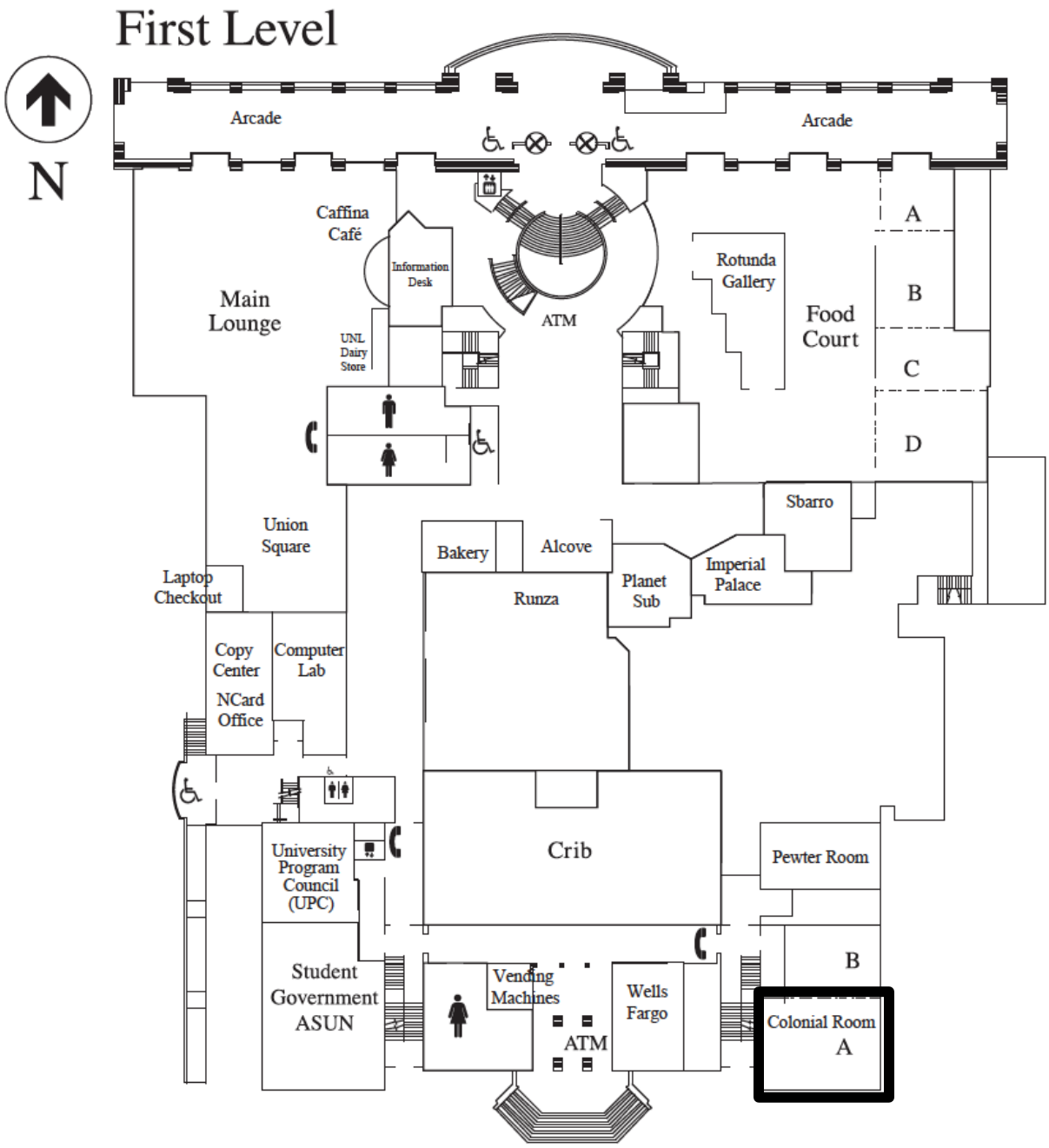
University of Nebraska-Lincoln Campus and Surrounding Area


First Level
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Arcade
Arcade
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UNL Dairy Store
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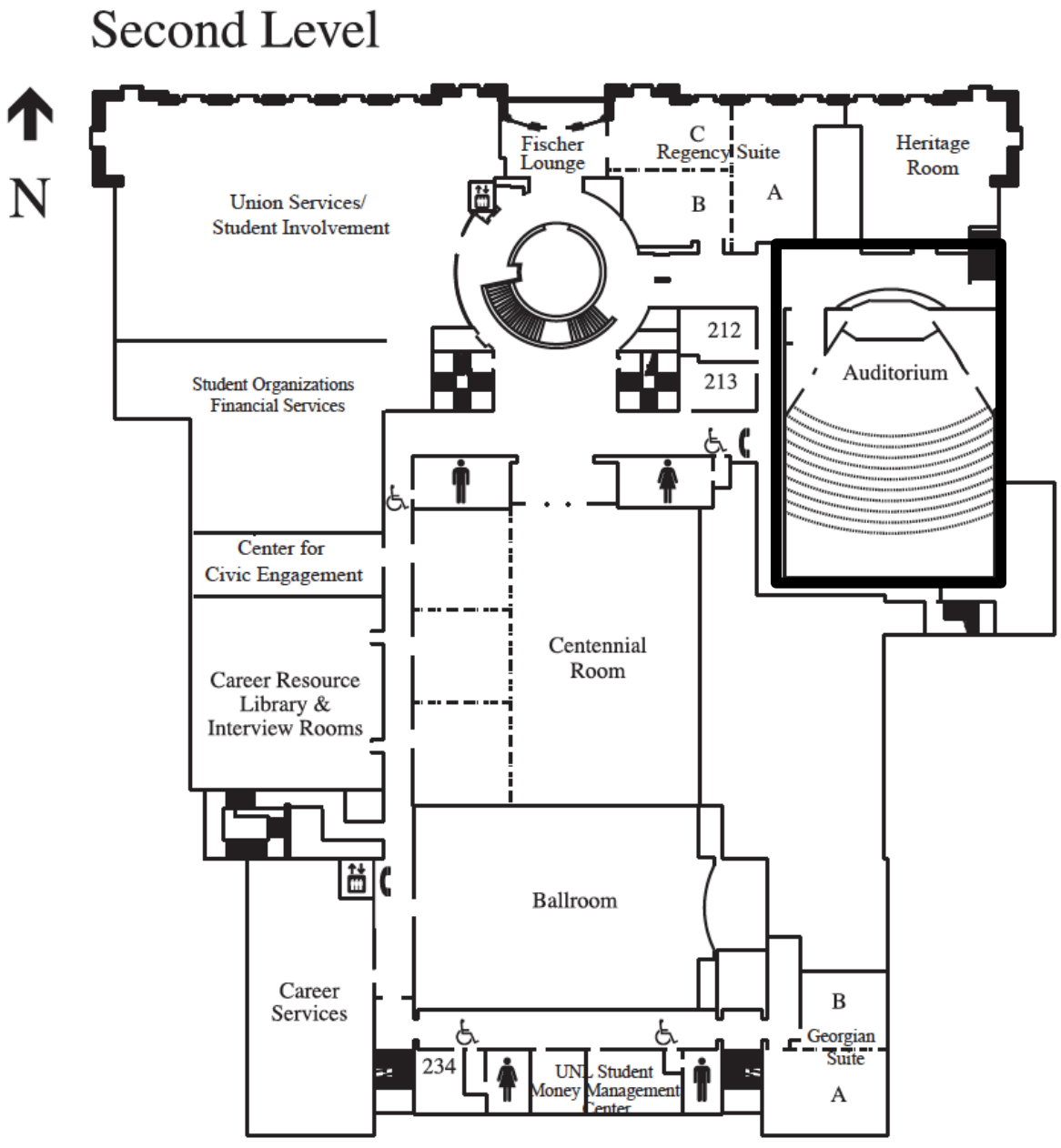
Second Level
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Skywalk
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Coat Rm
Bar & Grill
Atrium
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10th Street
Entrance
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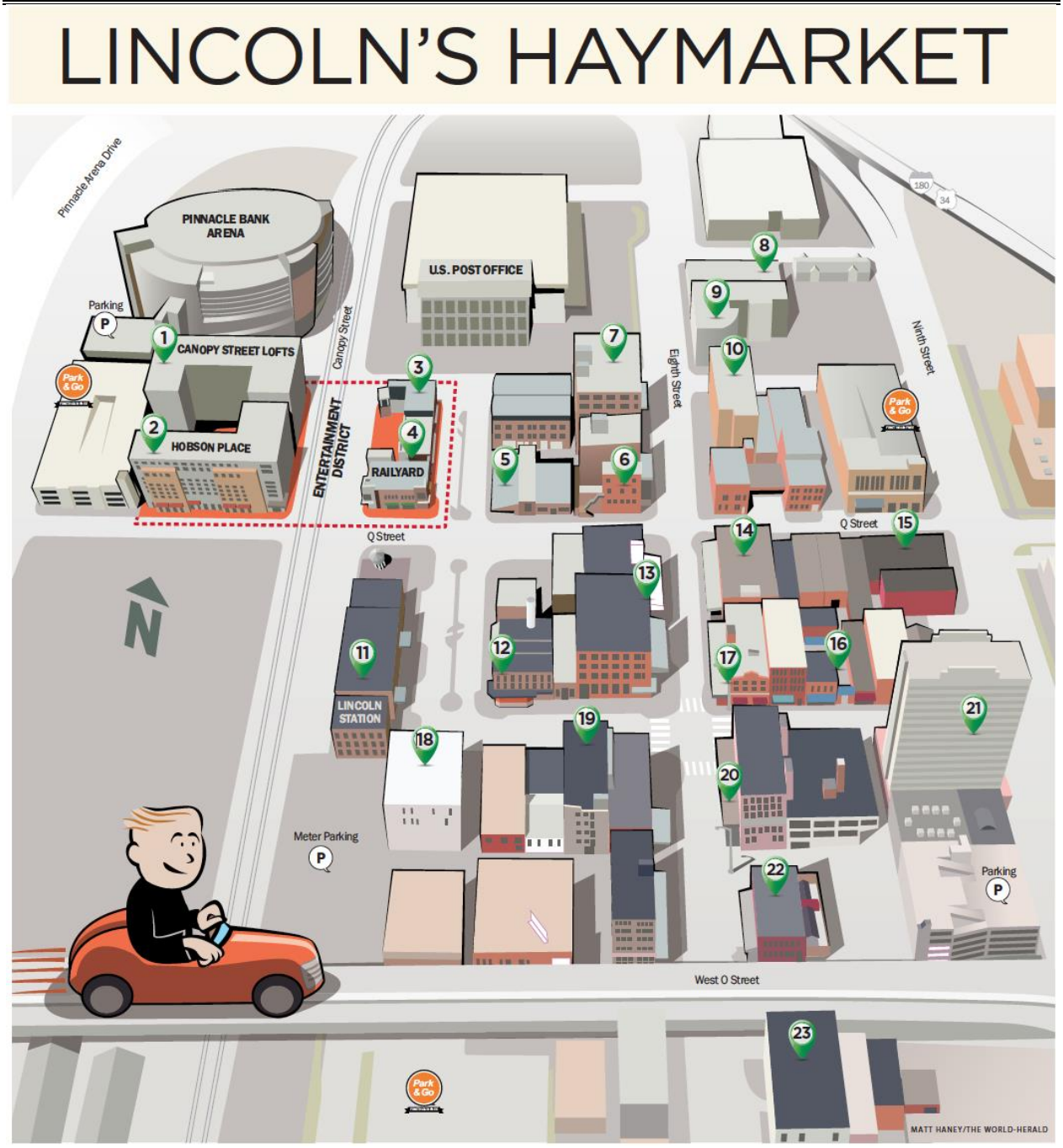


Located 2 blocks west of the Hotel, the Haymarket is the rejuvenated "old town" area of Lincoln and the new entertainment hub of the city. If you can't find a cuisine or micro-brew there to call your favorite, you just aren't trying! Entertainment opportunities abound, and art galleries and specialty shops round out the fare. For detailed lists of restaurants, clubs, galleries, shopping and current events, scan the QR code on the left!

1 **CANOPY STREET LOFTS (601 R Street)**
Hiro 88 (Sushi)*
Mellow Mushroom Pizza (Stone Baked Pizza)*
Jimmy John's (Sandwiches)*
El Mariachi Taco Cantina (Mexican)*
Rocket Fizz (Candy & Specialty Soda)*

2 **HOBSON PLACE (600 Q Street)**
Hyatt Place*

3 **RAILYARD PUBLIC MARKET (Open Market/food court)**
Maize Popcorn (Gourmet Popcorn)*
KD Designs (Retail)*
Sanders Specialty Meats (Meat Products)*
The Doughnut Hole (Baked Goods)*
Breezy Island Ice (Shaved Ice)*

4 **RAILYARD (350 Canopy Street)**
Longwell's (Bar/BBQ)*
Rule G (Bar/Night Club)*
Buffalo Wings & Rings (Wings & Burgers)*
Gate 25 (Bar/Restaurant)*
Jack & June (American Cuisine)*
Vega (Bar/Restaurant/Live Music Venue)*

5 **HIDE & FUR BUILDING (728 Q Street)**
The Cask (Craft Cocktail & Beer Bar)
The N Zone (Bar & Grill)

6 **IRONWORK BUILDING (301 N 8th Street)**
Leadbelly (American Cuisine)

7 **SULLIVAN BUILDING (311 N 8th Street)**
Maggie's (Vegetarian Café)
Pies and Pints (Bar/Pizza)

8 **BREAD AND CUP (440 N 8th Street)**
(Farm-to-Table Fare)

9 **COURTYARD BY MARRIOTT (808 R Street)**
(Bistro-Breakfast & Dinner)*

10 **HILTON GARDEN INN (801 R Street)**
Flatwater Grill (American Cuisine)*

11 **LINCOLN STATION BUILDING (201 N 7th Street)**
Lincoln Visitors Center (Lincoln Information)
JTK (French Bistro)

12 **BENNETT HOTEL & CAFÉ AND SHOP BUILDINGS**
Lazlos (Brewery & Grill)

13 **CANDY FACTORY AND LAU BUILDINGS**
The Oven (Indian Cuisine)
Brewsky's (Sports Bar/Restaurant)
El Potrero (Mexican)
Buzzard Billy's (New Orleans Cuisine)
Starlite Lounge (Bar)

14 **HUBER BUILDING**
Brix & Stone (Gastro Pub)
Licorice International (Retail)
From Nebraska Gift Shop (Retail)

15 **BARRY'S (Bar & Grill)**
10 Below (Nightclub)

16 **LINCOLN FIXTURE, VIETH AND HARPHAM BROTHER BUILDINGS**
Old Chicago (Bar & Grill)
Tavern on the Square (Bar)
Vincenzos (Italian)

17 **STACY BROTHERS BUILDING (800 P Street)**
The Mill (Coffee House)

18 **CREAMERY BUILDING**
Ivanna Cone (Premium Ice Cream)

19 **SALVATION ARMY & GRAINGER BROTHERS WAREHOUSE BUILDINGS (151 N 8th Street)**
Rodizio Grill (Brazillian Steakhouse)*
McKinney's Irish Pub (Bar)*
Scooters (Coffee House)
Dozo (Sushi)

20 **LINCOLN DRUG CO. BUILDING (801 P Street)**
Doc's Place (Bar)

21 **HOLIDAY INN DOWNTOWN (141 N 9th Street)**
Red Onion (Bistro & Bar)

22 **ARMOUR & CO. BUILDING (800 O Street)**
Jack's Bar & Grill (Bar)

23 **CIGAR FACTORY (815 O Street)**
Sweep Left (Husker Themed Bar)

*(*indicates new)*

Haymarket District and Pinnacle Bank Arena

Haymarket Park

SCHEDULE OF EVENTS

Monday – April 23		
Registration/Silent Auction Drop-off	Embassy Suites – Hotel Lobby	6:00 PM – 8:00 PM
Tuesday – April 24		
Registration/Silent Auction Drop-off	Embassy Suites – Hotel Lobby	7:30 AM – 8:30 PM
Jacketing and Cradles Workshop	UNL – Nebraska Hall West – W436	8:30 AM – 5:00 PM
Teaching Observational and Tactile Skills Required for Fossil Preparation	UNL – Nebraska Hall East – E422.1	8:30 AM – 12:00 PM
		1:30 PM – 5:00 PM
Specify Collections Database Workshops	UNL – Nebraska Hall East – E327	8:30 AM – 12:00 PM
		1:30 PM – 5:00 PM
Omaha's Henry Doorly Zoo & Aquarium	Meet in hotel lobby at 7:30am	8:00 AM – 5:00 PM
Ford Conservation Center/Steamboat	Meet in hotel lobby at 7:30am	8:00 AM – 5:00 PM
Registration/Silent Auction Drop-off	Embassy Suites – Hotel Lobby	6:00 PM – 9:00 PM
Wednesday – April 25		
Registration/Silent Auction Drop-off	UNL – Student Union – Auditorium	7:30 AM – 8:25 AM
Welcome/Announcements	UNL – Student Union – Auditorium	8:25 AM – 8:30 AM
Health and Safety Symposium	UNL – Student Union – Auditorium	8:30 AM – 10:30 PM
Break/Poster Session		10:30 AM – 11:00 AM
Health and Safety Symposium	UNL – Student Union – Auditorium	11:00 AM – 12:00 PM
Lunch	**On your own**	**12:00 PM – 1:30 PM**
Conservation of *In Situ* Sites Symposium	UNL – Student Union – Auditorium	1:30 PM – 3:00 PM
Break/Poster Session		3:00 AM – 3:30 PM
Conservation of *In Situ* Sites Symposium	UNL – Student Union – Auditorium	3:30 PM – 5:00 PM
Opening Reception	UNL – Morrill Hall	6:30 PM – 9:00 PM
Thursday – April 26		
Registration/Silent Auction Drop-off	Embassy Suites – Hotel Lobby	7:30 AM – 8:30 AM
Workshops – Session 1	UNL – Various (See pg. 19)	8:30 AM – 10:00 AM
Break	UNL – Nebraska Hall East – E421	10:00 AM – 10:30 AM
Workshops – Session 2	UNL – Various (See pg. 19)	10:30 AM – 12:00 PM
Lunch	**On your own**	**12:00 PM – 1:30 PM**
Workshops – Session 3	UNL – Various (See pg. 20)	1:30 PM – 3:00 PM
Break	UNL – Nebraska Hall East – E421	3:00 PM – 3:30 PM
Workshops – Session 4	UNL – Various (See pg. 20)	3:30 PM – 5:00 PM
Trivia/Game Night	Embassy Suites – Bar and Grille	8:00 PM – 10:00 PM
Friday – April 27		
Announcements	Embassy Suites – Regents Ballroom C	8:20 AM – 8:30 AM
Oral Presentations	Embassy Suites – Regents Ballroom C	8:30 AM – 10:00 AM
Break		10:00 AM – 10:30 AM
Oral Presentations	Embassy Suites – Regents Ballroom C	10:30 AM – 12:00 PM
Lunch	**On your own**	**12:00 PM – 1:30 PM**
Oral Presentations	Embassy Suites – Regents Ballroom C	1:30 PM – 3:00 PM
Break		3:00 PM – 3:30 PM
Oral Presentations	Embassy Suites – Regents Ballroom C	3:30 PM – 4:30 PM
Annual Business Meeting	Embassy Suites – Regents Ballroom C	4:30 PM – 5:00 PM
Closing Banquet/Silent Auction	Embassy Suites – Regents Ballroom B	6:00 PM – 10:00 PM
Saturday – April 28		
Ashfall Field Trip – Lunch Provided	Meet in hotel lobby at 7:30 AM	8:00 AM -- 7:00 PM

Jacketing and Cradles

Storage jackets are a great way to preserve specimens too large to fit in drawer-scale housings. The solution for fossils bound for cabinets, open shelves or even floors, these jackets are designed so that fragile specimens need never be without support during storage, study or even CT scanning. Made from archival grade materials they ensure maximum support over the long haul.
In this workshop we'll focus on Smithsonian style "clamshell" jackets made of plaster, fiberglass and polyethylene foam. Participants will learn:

- how to set-up the specimen and workspace for jacketing
- how to analyze the specimen to optimize jacket design
- adding temporary fills to create voids and avoid undercuts
- tailoring the liner
- proper mixing and handling of FGR 95 plaster
- buildup of plaster and fiberglass layers
- creating support structures in the jacket using polyethylene foam
- trimming, finishing, sealing and labeling the jacket

We'll also touch on alternative techniques and materials, such as liners made from polyester felt. Participants will get hands-on experience helping to make a jacket. This will involve long periods standing, potentially getting plaster on clothing, handling (with gloves!) coarse fiberglass mat. You are welcome to bring your own particulate filter respirators and aprons, but appropriate PPE will be provided.

Organizer:

Alan Zdinak
Natural History Museum of Los Angeles County

Teaching the Observational and Tactile Skills Required for Fossil Preparation

One of the biggest challenges all fossil preparation labs face is finding a repeatable formula for introducing and then developing the mental and tactile skills needed for proper modern fossil preparation techniques. Modern paleontology requires fossil preparation to first recognize, and then with appropriate tactile approach, expose and preserve as much associated information as possible in specimens being prepared, stabilized or repaired. All these skills need to be taught on a recurring basis as new students, volunteers or seasoned academics with little hands-on experience pass through the laboratory.
The single easiest way to teach the observational and tactile skills required for appropriate fossil preparation is, when possible, through the use of a teaching or discussion microscope. With this tool, the experienced preparator can perform tasks while describing the reasoning and thought process as the 'rookie' is observing with full three-dimensional vision. Then, places can be reversed and the rookie can work with direct feedback from the experienced 'teacher'. Appropriate tool choice, evaluation of specimen matrix properties, angle of attack, amount of pressure applied, size of matrix nibble to be removed are a few of the challenging ideas needing teaching to new people in the lab. Delivery of appropriate quantity and type of adhesives or consolidants is another critical concept required for students to get off on the right foot. This workshop is also designed to help reinforce a teaching method for introducing microscopy skills required in modern fossil preparation.

This workshop is meant as a starting point for people in a position of training or oversight in a preparation setting and is not intended as a how-to-prepare-fossils experience. All skills discussed in the workshop, observational or mechanical, apply universally to fossil preparation whether working on gigantic sauropods or micro specimens. Every participant will have their own specimen to keep as record of concepts taught. Participants will be led through a series of skills, observational as well as tactile, that can be easily reapplied at their home institutions in a teaching context. Mechanical matrix removal via airscribe and pin vice/needle as well as introductory adhesive delivery techniques with tools like micro-oilers and tweezers will be the focus of the tactile skills examples. The importance, relevance and ease of documentation during the preparation process will also be addressed.

Organizers:

Mike Eklund
Research Associate University of Texas and ThinkLabZ

Gregory Brown
Retired, University of Nebraska State Museum

Specify Collections Database Training

The Specify biological collections management system supports all of the core data entry, edit, and report functions expected of a modern, research database platform. In addition, it tracks museum curatorial transactions, links images and documents to specimen records, has a public web portal, and publishes data to internet aggregators in the Darwin Core standard. The development of Specify began 30 years ago as an NSF-funded program with the goal of creating an accessible standard system of database management for biological (and by extension, paleontological) collections.
This workshop will cover four general topics, two in the morning session and two in the afternoon.
Morning:

1. Specify Capabilities Overview
2. Specify Workflows for Paleontology Collections

Afternoon:

1. Customizing Specify Preparation and Conservation Modules
2. Applications for Specify data

With input from the paleontological collections-care community, we hope to help create a module that fulfills our need to fully document preparation and conservation treatments specific to the field of paleontology.

Organizers:
Norine Spears and Rod Spears
Specify Collections Consortium

Angella Thompson
Master Specify User

Gerald R. Ford Conservation Center and The Steamboat Bertrand Museum

The Ford Conservation Center is a regional conservation facility, part of the Nebraska State Historical Society. We offer services to private individuals, museums and libraries, corporations, and state and federal agencies.

Services include the conservation examination and treatment of three-dimensional objects, paintings, and works on paper, as well as consultations on many collection-related topics such as institutional assessments and condition surveys on collections.

The staff of the Ford Center represents years of varied professional training, specialized study, and intensive experience in the art and science of conservation. Ford Center conservators have trained and worked at major cultural institutions in the United States and abroad and keep abreast of the latest research and innovations in conservation practice.

DeSoto National Wildlife Refuge, located near Missouri Valley, Iowa, is home to a premier archeological collection of over 250,000 artifacts excavated from the buried wreck of the Steamboat Bertrand. On April 1, 1865, the sternwheeler hit a submerged log, thirty miles north of Omaha, Nebraska. Bound for the newly discovered goldfields of Montana from St. Louis, Missouri, the Bertrand sank into the depths of the Missouri River; and after initial salvage efforts, her cargo was written off as complete loss.

Using historical documents and a flux gate magnetometer, modern treasurer hunters, Sam Corbino and Jesse Pursell located the wreck on DeSoto National Wildlife Refuge in 1968. As the boat was on federal property, the salvors agreed under the requirements of the American Antiquities Preservation Act of 1906, to turn over all recovered artifacts to the U.S. Fish and Wildlife Service for permanent exhibition and preservation in a public museum.

By 1969, the vessel's cargo was completely excavated from its thirty feet deep, mud tomb. Unfortunately for the salvors, the treasure they sought had eluded them. Insurance company divers had apparently removed most of the mercury and other valuables soon after the ship sank. However, what had been left was a diversity of tools, clothing, and food items. The Bertrand's cargo was remarkably well preserved, and the refuge's collection is a unique time capsule for researchers and visitors interested in America's 19th century material culture.

Omaha's Henry Doorly Zoo and Aquarium

Unleash your sense of wonder among 160 acres of plants, animals and unique habitats from around the world, right here in Omaha, Nebraska.

Immerse yourself in a desert environment at the Desert Dome, the world's largest indoor desert located under the world's largest glazed geodesic dome. See plant and animal life from three of the world's deserts: the Namib Desert of southern Africa, the Red Center of Australia and the Sonoran Desert of the southwest United States.

Navigate the ocean floor as sharks and other marine life circle overhead in the Suzanne and Walter Scott Aquarium, the largest aquarium within a Zoo. Discover polar regions, temperate oceans, coral reefs and the Amazon, as well the wildlife that inhabit these areas, from Antarctic penguins, puffins, sea turtles, jellyfish, stingrays, Giant Pacific octopus, moray eels and colorful fish.

Explore the natural rainforest environment as you walk through the Lied Jungle, North America's largest indoor rainforest. Cross a unique swing bridge, through wet caves and beyond swooping tree limbs to the sounds of crashing waterfalls, see gibbons and other primates swinging in the canopy and experience exotic plant life.

Travel through the 28-acre African Grasslands exhibit with the likes of elephant, white rhino, cheetah, sable antelope, bongo, ostrich and impala rising into view upon your every move. See eye-to-eye with reticulated giraffe from the all-new Giraffe Encounter. Feed and brush the African pygmy goats at the kraal. View the African lions from the peak of the exhibit, while they gaze into the distance over the entire exhibit.

Health and Safety Symposium

7:30-8:25	Registration open
8:25	**Gregory Brown – Host Committee Co-Chair** OPENING REMARKS
8:30	**Anthony Maltese, Rocky Mountain Dinosaur Resource Center** PIKES PEAK REGIONAL CREW LEADER TRAINING PROGRAM
9:00	**Mike Eklund, Research Associate, University of Texas; ThinklabZ** EYE SAFETY
9:30	**Kait Matthes, MPAS, PA-C, Sutton Dermatology and Aesthetics** SUN HAZARDS AND SAFETY
10:00 – 10:30	**BREAK/POSTER SESSION (Hallway near Auditorium)**
10:30	**Lisa Mensah, Safety Specialist, UNL Environmental Health & Safety** AIR QUALITY AND VENTILATION
11:00	**Dan Olsen, Senior Environmental Specialist, UNL Environmental Health & Safety** CHEMICAL SAFETY
11:30	**Q&A, PANEL DISCUSSION**
12:00 -- 1:30	**LUNCH (on your own)**

Conservation of In-Situ Sites Symposium

1:30	**Gregory Brown, Retired UNSM** ASHFALL FOSSIL BEDS
2:00	**Nicole Ridgwell, PhD Student at South Dakota School of Mines and Technology** DINOSAUR NATIONAL MONUMENT
2:30	**Nicole Ridgwell, PhD Student at South Dakota School of Mines and Technology** CLEVELAND-LLOYD DINOSAUR QUARRY
3:00 – 3:30	**BREAK/POSTER SESSION (Hallway near Auditorium)**
3:30	**Shawn Haugrud, Lab and Field Manager at Gray Fossil Site** THE GRAY FOSSIL SITE AND MUSEUM
4:00	**Justin Wilkins (Presenter Willow Nguy)** THE MAMMOTH SITE OF HOT SPRINGS, SD
4:30 – 5:00	**Q&A, PANEL DISCUSSION**

6:30 – 9:00 **OPENING RECEPTION, UNL CAMPUS – MORRILL HALL**

Schedule of Events ~ Wednesday, April 25
Student Union Auditorium Hallway, UNL Campus
Poster Session

10:00 – 10:30 and **3:00 – 3:30 Poster Reception during Symposia Breaks**

David Alderks
"POST MODERN" RELIEF MOUNT TECHNIQUES UPDATING THE HERMANN 1909 RELIEF MOUNT METHOD

Kathleen A. Brill and Emmett Evanoff
USING HISTORICAL PHOTOGRAPHS TO LOCATE FOSSIL LOCALITIES OF EARLY PALEONTOLOGISTS: EXAMPLES FROM THE BRIDGER BASIN, SOUTHWEST WYOMING, AND THE WHITE RIVER BADLANDS OF SOUTH DAKOTA

Linsly J. Church, Norman Wuerthele, Amy C. Henrici, Gretchen Anderson, and James Leacock
LIGHTWEIGHT, RIGID SUPPORT CRADLES FOR FRAGILE BUT HEAVY SPECIMENS, MADE FROM AN EPOXY CLAY COMPOUND

Shawn Haugrud
RECONSTRUCTION OF A MASTODON JAW USING B-76 IN A NEW 'SPIDER-WEBBING' TECHNIQUE

Carrie Howard
3-D SCANNING FOSSILS AT THE LA BREA TAR PITS, LOS ANGELES, CA WITH THE ARTEC SPACE SPIDER

Ian Macdonald
PREPARATION OF A LARGE, WELL-PRESERVED CHASMOSAURINE (DINOSAURIA: ORNITHISCHIA) SKULL FROM THE LATE CRETACEOUS OF ALBERTA, CANADA

Hillary McLean
BUILDING HISTORY: MAKING A FOSSIL PREP LAB AND COLLECTIONS SPACE IN RURAL MONTANA

Andrew Rossi and Levi Shinkle
IT'S NOT CHILD'S PLAY – UTILIZING CHILDREN AS FOSSIL PREPARATORS

Rhiann Russell, Tom Courtenay, and Brandon Strilisky
RETHINKING CONSERVATION BEST PRACTICES AT THE RTMP

Stephany Potze, Jessie George, Beau T. Campbell, Karin A. Rice, and Glen M. MacDonald
TREES FROM TAR: FINDING THE BEST CLEANING TECHNIQUE FOR FOSSIL WOOD IDENTIFICATION AT RANCHO LA BREA

Deborah E. Wagner
DEVELOPMENT OF AN INFOGRAPHIC FOR SAFE AND ERGONOMIC MICROSCOPE SETUP

8:30 – 10:00 Session 1 – Session assignment is indicated on the reverse of the name badge.

Basic Molding and Casting
Organizers: Carrie Herbel, Jeremy McMullin
Location: Nebraska Hall West – W410 (Lab)

Collections Tours
Organizers: George Corner, Shane Tucker, Thomas Labedz
Location: Nebraska Hall West – Meet at W436

Extension Science: Virtual Field Trips
Organizer: Kathy French, Annie Mumgaard, Cindy Loope
Location: Morrill Hall – Meet at east door by 8:20

Historic Adhesives and Consolidants, and Agents of Deterioration
Organizer: Gregory Brown
Location: Nebraska Hall West – Collections, meet at W436

Imaging Techniques for Specimen Documentation and Investigation
Organizers: Mike Eklund and Conni O'Connor
Location: Nebraska Hall East – E422.1 VP Library (Meet at W436)

10:00 – 10:30 BREAK (Nebraska Hall – E421)

10:30 – 12:00 Session 2 – Session assignment is indicated on the reverse of the name badge.

Basic Molding and Casting (cont'd)
Organizers: Carrie Herbel and Gregory Brown
Location: Nebraska Hall West – W410 (Lab)

Collections Tours
Organizers: George Corner, Shane Tucker, Thomas Labedz
Location: Nebraska Hall West – Meet at W436

Organizing a Volunteer Program
Organizer: Vanessa Rhue
Location: Student Union – Colonial A

Records Conservation
Organizer: Peterson Brink, Traci Robison, Blake Graham
Location: Love Library South – 221 (Peterson Room)

12:00 – 1:30 LUNCH (on your own)

12:00 – 1:30 Volunteer/Student Roundtable
Organizer: Vanessa R. Rhue, Matthew Miller
Location: Student Union – Colonial A
(Bring your lunch back to Colonial A and join us for a meet and greet)

Workshops, Tours, and Round Table Discussions

1:30 – 3:00 **Session 3 – Session assignment is indicated on the reverse of the name badge.**

Advanced Topics in Molding and Casting
Organizers: Carrie Herbel and Gregory Brown
Location: Nebraska Hall West – W410 (Lab)

Automontage Microphotography Demo
Organizer: Matt Paulsen, Gabor Racz, Jim Schulte
Location: Nebraska Hall West – Meet at W436

Collections Tours
Organizers: George Corner, Shane Tucker, Thomas Labedz
Location: Nebraska Hall West – Meet at W436

3:00 – 3:30 **BREAK (Nebraska Hall – E421)**

3:30 – 5:00 **Session 4 – Session assignment is indicated on the reverse of the name badge.**

Advanced Topics in Molding and Casting (cont'd)
Organizers: Carrie Herbel, Gregory Brown
Location: Nebraska Hall West – W410 (Lab)

Collections Tours
Organizers: George Corner, Shane Tucker, Thomas Labedz
Location: Nebraska Hall West – Meet at W436

Lindoe Technique
Organizer: Conni O'Connor
Location: Nebraska Hall West – W512 Anthropology (Meet at W436)

Pyrite Deterioration
Organizer: Lisa Herzog
Location: Nebraska Hall East – E422.1 VP Library (Meet at W436)

8:20 **Welcome/Announcements**

8:30 **R. George Corner**
THE CARE AND FEEDING OF A LARGE PALEONTOLOGICAL RESEARCH COLLECTION: A SHORT STORY OF A LONG NARRATIVE

8:45 **Amanda Millhouse**
DEVELOPING AND IMPLEMENTING WORKFLOWS FOR CATALOGING AND REORGANIZATION PROJECTS IN THE SMITHSONIAN NATIONAL MUSEUM OF NATURAL HISTORY DEPARTMENT OF PALEOBIOLOGY

9:00 **Alan Zdinak and Steve Jabo**
ROCK 'N' ROLL STORAGE JACKETS

9:15 **Scott Johnston, Anna Minnebo, Adam Rountrey, and William Sanders**
TRADING PLACES: SOLUTIONS TO CHALLENGES IN MOVING A LARGE VERTEBRATE PALEONTOLOGY COLLECTION

9:30 **Vanessa R. Rhue**
THE GOOD, THE BAD, AND THE UGLY: WHY SELECTING INERT, LONG-LASTING MATERIALS MATTERS

9:45 **Keely Rennie-Tucker**
TRANSPORTING A TITANOTHERE: A CASE STUDY FROM SCOTTS BLUFF NATIONAL MONUMENT

10:00 - 10:30 **BREAK**

10:30 **Shane T. Tucker, Jesse Korus, and R.M. Joeckel**
3-D SITE CHARACTERIZATION USING UNMANNED-AIRCRAFT PHOTOGRAMMETRY AND GROUND PENETRATING RADAR (GPR): EXAMPLES FROM THE ARIKAREE GROUP IN WESTERN NEBRASKA

10:45 **Steven R. Clawson, Joseph Peterson, and Jonathan P. Warnock**
THE LIVING MAP: APPLICATIONS OF CLOSE-RANGE PHOTOGRAMMETRY TO VERTEBRATE PALEONTOLOGICAL RESEARCH AND OUTREACH

11:00 **Patrick Wilson**
A CASE STUDY FOR THE USE OF POLYETHYLENE GLYCOL AS A FIELD SURFACE CONSOLIDANT

11:15 **DARREN H. TANKE**
DATA CONSERVATION OF IN SITU DINOSAUR QUARRIES IN ALBERTA, CANADA: RESOLUTION AND SITE PRESERVATION OF A PREVIOUSLY LOST 1964 HADROSAUR QUARRY THROUGH SLEUTHING, TRASH ANALYSIS, AND PHOTOGRAMMETRY

11:30 **VICEN CARRIÓ AND SUZIE STEVENSON**
THE NEW GEOLOGICAL LABORATORY AT THE NATIONAL MUSEUMS SCOTLAND, EDINBURGH (UNITED KINGDOM)

11:45 **RENÉ HERNANDEZ-RIVERA, RICARDO SERVÍN-PICHARDO, AND ANGEL ALEJANDRO RAMÍREZ VELASCOS**
THE RESTORATION OF THE DIPLODOCUS CARNEGII DINOSAUR CAST OF MEXICO CITY

12:00 - 1:30 **LUNCH (on your own)**

Platform Presentations

1:30 **NICOLE RIDGWELL**
CREATING A PUTTY-LIKE GAP-FILLER USING PARALOID B-72, ETHANOL, AND MARBLE DUST

1:45 **LISA HERZOG**
PYRITE DECAY MITIGATION

2:00 **JEAN-PIERRE CAVIGELLI AND TOM KAYE**
REPORT ON THE EFFECTS OF AIR ABRASION ON FOSSIL MAMMALIAN ENAMEL VIEWED WITH A SCANNING ELECTRON MICROSCOPE

2:15 **CHRISTOPHER CAPOBIANCO**
INCORPORATING PHOTOGRAMMETRY INTO THE PREPARATOR'S WORKFLOW: TWO CASE STUDIES

2:30 **DALE ZELINSKI, LEE HALL, AMANDA MCGEE, AND MICHAEL RYAN**
A 30-YEAR CASE STUDY FOR PREPARATION METHODS IN BLACK SHALES: MARINE VERTEBRATES FROM THE LATE DEVONIAN (FAMENNIAN) CLEVELAND MEMBER OF THE OHIO SHALE FORMATION, OHIO, USA

2:45 **AMY KOWALCHUK AND LORNA J. O'BRIEN**
TECHNICAL CHALLENGES OF MOUNTING A TYRANNOSAUR SKULL IN EXPLODED VIEW

3:00 – 3:30 **BREAK**

3:30 **AARON GITERMAN**
SHARPENING, CARE, AND MODIFICATION OF METAL TOOLS FOR FOSSIL PREPARATION

3:45 **MATTHEW T. MILLER AND HOLLY LITTLE**
SUCCESSES, PITFALLS, AND ASPIRATIONS: A BRIEF HISTORY OF THE NATIONAL MUSEUM OF NATURAL HISTORY (SMITHSONIAN INSTITUTION) PALEOBIOLOGY COLLECTIONS VOLUNTEER PROGRAM

4:00 **CRISTINA M. ROBINS**
A BLUEPRINT FOR TRAINING STUDENTS IN FOSSIL PREPARATION TOOLS AND TECHNIQUES

4:15 **CORY REDMAN, KATHLEEN BITTERMAN, SUSUMU TOMIYA, AND JULIE MEACHEN**
TRAPPING STUDENTS WITH FOSSILS

4:30– 5:00 **ANNUAL BUSINESS MEETING**

A short business meeting will follow the general platform presentations.

Please join us to learn more about AMMP and how you can become involved in shaping the society. We exist because of you and we want your feedback! Feel free to raise any questions or suggestions during the open forum after the presentation. We exist because of you and we want your feedback! Feel free to raise any questions or suggestions during the open forum after the presentation.

6:00 **SILENT AUCTION VIEWING AND BIDDING OPEN**
HOSTED AND CASH BAR OPEN

7:00 **SILENT AUCTION OFFICIALLY ENDS**
PENS DOWN!
WINNING BIDS TO CASHIER FOR PAYMENT

7:05 **DINING BEGINS**

Banquet Menu

Salad

Strawberry Pecan Salad ~ *Mixed greens, sliced strawberries, candied pecans and gorgonzola cheese crumbles with raspberry vinaigrette or peppercorn*

Entrées

Prime Rib ~ *Traditional slow roasted prime rib with red wine au jus and horseradish cream*

or

Chicken Florentine ~ *Breast of chicken stuffed with spinach, mushrooms and cheeses wrapped in puff pastry with an underlay of herb beurre blanc sauce.*

with

Fresh seasonal vegetables
Chef's choice of starch course

Dessert

Chocolate Lovin Spoon Cake

8:00 **CLOSING REMARKS**

ELECTION RESULTS

AWARD PRESENTATIONS

The **William W. Amaral Legacy Award** is a lifetime achievement award in recognition of significant and lasting contribution to the field of paleontology through advancement of the objectives of AMMP.

Throughout his career, Bill demonstrated a commitment to the principles of our profession. Bill was a teacher, an advocate, an innovator, and a skilled practitioner. Working within the Society of Vertebrate Paleontology, he raised standards and expectations about what a fossil preparator is and does, helping to build a community by championing the very idea of profession. He participated in fieldwork for more than 40 years and worked to improve or develop techniques for collecting and preparing fossils even into retirement.

Named in honor of the late William W. Amaral, recipients of this award embody the traits that Bill personified, and that he spent his career working to instill in others – patience, vigilance, collegiality, and above all, a drive to advance techniques in paleontology.

The **Association for Materials and Methods in Paleontology Service Award** recognizes individuals who have made a substantial contribution to the association above and beyond the duties of typical members. Nomination is made by the Board of Directors.

Proceeds from the silent auction will assist in funding the **Russ McCarty Student Travel Award**. Named in honor of the late Russell McCarty of the Florida Museum of Natural History, this award will provide one year of membership, waived registration fees, and a stipend to help support travel to present at the annual meeting of the Association for Materials and Methods in Paleontology. To be eligible, nominees enrolled in a graduate or undergraduate program, and must have submitted an abstract for the meeting. Nominations can come from the general membership, and student nominees need not be current members of the association.

SILENT AUCTION TOTAL

FUTURE PLANS

ENTERTAINMENT

René Hernandez-Rivera, Harmonica

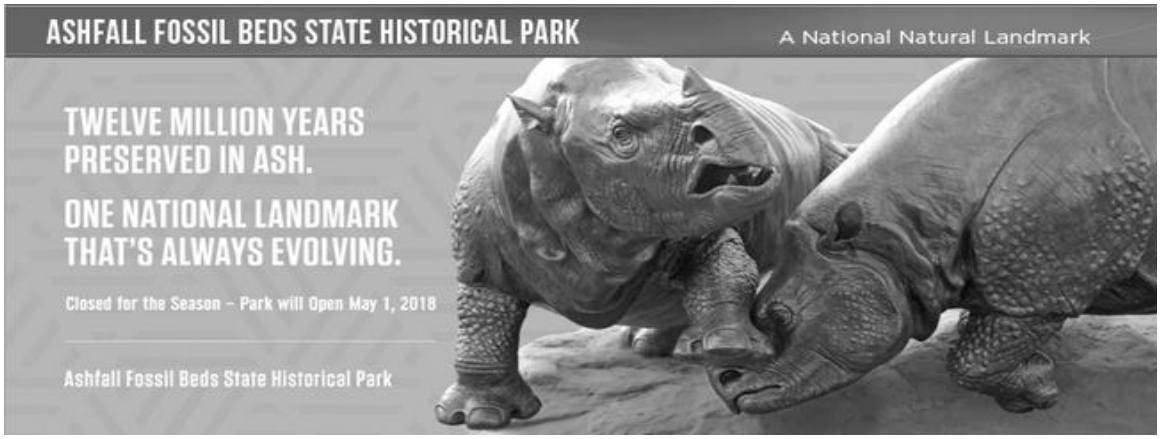
ASHFALL FOSSIL BEDS STATE HISTORICAL PARK

Field Trip Organizers: Gregory Brown, Rick Otto, Shane Tucker

Our premier field trip is planned for Saturday, April 28. Because the Ashfall Fossil Beds Historical Park is an adventure no one should miss, it is our only event planned for our final day. Transportation for up to 75 people will be provided. Because of the popularity of this trip, in addition to a modern 54-passenger motor coach we will add two 12 passenger vans. Passengers on the bus will be able to enjoy in-transit showings of the Nebraska ETV Emmy-winning documentary *Paleo Sleuths* to help pass the time. There may also be a showing of some "paleo-parody features" that will give you ample opportunity to make fun of one or two paleontologists you may know. Free on-board WiFi will also be available for those who just can't bear to be unconnected. Unfortunately, the vans are not equipped with AV capabilities. If you ride one of the vans up, feel free to guilt one of your friends on the bus to change places with you for the trip back to Lincoln if you'd like to see the video.

At Ashfall, we will see exquisitely detailed, articulated skeletons of Miocene wildlife: Rhinos, horses, camels and other mammals, preserved *in situ* in their death positions. Site taphonomy, conservation strategies and super volcanoes all will be up for discussion!

Snacks and beverages will be provided on the bus. The Friends of the Museum Ashfall Fossil Beds Chapter will be providing lunch for all participants.



7:30 AM **Transportation will arrive outside the hotel.**

8:00 AM **Depart from Host Hotel at 8:00AM SHARP!**

7:00 PM **Approximate scheduled return to hotel. Actual time may vary slightly.**

Workshop Descriptions

ADVANCED TOPICS IN MOLDING, CASTING, AND NATURE FAKING
Organizer: Carrie Herbel, Gregory Brown
Location: Nebraska Hall West – W410 (VP Lab)
Sessions: 3 – 4

Advanced Topics in Molding and Casting will focus on "tricks of the trade". While some projects will require nothing more than basic techniques, the vast majority will require far more. Specimen size, morphological complexity, fragility, chemical composition and other factors will combine to make each project an exercise in creative thinking based upon a thorough knowledge of an arsenal of materials and methods. These skills and knowledge can certainly not be taught in a half-day workshop, but we hope to introduce you to the process of designing a project that will minimize risk of damage to specimens while producing an accurate replica for research or display. You may sign up for both the morning session (Basic Molding and Casting) and the afternoon Advanced Topics session, or you may sign up for just one or the other alone, depending upon your personal needs.

"Nature-Faking" is the art of duplicating the complex multi-layered coloration of fossils. While research-quality casts are best produced in a neutral-color high-resolution medium such as epoxy (to enhance visibility of minute detail) and left unpainted, casts for display or donor appreciation are often painted to resemble the original specimen. Achieving an accurate representation of the original is often a challenging task and requires a battery of techniques (including washes, dry-brushing and highlighting) and a unique way of "seeing" a specimen. In addition to demonstrating our favorite techniques, we encourage attendees to share their own. Casts will be provided for practice during the workshop. Other methods such as in-mold painting and inclusion-casting will also be demonstrated.

AUTOMONTAGE MICROPHOTOGRAPHY DEMONSTRATION
Organizer: Matt Paulsen, Gabor Racz, Jim Schulte
Location: Nebraska Hall West – Meet at W436
Session: 3

Micro- and Macro-photography suffer from a single serious flaw: shallow depth of field. For small objects, the depth of usable focus may be less than one millimeter. If important morphological features are outside of this range, they will be blurry in the resulting image. However, if multiple images are taken, each from a different focus distance, and the resulting images combined using photo-stacking software, the resulting image will exhibit sharp focus throughout the desired range of depth. At the high end of available systems is Syncroscopy's Auto-Montage, but, thanks to modern software development, similar capabilities are now available at affordable prices (e.g. **Helicon Focus**) or free (e.g. CombineZP). A demonstration of UNSM's Auto-Montage system will be followed by an introduction to some affordable photo-stacking options.

BASIC MOLDING AND CASTING
Organizer: Carrie Herbel, Jeremy McMullin
Location: Nebraska Hall West – W410 (Lab)
Sessions: 1 – 2

This workshop will combine hands-on exercises and demonstrations to provide the attendees with a basic understanding of molding and casting techniques and materials. A sound understanding of the basics will allow you to skip many of the otherwise inevitable "teaching-moments" (mistakes) that many have made along the way. Design and construction of simple one- and two- piece silicone molds will be demonstrated as well as some of the secrets of making flawless resin casts.

COLLECTIONS TOUR
Organizers: Shane Tucker, George Corner, Thomas Labedz
Location: Nebraska Hall West – Meet at W436
Sessions: 1, 2, 3, 4

The University of Nebraska State Museum is the state's natural history repository. There are eight divisions (Anthropology, Botany, Entomology, Geology, Invertebrate Paleontology, Parasitology, Vertebrate Paleontology, and Zoology) which house more than

EXTENSION SCIENCE: VIRTUAL FIELD TRIPS
Organizer: Kathy French, Annie Mumgaard, Cindy Loope
Location: Morrill Hall – Meet at East door by 8:20
Session: 1

School groups from across the state have traditionally visited the University of Nebraska State Museum for field trips and programs from the Museum's Education department staff. Recently, the Museum has adopted state-of-the-art technology to extend the reach of its programs by bringing live interactive video and audio into classrooms far beyond the state's borders. This technology allows children and adults to enjoy experiences once unavailable to them: Sharing the thrill of discovery in a remote laboratory or field site and talking with scientists as they ply their trade. Learn how it is done, and what possibilities the technology may hold for your museum.

HISTORIC ADHESIVES AND CONSOLIDANTS AND THE AGENTS OF DETERIORATION
Organizer: Gregory Brown
Location: Nebraska Hall – Collections (Meet at W436)
Session: 1

Historic collections are not just a repository for specimens, but a library of past techniques and materials used in the preparation and conservation of fossils. This survey of the UNSM collections will focus on recognizing some of these materials and noting their long-term efficacy and archival qualities (or lack thereof!). In addition, we will discuss the Agents of Deterioration and how they are (or are not!) addressed in collection storage systems. This workshop is an exercise in seeing collections with a critical perspective to help you assess your own collections and recognize how specimens may still be at risk. Attendees are encouraged to discuss the application of remedial and preventive conservation principles and the best ways to avoid, block or minimize the Agents of Deterioration.

IMAGING TECHNIQUES FOR SPECIMEN DOCUMENTATION AND INVESTIGATION
Organizers: Mike Eklund and Conni O'Connor
Location: Nebraska Hall East – E422.1 VP Library (Meet at W436)
Session: 1

Innovative imaging and lighting allow us to see and capture specimen information not otherwise discernible. This presentation will introduce some simple documentation and investigation strategies and techniques that are useful before, during, and after the preparation or conservation of paleontological specimens. First, we will explore visible lighting techniques that will aid in providing a better representation of structures that are critical to recognize, preserve and document. Next, the usefulness of fluorescing techniques will be demonstrated as an investigation and documentation tool for all specimens, whether looking for evidence of prior specimen treatments or trying to identify the presence of new specimen data such as soft-tissue. These techniques are so simple they can be easily incorporated into any institution's laboratory. Finally, we will examine some working solutions incorporating newer imaging options which help provide continuity in specimen documentation during the preparation process, enabling more valuable records for future use.

THE LINDOE TECHNIQUE
Organizer: Conni O'Connor
Location: Nebraska Hall West – W512 (Anthropology)
Session: 4

First described by Clive Coy and Allan Lindoe, the "Lindoe Technique" is a method of creating hyper-realistic replicas of very low-relief or no-relief specimens. A slightly modified technique was used to create strikingly accurate replicas of plant and insect fossils from the Florissant Fossil Beds in Colorado and described in a poster by Conni O'Connor, Kelly Hattori and Mariah Slovacek. Don't just read the poster, come get your hands dirty and take home your own Florissant "fossil". Ideal for display, teaching, and hands-on activities without risking original, fragile, paper shale specimens.

ORGANIZING A VOLUNTEER PROGRAM
Organizer: Vanessa Rhue
Location: Student Union – Colonial A
Session: 2

Persons who freely offer their time, talent, and skills to prepare and/or conserve fossil specimens and their associated data make incredible contributions to the field of paleontology. While enlisting a volunteer task force is a familiar concept to many of us, organizing an effective volunteer program can be a daunting task. This workshop is aimed at equipping volunteer managers with best practices for creating, managing, and developing a refreshed volunteer program at their home institution. A case study from the Natural History Museum of Los Angeles County will be presented to open discussion about volunteer recruitment, selection, training, evaluation, appreciation, and feedback. Special attention will be given to identifying suitable volunteer projects and structuring team workflows. Participants will learn about best practices from other institutions, receive handouts, and create a personalized template for implementing a new or improved program at their home institution.

PYRITE DETERIORATION: MYTHS AND METHODS
Organizers: Lisa Herzog
Location: Nebraska Hall East – E422.1 VP Library (Meet at W436)
Session: 4

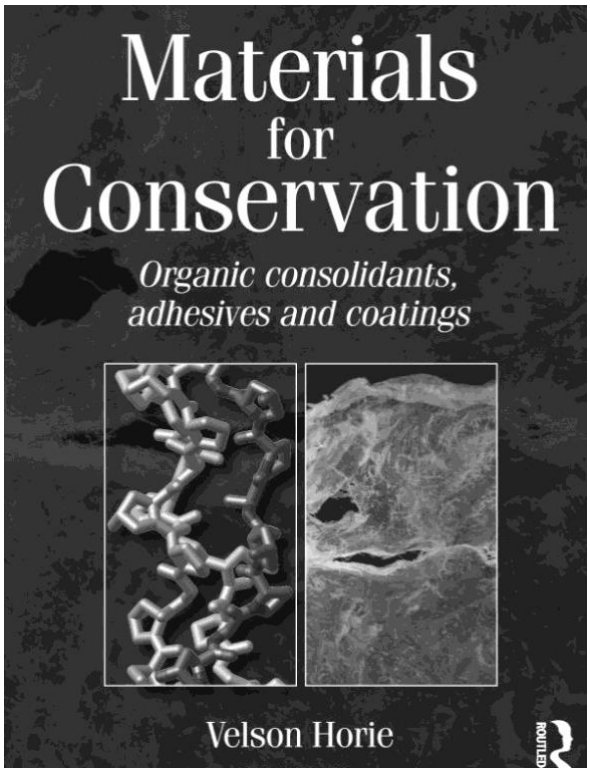
Pyrite decay, also known as pyrite disease, is a serious problem for fossil and mineral specimens that contain unstable forms of Pyrite and Marcasite. Historic literature on the causes and recommended treatments to arrest the chemical process is useful but can also be inaccurate. This workshop will provide an in-depth look at the properties of Pyrite, Marcasite, diagenesis, and treatment options for specimen conservation. Samples of decaying and stable specimens will be on hand, as well as recommended materials for conservation practices. Participants will go home with a guide to Pyrite decay mitigation practices.

RECORDS CONSERVATION
Organizer: Peterson Brink, Traci Robison, Blake Graham
Location: Love Library South – Meet at Rm 221 (Peterson Room)
Session: 2

To a paleontologist, fossils are the primary data upon which the science depends. It is our responsibility to reveal the data trapped in the matrix and to assure that the data (the fossil) survives preparation, study, handling, long-term storage and the ever-present agents of deterioration that are always trying to destroy the data. But our responsibility goes beyond the fossils themselves to include the preservation of all the field notes, specimen labels, curatorial notes, contextual information, photographs, conservation records and similar information associated with every specimen. These records may be paper, film, photographs, digital devices and other media far more ephemeral that the fossils themselves. University of Nebraska archivists and others will describe their strategies for these types of records.

VOLUNTEER/STUDENT ROUND TABLE DISCUSSION
Organizers: Vanessa Rhue
Location: Student Union – Colonial A
Session: Lunch

Are you new to AMMP? Would you like to meet other volunteers and students in the prep & collections care community? You're invited to join us for a meet and greet lunch at the Student Union Building. Grab a bite to eat (lunch is not provided but you are most welcome to bring your lunch) and join us in Colonial Room A. We'll be gathering to make new friends and talk about our current projects.



Did you know…

that this is one of the most important books to have in your library?

Abstracts, Alphabetical by Primary Author

“POST MODERN” RELIEF MOUNT TECHNIQUES UPDATING THE HERMANN 1909 RELIEF MOUNT METHOD

David Alderks
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In 2006 the Utah State University Eastern Prehistoric Museum excavated the "Gooseneck" *Allosaurus fragilis* from the San Rafael Swell in East Central Utah. In 2017 the museum wanted to place this specimen on exhibit and decided to use the wall mount method developed by A. Hermann at the American Museum of Natural History in 1907 and published in 1909. Hermann’s method involves building a wood and iron frame box, with a rebar mesh in the box. Fossil material is tied to the rebar and plaster is poured to secure the mount. After careful analysis of Hermann's method, it was determined that steps could be taken to significantly lighten the relief mount without detrimentally affecting the integrity of the exhibit. This method of mounting was chosen to show this specimen as it was *in situ* in the classic death pose. To do this, we used lighter modern materials, for example, replacing the Rebar with heavy duty .25 polyethylene mesh netting. The mount was further lightened by using less casting plaster and by replacing some of the plaster with polystyrene foam insulation board. When the Allosaurus fragilis relief mount was complete, no problems with strength or stability were encountered when erecting the exhibit. We estimate that the final project weight for the 8 ft. x 9 ft. the display was 750 kg lighter than by following 1909 method.

USING HISTORICAL PHOTOGRAPHS TO LOCATE FOSSIL LOCALITIES OF EARLY PALEONTOLOGISTS: EXAMPLES FROM THE BRIDGER BASIN, SOUTHWEST WYOMING, AND THE WHITE RIVER BADLANDS OF SOUTH DAKOTA

Kathleen A. Brill*, Emmett Evanoff[1], and Levi Moxness[2]
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[2]North Dakota Geological Survey, Bismarck, North Dakota, United States of America
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One of the inherent problems of a historic collection such as that at the American Museum of Natural History (AMNH) is that many of the early specimens have poor or incomplete locality data. Fortunately, the early geological and paleontological surveys after the Civil War and into the early Twentieth Century included photographers that recorded the landscape and places of geologic and paleontologic interest. The locality information that the early geologists and paleontologists recorded was very generalized considering that they had no detailed topographic maps, aerial photographs, or GPS units as we have today. The photographs that were taken are a valuable resource of specific areas they visited, where they made their geologic observations, and where they collected important fossils including type specimens. Many of the historic photographs from these expeditions are now available online through organizations such as the U.S. Geological Survey, the National Park Service, and the American Museum of Natural History. After gathering copies of the original photographs, we locate the photograph sites on the ground using knowledge of the overall field areas gained from past field experience. Once the general areas have been determined, we narrow the areas further with paper copies of the historical images looking for prominent features on the landscape that can be matched to the original photograph. When a photo site is found, duplicate views of the original photographic image are taken using modern digital cameras, typically using a wide-angle lens ranging from 18 mm to 25 mm covering an area slightly wider than the original photograph. We record the date and time of day of the new image along with GPS readings for the site (in latitude/longitude and UTM coordinates). The azimuths of prominent features on the landscape horizon or in the mid-ground from the photo sites are measured using a Brunton compass. The sites are plotted on topographic maps in the field and these locations are checked in the office using modern topographic map databases and the GPS data. We will present examples from three historical photographers, William H. Jackson and Albert Thompson who worked in the Bridger Basin of southwestern Wyoming in 1870 and 1903, respectively, and Harold R. Wanless who worked in the White River Badlands of South Dakota in 1920.

INCORPORATING PHOTOGRAMMETRY INTO THE PREPARATOR'S WORKFLOW: TWO CASE STUDIES

Christopher Capobianco
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Photogrammetry is a relatively fast, low cost method of digitization that has become increasingly popular in paleontology over the past decade. However, photogrammetry and its uses has been primarily focused on its applications to research and fieldwork, with little emphasis on its uses in preparation and curation. In certain situations, photogrammetry has become an essential part of the preparation process, and two case studies will be discussed as to its usefulness.

The first involved a request for destructive sampling of *Coelophysis* tibia and fibula from a partially articulated specimen. After discussion with the researcher, two samples were taken from two specimens to be thin sectioned. Prior to preparation, each specimen was photographed to create a photogrammetry model to document the bone placement in 3D space. The bone was sent off to the researcher to be molded, cast, and CT-scanned prior to beginning destructive sampling.

The second case was an articulated *Proterogyrinus* forelimb. The MCZ wanted to digitize the entire forelimb for research but had little success CT scanning the entire block. Since the block had already been over-prepared, it was decided the best course of action would be to prepare each bone to be individually scanned. To document this, 142 photos were taken of the specimen and stitched together in Agisoft Photoscan to create a complete photogrammetry model. Before preparation, a mold and cast were made for future comparison with a 3D printed version of the photogrammetry model.

With the increasing demands for destructive/consumptive sampling, curatorial staff have been tasked with the difficult decision of whether to allow specimens to be destroyed. When applicable, incorporating photogrammetry into your preparation workflow can provide additional information to be archived with destructive processing, and allows for more flexibility for future research projects. Additionally, the increase in resolution coupled with the decrease in price of 3D printing makes photogrammetry and other digitization methods of greater importance to the future of collection management.

THE NEW GEOLOGICAL LABORATORY AT THE NATIONAL MUSEUMS SCOTLAND, EDINBURGH (UNITED KINGDOM)

Vicen Carrió* and Suzie Stevenson
National Museums Collection Centre, Edinburgh, Scotland, United Kingdom
*v.carrio@nms.ac.uk

In 2013, the National Museums Scotland (NMS) received funding for the construction of a new building and the renovation of an existing building for all the NMS's conservation and analytical research. This presentation will focus on the geological laboratory. The areas had to accommodate the needs of the curators and accommodate different processes and techniques that may be used in the future. Thanks to visits and ideas from other laboratories, and a variety of sources gathered during conferences and discussions with other colleagues in the field, the lab was designed to be state-of-the-art in geology preparation. One priority was natural light (to be able to prepare specimens better) which resulted in changes to the architect's plans and in the shape of the areas. There are three defined areas: a clean lab for conservation, housing, etc., a mechanical lab where air abrasive and vibratools are the core techniques used and a dirty lab for cutting and polishing rocks- which includes an area for acid preparation. All benches are made of chemically-resistant resin of light cream colour, with conduit to protect electric cables and air lines. Although the labs have plenty of natural light, Scotland is quite dark in the winter and bright rooms were created by using low wattage LED light. Particulate air filtering is externally vented. The new acid area, for the use of hydrochloric and other acids, is comprised of a stainless-steel tank with a wall hood, spill pits, a shower and an eye wash station. One major challenge for the architects was vibration. The lab adjacent to the geology lab is the analytical and research lab with equipment which ranges from PDA-UPLC, XRF, SEM-EDX to XRD and FTIR. In order to isolate noise and vibration special walls were constructed. All benches were kept in sections to avoid transferring movement produced by users.

REPORT ON THE EFFECTS OF AIR ABRASION ON FOSSIL MAMMALIAN ENAMEL VIEWED WITH A SCANNING ELECTRON MICROSCOPE

Jean-Pierre Cavigelli*[1] and Tom Kaye[2]
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[2]Foundation for Scientific Advancement, Sierra Vista, Arizona, United States of America
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The use of air abrasion for fossil preparation has become quite popular in the past several decades. In general, minimal damage is done at a macro level to fossils by judicious use of air abrasive equipment. Studies in fossil dental microwear and enamel structure are found throughout the literature. The question arises, that since some of these teeth may be prepared using air abrasives, does matrix removal via air abrasion also remove or alter useful information from fossil enamel? Looking for answers to this question, samples of pristine enamel from White River mammals were prepared and imaged with a scanning electron microscope. These samples were then 'cleaned' with an air abrasion machine and reimaged. Samples were processed to look for the results of two different abrasive powders at 20, 40, 60 and 80 psi. A jig was constructed to hold the air abrasive nozzle at the same distance and angle for each sample. Two commonly used powders in paleontological air abrasion were used: fine sodium bicarbonate, and dolomite. The tests started with the smallest, softest powder (fine sodium bicarb) at 20 psi for five seconds. A simple blocker (a piece of sheet metal) was placed into the abrasive stream before turning the air abrasive on to block the initial blast which visibly delivers more powder than the later constant flow. The timing of the actual air abrasive action was started when this blocker was removed, so that the timed blasting was all from steady flow, and not affected by the initial excessive flow. Subsequent imaging at 1500x found that this was destructive to the enamel surface. The time was lowered to 2 seconds and this was also quite destructive to both enamel surface and enamel crystals at the broken edge of the tooth. It was found that dolomite at 20 psi is much less destructive, but dolomite at 40 psi erases all structure on the enamel surface. We suggest further experiments to see how lower psi (below 20 psi?) affects fossilized enamel and urge caution with current practices. Fossils cleaned with air abrasives should be labeled as such in case future researchers want to look at them under high magnification, and this should be noted in publications on these specimens.

LIGHTWEIGHT, RIGID SUPPORT CRADLES FOR FRAGILE BUT HEAVY SPECIMENS, MADE FROM AN EPOXY CLAY COMPOUND

Linsly J. Church*[1], Norman Wuerthele[1], Amy C. Henrici[1], Gretchen Anderson[1], and James Leacock[2]

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In 2014, the Section of Vertebrate Paleontology at Carnegie Museum of Natural History (CM) received a grant from the Institute of Museum and Library Services to upgrade storage of the 472 holotypic specimens in the collection. Initially, cradles of plaster reinforced with fiberglass and lined with felt were created. Although supportive, the plaster cradles were heavy, tended to break, and shed fiberglass splinters when handled. An alternative method was needed. To address this issue, we modified a technique used by Mr. James Leacock of Multiform Studios to create exhibit mounts for CM's Mesozoic gallery, Dinosaurs in Their Time. Unfortunately, the marine epoxy that he used, Pliacre, is no longer available. Therefore, we experimented with three Oddy tested products and found that Apoxie Sculpt–a self-hardening, two-part, permanent, waterproof epoxy clay compound–was the best substitute. The cradles consist of mixed epoxy clay rolled flat, lined with acrylic felt, and custom formed. The epoxy clay allowed for specialized, less messy cradle creation for medium to large-sized fossil mammal skulls, jaws, and postcranial bones with great success. Cradles made using the epoxy clay are durable, light weight, and add little to specimen height, which makes for efficient use of storage space. The only disadvantage of these cradles relative to their plaster counterparts is the greater cost of the epoxy clay; consequently, this method is not cost-effective for very large specimens such as sauropod dinosaur limb bones. Recently, we made an epoxy clay cradle for a fossil skeleton preserved in one plane of soft matrix in a block supported by a failing plaster field jacket. The block tended to bend and crack when lifted. We used the epoxy clay to reinforce the bottom surface of the plaster field jacket and added handles for easier manipulation. Because of the block's size, several batches of epoxy clay needed to be mixed and flattened, leading to the problem of the first batch mixed beginning to set while other batches were being prepared. We will need to address this problem when we create cradles for large specimens being loaned for a traveling exhibit.

THE LIVING MAP: APPLICATIONS OF CLOSE-RANGE PHOTOGRAMMETRY TO VERTEBRATE PALEONTOLOGICAL RESEARCH AND OUTREACH

Steven R. Clawson*[1], Joseph Peterson[1], and Jonathan P. Warnock[2]
[1]University of Wisconsin-Oshkosh, Oshkosh, Wisconsin, United States of America
[2]Indiana University of Pennsylvania, Indiana, Pennsylvania, United States of America
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Taphonomic, taxonomic, and paleoenvironmental analyses require knowledge of bone distribution, as orientation and accumulation rates of bone are constrained by a variety of depositional and biogenic facies. In some circumstances, grid maps of bones are quickly drafted and/or poorly resolved, offering little but general and often skewed two-dimensional estimations of bone orientation. Photogrammetry, which produces 3-dimensional textured models of objects using an assemblage of choreographed digital photographs, offers a more accurate means of resolving the positions of bone. One step further, 'living' photogrammetric maps allow researchers to view bones in three dimensions throughout the course of excavation. As a case study, the authors produced a living map representing the bones exposed and collected at the Cleveland-Lloyd Dinosaur Quarry (CLDQ) of Emery County, Utah, from the 2014-2017 field seasons. Photogrammetry in future seasons will continue to allow visualization of bones in three dimensions, even after the currently exposed elements have been removed.

THE CARE AND FEEDING OF A LARGE PALEONTOLOGICAL RESEARCH COLLECTION: A SHORT STORY OF A LONG NARRATIVE

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The University of Nebraska was established in 1869 at the organizational meeting of the Board of Regents. In their visionary budget, four percent ($1,000) of the total was set aside for the creation of a “cabinet” of natural history objects. In 1891 the University hired Erwin Hinckley Barbour, a protégé of O.C. Marsh at Yale, to teach the geological sciences and to direct its primitive museum. The next field season a relationship began between Barbour and Charles Henry Morrill, a member of the Board of Regents and a proud Nebraskan. Morrill was indignant that many of the state’s fossil resources were being shipped away to enhance the great exhibit halls of the eastern museums. For over thirty years the Museum’s annual Morrill Expeditions allowed Barbour to add thousands of specimens to the exhibit cases and research cabinets. After the initial season a major problem that plagued the Museum for over 100 years was first made apparent. The building was literally bursting at the seams as its floors were sagging in from the heavy field jackets. Collections not on display found their way to underground steam tunnels, empty downtown stores and even an abandoned indoor swimming pool at a Lincoln sanitorium. Later collecting by UNSM field parties and large WPA expeditions added greatly to the burgeoning vertebrate paleontology holdings Even though in the following decades two buildings (Old Museum Building, 1908 and later Morrill Hall, 1928) were erected to exhibit materials there were never enough funds to construct housing for non-exhibit items. Many of these languished in their former haunts for years, being moved often as areas became available in more favorable situations. In 2006 space became available (27,000 square feet) in the basement of Nebraska Hall and a century-old problem had become a thing of the past.

SHARPENING, CARE, AND MODIFICATION OF METAL TOOLS FOR FOSSIL PREPARATION

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Fossil preparation involves the use of a variety of mechanical tools including carbide needles, pneumatic air scribes, knives, picks, and many more. Understanding the basic properties of these materials is an important factor in tool maintenance. It enables faster and more accurate results when working on a specimen, saving working time, and reducing the risk of accidental damage. Properly caring for a tool will also extend its working lifespan thus avoiding the accumulation of non-functional equipment in the lab. Properly maintained tools are less likely to slip and injure a user, and should an accident nonetheless occur, a clean cut will heal faster than one made by a jagged and poorly maintained instrument.

A kit of materials used to care for metal tools has been assembled based on experience and includes: Powered rotary tools (e.g. Dremel or Foredom); diamond rotary discs, burrs, and files; green silicon carbide grinding stones and burrs; rubber and felt polishing/grinding burrs; manual knife sharpeners; whetstones of multiple grits ranging from 400 - 6000; rust erasers; wet/dry polishing paper; green chromium oxide abrasive polish.

Essential tools can encounter a high degree of wear such as needles used for pin vise work, as well as dental picks and ethafoam knives. A protocol detailing methods to repair, modify, sharpen, and hone includes the following: Sharpening using rotary grinding tools for tungsten carbide and stainless steel needles; honing an edge using a series of progressively finer grit whetstones for metal ethafoam (or other) knives of high carbon non-ceramic steel and finishing by stropping with a polishing paper or abrasive polish; grinding and honing using a variety of rotary burrs for dental picks or other unusually shaped small tools typically composed of stainless steel.

RECONSTRUCTION OF A MASTODON JAW USING B-76 IN A NEW 'SPIDER-WEBBING' TECHNIQUE

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Recent work at the Gray Fossil Site has yielded multiple individuals of an unidentified species of *Mammut*, including a nearly complete specimen. The specimen is quite large, with initial estimates putting it around 16 Tons. The specimens appear to have been buried in a rock slide. The nature of their deposition required extensive reconstruction of crushed areas. After preparation, we began reconstruction of crushed areas of the jaw. We used Butvar B-76 50/50 v/v with acetone as adhesive. Prior to assembly we checked all pieces for contact area with other fragments and then coated the interior cancellous surfaces with Butvar B-76, leaving a 1cm margin at the edge. After setting, pieces were bonded with Butvar B-76 at their contacts in a simple butt joint. Once pieces formed a complete cross section of bone, adjustments to the overall structure were made by temporarily softening the glue joints with acetone. We then applied a bead of glue along the exposed cancellous between the pre-glued patches. The fresh Butvar B-76 partially dissolved and bonded with the margin of the set glue. Considering stress load, coating the entire interior surface of the bone functions like a continuous strap joint. For stability the void left by missing bone was filled with Butvar B-76 using our spider-webbing technique. With the tip of the glue tube we attached beads of Butvar B-76 to the pre-glue, and pulled them into threads across the void to an opposing interior surface. Threads are up to 15cm in length. Threads were attached to each other to make a cancellous replacement that matched the contours of the missing bone, including leaving internal canals and fenestrae. To replace missing bone surface, we used aluminum mesh cut to shape. Butvar B-76 was applied in 4 layers with setting in between. First on the inner surface, then the outer surface of the aluminum patch. Layer 3 was applied to the web underlay and then the patch was bonded to it. Layer 4 was applied to the outer surface of the patch and allowed to set. We successfully reconstructed the jaw, measuring approx. 133cm in length, using these techniques. The reconstruction is reversible, light-weight, and strong.

THE RESTORATION OF THE *DIPLODOCUS CARNEGII* DINOSAUR CAST OF MEXICO CITY

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In 1928 the Mexico City received a gift from Andrew Carnegie's widow: a plaster cast of the dinosaur *Diplodocus carnegii* (nicknamed "Dippy"). This was the 9th cast in the world and the first dinosaur skeleton displayed in a Mexican museum. At that time (1930) the skeleton was assembled in the National Museum of Natural History. After the close of that museum, the cast was relocated to the new Natural History Museum in Chapultepec in 1964.

In this new site, the cast had unfortunate anatomical modifications that were the result of inadequate manipulation and incorrect assembly of certain parts of the skeleton. For example, the typical tail shape of that time, on the ground, was curved due to limitations in the space of the exhibition hall. For decades the cast was damaged by vandalism and poor conditions in the museum´s hall. Since the assembly in the 1960's, several inadequate restorations were made (including changes in color from the original black). The last, in the mid 2000´s, included many important repairs, especially in the tail and the skull.

In 2017 part of the museum was remodeled; including restoration of the Dippy cast with advisory and technical work under the direction of one of the authors (R.S.P.). The project had 3 phases: 1) Disassembly. 2) Restoration: including extensive repairs of each of the damaged elements, reconstruction of missing parts improvement of pieces with inaccurate anatomy and new dark gray color painting. The main materials used were plaster of Paris and dental plaster (to model and as an adhesive), instant cyanoacrylate glue as adhesive and wires as structural elements, water-based sealers, primer and acrylic paint. 3) Reassembly: including changes in the neck, tail, manus, pes and forelimb positions according to known diplodocid anatomy. The complete team included 1 sculptor, 1 biologist, 4 students, 5 technicians and 1 architect.

This project was completed in almost 8 months. The result is a more accurate display for public view that provides greater understanding about paleontological knowledge of one of the best-known dinosaurs and conservation of an important historical piece for Mexico.

PYRITE DECAY MITIGATION

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The North Carolina Museum of Natural Sciences Paleobotany and Vertebrate Paleontology Collections contain specimens with active pyrite decay. These specimens were identified by the presence of pyrite-oxygen-water redox reaction byproducts. This includes rust, yellow, and/or white powder residue. Most notably, the museum's *Acrocanthosaurus atokensis* specimen (NCSM 14345) bears unstable pyrite and has been treated for active decay on multiple occasions. With continuing decay, caused in part by an unstable environment, it was determined that all fossil elements should be removed from display, treated and rehoused in collections. Controlling pyrite decay on fossil specimens requires a reduction in relative humidity (water vapor) and a reduction of available oxygen. The application of a barrier compound directly on the specimen is inadequate to stop or control decay. A thorough review of available literature was conducted to create an appropriate mitigation protocol. The protocol includes 6 distinct steps as follows: (1) Remove pyrite decay by-product both mechanically and chemically using anhydrous solvent, (2) Desiccate specimens by oven drying at low temperature (200-250°F), (3) Stabilize specimen with archival consolidant (Paraloid B-72), (4) Assess the need for custom support systems such as custom plaster cradles or polyethylene foam cavity mounts, (5) Encase specimen in oxygen and moister barrier film (FilmPak) with sachet of blue indicating desiccant, oxygen scavenger and indicator cards, (6) place specimen in gasket-sealed collections cabinetry. This project was supported by a National Science Foundation Collections in Support of Biological Research Grant (NSF CSBR award 1560871).

3-D SCANNING FOSSILS AT THE LA BREA TAR PITS, LOS ANGELES, CA WITH THE ARTEC SPACE SPIDER

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Digital 3D modeling in museum collections can be useful in creating an easily accessible visual of a specimen to aid in research, education, and collection preservation. The 3D model files are manipulable, contain measurements, and can be 3D printed to create a physical replica. They are made with photogrammetry and different types of scanners. Here I present how the Artec Space Spider, a handheld scanner based on structured light technology, has so far been used with the collection at the La Brea Tar Pits and Museum. Scanning projects were based on current research and collections needs, including (1) digital replication of specimens prior to destructive sampling (2) the production of 3D printed specimens for educational purposes; and (3) participation in a collaborative theatre art exhibit. The size of scanned bones ranged from a 1 cm Microtus sp. maxilla to a 55 cm *Bison antiquus* rib.

A scanning work space was set up with a laptop with a downloaded version of Artec Studio 12 (the scanner's software), a newspaper-covered turntable, and mounting materials (foam and clay) at hand. The scans were processed in Artec Studio 12 manually and automatically to form a 3D mesh of data points from which the model is built. 3D print files (.stl) and models with texture/color (.obj) were exported from the program and a .pdf file was created in Adobe Photoshop CC from the .obj file.

The time to make a model with no issues took 20 minutes to 2 hours depending on the size and complexity of the specimen. Shiny, smooth surfaces, and fossils with thin edges were more difficult for the scanner to read and sometimes needed extra landmarks to set around the fossil to help collect data. Sometimes features like thin (< 1 mm) edges and deep holes could not be recorded. The scanner does not have a high enough resolution to capture the features needed to identify specimens at the smallest end of the size range (those generally less than 5 cm), including *Microtus sp*, *Sylvilagus sp*, and Sciuridae dentaries; we are now experimenting with macro photogrammetry to achieve better resolution for these specimens.

TRADING PLACES: SOLUTIONS TO CHALLENGES IN MOVING A LARGE VERTEBRATE PALEONTOLOGY COLLECTION

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The vertebrate fossil collections of the University of Michigan Museum of Paleontology (UMMP) represent over 150 years of collecting and cataloging. This has led to an accumulation of approximately one million objects of diverse shapes and sizes, from huge mammoth tusks measuring meters long, to tiny shrew teeth resting on the heads of pins. Over the past three years, the UMMP has been engaged in preparing and moving this collection to a new off-campus collection/research site. Transporting this wide range of specimens has presented conservation challenges, and many unique difficulties have arisen. However, the move process is also an opportunity to update inventories, photograph drawers, and rehouse/repair specimens. In response to these difficulties, student technicians have developed novel ways to use common archival materials (corrugated plastic, polyethylene foam, hot glue and Paraloid B72) to create fast, easy, inexpensive and sturdy cradle-boxes for moving and storage of fragile specimens. These custom boxes, in addition to other new containers, have increased specimen safety during the move process and will protect even our most fragile specimens from day-to-day cabinet and drawer movements for years to come. For larger, heavier specimens, similar archival padding materials were adhered to pharmaceutical-grade plastic pallets, which can be accessed and moved by forklift. In setting up an entirely new collections facility, other problems were met and addressed. When loading new steel cabinets with heavy specimens, open-drawer deflection was found to be unsatisfactory due to a new cabinet glide design, but this was addressed by designing and applying low friction, ultra-high-molecular-weight polyethylene runner “prosthetics” to reduce the tipping angle. These challenges have taught us how to optimize cost, weight, and specimen safety. The solutions and equipment we are using will help us to maintain our collection in the best condition and make it accessible for study for another 150 years to come.

TECHNICAL CHALLENGES OF MOUNTING A TYRANNOSAUR SKULL IN EXPLODED VIEW

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A skull and partial skeleton of the tyrannosaur *Daspletosaurus torosus* was collected near Manyberries, Alberta from 2000 to 2011. The skull was nearly complete and disarticulated with little deformation. The Royal Tyrrell Museum of Palaeontology (RTMP) wanted to display it in a visually interesting and informative way. The concept of an exploded skull, also known as a Beauchene mount, was proposed. The skull was mounted half-articulated and half-exploded with the goal of showing visitors how many individual bones make up a tyrannosaur skull. This project presented many technical challenges. Many bones were too fragile for display or molding with traditional methods. Photogrammetry was used to create high resolution digital models of each bone, minimizing the risk of damage to the fossils. This was the first major photogrammetry project undertaken at the RTMP. For many paired elements, only the most complete and least distorted element was modelled then digitally mirrored to create the opposite side. Selective laser sintering was used to print the 3D models, which were made of DuraForm GF Plastic (a glass-filled nylon, polyamide powder). The maxillae and dentaries were cast in Aqua-Resin S3+L, using three-part molds made of Smooth-On Dragon Skin 10 FAST, and Smooth-On Rebound 25. The 3D prints were durable, to scale, and articulated well with the Aqua-Resin casts.

Designing the mount for the Beauchene skull posed a unique challenge. Technicians worked with a team of blacksmiths to create an artistic mount that added to the visual appeal while providing structural support. The 3D prints were suspended with string within a mockup display case to determine their placement. The armatures were then forged in relation to the elements, creating a series of branching armatures specifically curved to cradle the individual bones. The other half of the skull was articulated using aluminum pins and Devcon 2 Ton Epoxy and supported by forged armatures.

Painting the 3D prints was also challenging as some printing artefacts were visible. These artefacts were masked with paint and a replica surface texture was hand painted to give the illusion of natural bone features.

PREPARATION OF A LARGE, WELL-PRESERVED CHASMOSAURINE (DINOSAURIA: ORNITHISCHIA) SKULL FROM THE LATE CRETACEOUS OF ALBERTA, CANADA

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TMP 2014.022.0022 is the well-preserved, three-dimensional skull of a large (~1.8m skull length) chasmosaurine dinosaur, likely *Eotriceratops* or *Triceratops*. The skull is notable for several technical challenges associated with its collection and preparation including: its vulnerable position bridging the interface between a solid sandstone and blocky, fractured siltstone layer; the multipartite manner in which the specimen was, by necessity, extracted; the variable thickness (between ~2 mm and ~60 mm) and elongate (~2m wide, 1.5m long) nature of the frill; and the overall mass of the specimen (estimated at 900 kg).

The instability of the blocks was addressed with different consolidants. Ten percent Paraloid B-72 in acetone, the preferred consolidant at the Royal Tyrrell Museum of Palaeontology, was used on smaller blocks. Epo-Tek 301, a high-quality two-part epoxy, which was selected for its strength, optical transparency, and low viscosity, was used in addition to Paraloid B72 on the largest block. The ~725 kg main block was tilted and its jacket cut open in places to facilitate penetration of the epoxy.

Epo-Tek 301 was also used to adhere large blocks to the main skull block. The size of some blocks made the process of joining them problematic. In one case, a ~150 kg block needed to be lowered face down onto the main block. A plaster cast was made from a latex surface mold and test fitted to the main block. The block was then lowered in a partial jacket that gripped the margins without impinging on the contact surface. Three sides of the contact area were sealed with a combination of latex, vermiculite and fibre glass drywall tape, then epoxy was used to fill any void space.

Preparation of the frill blocks is complete and preparation of the main block is continuing. Future challenges to overcome will include the variable thickness and overall size and mass of the frill blocks, which makes their reassembly difficult. The intent is to support the frill blocks on one or more armatures separate from the main skull block. This specimen provides useful insight into what materials and methods are useful in large-scale, large-mass reassembly projects.

BUILDING HISTORY: MAKING A FOSSIL PREP LAB AND COLLECTIONS SPACE IN RURAL MONTANA

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The Carter County Museum (CCM) and Makoshika State Park are two different institutions with a lot of similar needs. Both are located in small, rural towns in Eastern Montana and both have incredibly rich and diverse fossil collections. Prior to 2017, these facilities contained fossil collections that had been packed away by previous managers using improper collection handling procedures, e.g. fossils were stored in cardboard boxes with no collection or field data associated, fossils sat broken out of proper support structures (Not sure what this means, please pick one of the following: fossils without proper support structures sat broken, fossils broken out of their support structures sat on tables, or lacking proper support fossils broke under their own weight), and no organizational structure was in place. Additionally, both labs were only using basic preparation tools and outdated methods. In the summer of 2017, the effort of bringing both facilities up to current collection and preparation lab standards was initiated. Multiple challenges which required creative problem-solving arose throughout the process. Replenishing broken and missing basic hand tools was solved by creating a relationship with a dentist in a nearby town. Impossible-to-find Hydrocal plaster was discovered to be shippable on a pottery wholesale website. Online shopping was a necessity in both remote locations and also kept all the purchases within tight budgetary constraints. Budget constraints also required creating a "priority" list of what tools were needed immediately and developing a fundraising strategy to purchase additional tools and equipment and ensure sustainable growth in the future. It was also apparent that both facilities were not fully utilizing the possibilities of their communities, especially in the case of Makoshika. Thus, an effort was started to engage the public. At both the CCM and Makoshika, tours of the fossil preparation labs were provided to school groups and community members, and meetings were held to discuss future use of the facility. Additionally, by coordinating large events at each institution, it became possible to showcase the value of these locations for scientific research, public outreach, and community engagement. By the end of the summer both institutions had successfully rehoused the collections and started fossil prep on a larger scale.

SUCCESSES, PITFALLS AND ASPIRATIONS: A BRIEF HISTORY OF THE NATIONAL MUSEUM OF NATURAL HISTORY (SMITHSONIAN INSTITUTION) PALEOBIOLOGY COLLECTIONS VOLUNTEER PROGRAM

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The impact of volunteers at the Smithsonian National Museum of Natural History (NMNH) is invaluable. Approximately 100 volunteers comprise between 60-70% of the workforce in the Department of Paleobiology. Their work contributes to all facets of the department from fossil preparation, construction of specimen housing, collections organization, and cataloguing, but until recently it was always in conjunction with research staff.

In the spring of 2016, collections management staff noted a need for more volunteer support and identified a list of projects involving collections digitization. The highest priorities were to reduce the cataloguing backlog of 39.5 million specimens, georeference 500,000 fossil localities, and photograph fossil holotypes for insurance purposes as well as use in research and outreach. Each project had its unique challenges not only in planning but identifying the appropriate volunteer suited for the task. Progress on the cataloguing project was slow initially due to poor volunteer vetting and training. Later iterations of vetting combined with training in the form of a four hour 'test' aided in curbing these issues. Volunteers that learned an in-depth workflow within four hours of one-on-one tutelage and were willing to ask questions became cataloguing volunteers. Eventually, georeferencing and fossil photography created similar protocols.
By the end of the first year, volunteers created over 9000 new digital catalogue records, photographed over 5000 fossil plant holotypes and georeferenced 8400 fossil localities from the west coast of the United States. The data then received post-processing and was standardized for ingestion into our collections information system by the department's Informatics Manager and data savvy volunteers. While time commitments by the staff have been staggering, the benefits to collections data and research are immeasurable."

DEVELOPING AND IMPLEMENTING WORKFLOWS FOR CATALOGING AND REORGANIZATION PROJECTS IN THE SMITHSONIAN NATIONAL MUSEUM OF NATURAL HISTORY DEPARTMENT OF PALEOBIOLOGY

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Historically, the Smithsonian National Museum of Natural History (NMNH) Department of Paleobiology cataloged vertebrate fossils on an ad hoc basis. In late 2014, we began a comprehensive project to catalog (assign catalog numbers and/or record data in digital collections database) all terrestrial mammal fossils and update existing catalog records. Data was entered into a spreadsheet, reviewed and edited in small batches, and then uploaded into our database. After a few months, we reduced the number of data fields to simplify cataloging and developed new standards to improve data quality and accessibility. Some data standards were incorporated into the cataloging workflow, while others were implemented after the project ended in early 2017. Though we were unable to catalog everything, we created 13,000 new records and updated 15,000 existing records. As the mammals cataloging project was ending, we were also preparing for the installation of new storage cases for the vertebrate fossil type collections. Within eight months, over 200 individual oversized specimens and 80 storage cases of fossils were relocated to accommodate the larger cases. Before anything was moved we created detailed specimen inventories to determine where all specimens would be relocated. To note the new storage locations, each oversize specimen was tagged with colored tape and magnetic labels were added to cases. This expedited the moving process since storage locations were already assigned for each specimen or case. As type fossils are moved into the new cases, they are being reorganized taxonomically using the inventory as the key to locating individual specimens. These recent projects have allowed the NMNH Department of Paleobiology to develop, test, and refine new workflows for cataloging and reorganizing collections. Though these were vetted with vertebrate fossils, they can also be adjusted and applied to other collections in the department.

TREES FROM TAR: FINDING THE BEST CLEANING TECHNIQUE FOR FOSSIL WOOD IDENTIFICATION AT RANCHO LA BREA

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The late Pleistocene asphaltic deposits at Rancho La Brea, California preserve millions of fossils, including numerous plant remains. The botanical fossils are important in reconstructing the former environmental conditions at Rancho La Brea. Identification of wood material retrieved from these deposits, however, is compromised by the impregnation of the cellular structure with asphalt, which can obscure microscopic detail when using basic identification approaches such as wood snapping or hand sectioning with a microtome. Additionally, asphalt saturated wood produces challenges for exact slicing of wood for identification purposes. Deterioration of structural stability over time results in a softening of the wood, thereby causing distortion of the cellular architecture when sectioned. Resin impregnation was found to be an effective way to combat this, however wood that is saturated with asphalt prevents the complete penetration of resin. Preliminary testing using three different preparation techniques (boiling wood specimens with Dawn, soaking, and sonication in an n-propyl bromide-based solvent) was undertaken to determine the best approach for the removal of the asphalt from wood tissue compared to an untreated sample. Pre-sliced wood samples (c. 2 cm in diameter) were collected from a single specimen (RLP501B, Pit 91) and subjected to the different preparation methodologies. Samples were then embedded with Epofix resin and sectioned to a thickness of 5-8µm for slide mounting, the samples were microscopically screened for identification and the three techniques assessed for clarity, of which ultrasonic cleaning (60 KHz, for 13 hours) with n-propyl bromide produced the best preliminary results. Observations that were noted during these preliminary investigations have raised new questions that will be addressed with future experimentation to fully understand the results. Further testing with greater sample sizes is now envisaged to corroborate these preliminary results.

TRAPPING STUDENTS WITH FOSSILS

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Natural Trap Cave (NTC), located in northern Wyoming, has produced a treasure trove of fossils from the Late Pleistocene to early Holocene (31,000 -3,000 years ago). NTC was originally excavated from 1974 -1984 by L. Martin and M. Gilbert of University of Kansas and University of Missouri, respectively. The cave was reopened from 2014-2017 by a team of researchers, led by J. Meachen of Des Moines University (DMU). Since reopening NTC, four to six high school students have been curating the vertebrate micro- and macro-fossils recovered from the cave as part of an outreach program. The objective of this program is for the students to develop an understanding of the form and function of the vertebrate skeleton, preservational biases in the fossil record, and participate in each of the curatorial steps (cleaning, repair, identification, cataloging, and photographing) used for the long-term preservation of fossils.

The students that participate in this outreach program are from Des Moines High School Central Campus and come to DMU every Wednesday for two hours during a semester, receiving high school and college credit for participating. The students have little to no background in paleontology, curation, or anatomy, so activities (e.g., assigned readings, discussions, demonstrations, 'hands-on' exercises, and traditional lectures) are designed around the fundamentals. Examples include reading NTC publications, drawing and identifying disarticulated skeletal elements of modern vertebrates, and discussions about taphonomic processes. Approximately 40 students over eight semesters (Fall, 2014 – Spring, 2018) have taken part in this outreach program and over 3000 fossils have been curated to date. Several of the students have presented posters on the work they have done as part of this outreach program at the numerous district and state science fairs held annually in Iowa and received accolades.

TRANSPORTING A TITANOTHERE: A CASE STUDY FROM SCOTTS BLUFF NATIONAL MONUMENT

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Scotts Bluff National Monument (SCBL), a unit of the National Park Service (NPS), was established in 1919 by Presidential proclamation. The monument currently encompasses 3,003 acres of prairie and bluff habitat located in the Panhandle of western Nebraska. The facilities of the monument, including the visitor center, were primarily designed and built by the Works Progress Administration and the Civilian Conservation Corps in the 1930s and expanded by the NPS initiative known as the Mission 66 program. SCBL is currently in the process of developing and implementing building renovations and the design of new exhibits. During the summer of 2017, SCBL needed museum specimens and objects removed from the current exhibit space in the visitor center in preparation for upcoming renovations to the facility and the Mission 66 exhibits. A team of museum professionals from around the Midwest Region of the National Park Service traveled to the park to pack and transport the aforementioned museum materials. This case study focuses on the challenges faced by the team and park staff to properly pack and transport a large Titanothere skull at the park and relocate it to an NPS facility in Independence, Missouri. Challenges faced during planning for the move included 1) packing and/or crating a fossil of undetermined weight (the fossil was encased in an exhibit panel only accessible from the front), 2) determining the appropriate size crate and padding materials for the fossil, and 3) coordinating and collaborating with appropriate park staff for handling of the fossil. Packing materials included a custom-size crate and polyethylene foam for the Titanothere. Two-inch thick, 2.2# density polyethylene foam was used to line the crate and thinner polyethylene sheets were used for wrapping around protruding parts of the fossil. The crate, constructed of heat-treated pine and plywood, was designed so that a side and the top may be easily removed. For other objects, the team used a variety of archival packing materials including acid-free tissue, polyethylene foam, B-flute corrugated board for supports, as well as different methods of packing specific objects.

THE GOOD, THE BAD, AND THE UGLY: WHY SELECTING INERT, LONG-LASTING MATERIALS MATTERS

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When it comes to making decisions about the materials we use, we tend to rely heavily upon the recommendations of trusted colleagues and resourcefully select what is readily available or affordable. As workers in the 21st century, we have the benefit of looking back upon the historical record of our trade and can visually discern the advantages and disadvantages of choices made by our predecessors. Considering this, what can we observe about the long-term stability of materials used in the past? How does this knowledge inform us to make better decisions today? Surveying active and potential dangers to a collection increases our knowledge of how objects are susceptible to agents of deterioration. Supplementing these observations with a current understanding of materials science and conservation research can inform the selection of new materials for their particular property characteristics and applications. Prioritizing solutions may involve implementing changes to adhesive selection, housing materials, labeling methods, and storage environments. This case study demonstrates how materials such as non-archival foams, rubber, tapes, and raw cotton can degrade or jeopardize the long-term support of an object, leave residues or fibers, become brittle or yellow in appearance, undergo chemical change, or invite unwanted pests to nest. Noting and mitigating the absence of other materials and techniques, such as the encapsulation of paper labels or the use of lightfast inks, can prevent future data loss. Creating a visual glossary of examples from your collection can aid in the identification of less than desirable materials and document the resulting effects upon an object over time. Selecting materials known to be inert and long-lasting, such as closed-cell polyethylene foams, polyesters, Tyvek, and acid-free papers and boards can maintain the data integrity of scientific collections for years to come. Assessing the condition of objects in a collection and learning to recognize ways to improve their care will inform standards of best practices and stewardship today.

CREATING A PUTTY-LIKE GAP-FILLER USING PARALOID B-72, ETHANOL, AND MARBLE DUST

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A commonly used technique to create a reversible material for gap-fills is to mix Paraloid B-72 and an inert bulking agent. While a reversible fill is often preferable to an irreversible epoxy, the epoxy often has better working properties. Paraloid mixture gap-fills can bubble at the surface. They can also be tackier and have a thinner viscosity than epoxy putties and are thus more difficult to manipulate.

It is possible to create a gap-filler using archival and reversible materials that more closely resembles the working properties of epoxy putty. This “Paraloid Putty” uses a solution with greater than 50% Paraloid B-72 in anhydrous 99.5% laboratory-grade ethanol. The thick Paraloid B-72 is mixed and then kneaded with marble dust in a ratio greater than 1:4 (resin:filler). The final product has the consistency of putty and is only slightly sticky. It can be manipulated into cracks as thin as a few millimeters and smoothed over immediately with a single application of ethanol. Once set, the filler has an inflexible, hard surface, free of bubbles, and does not shrink around the edges.

Creating the thick Paraloid B-72 solution in ethanol requires a variation on the cheesecloth method. The Paraloid is allowed to completely dissolve out of the cheesecloth into the ethanol without stirring. Most of the Paraloid will settle on the bottom of the container, then the thin solution on top can be decanted leaving behind a solution that is slightly more viscous than a 50% mixture of Paraloid B-72 in acetone (concentration is estimated at 55-60%). The thick mixture can be poured into a dispensing bottle.

To create the putty, a pea size amount of marble dust is mixed in an approximately 1:1 ratio with the Paraloid B-72 solution. This is mixed thoroughly, and more marble dust added repeatedly until the dust will no longer incorporate and it stops sticking to the spatula. At this point it looks unusable, but can be kneaded with the fingers like dough until it has a smooth, putty like texture. The putty has a working time of about 15-20 minutes before it starts to dry out. Coloring the mixture is best achieved by premixing a small amount of dry earth pigment with the marble dust.

A BLUEPRINT FOR TRAINING STUDENTS IN FOSSIL PREPARATION TOOLS AND TECHNIQUES

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The University of California Museum of Paleontology recently entered a partnership with the San Francisco Public Utilities Commission to prepare approximately 1300 Miocene-age fossil blocks found at the Calaveras Dam construction site in the San Francisco Bay area. These include vertebrate, invertebrate, and paleobotanical fossils. This project necessitated the hiring of a project manager/fossil preparator to reopen the years-defunct but incredibly well-equipped fossil preparation lab on the UC Berkeley campus.

In order to process the large number of fossils, I established a training program for interested undergraduate students. Applicants were screened for skills in art and/or science. Knowledge of neither geology nor anatomy was required; skills and activities that utilized patience and attention to fine detail were prioritized. Students work 10 - 12 hours per week, in two-hour minimum shifts.

Safety is taken seriously in the lab, and all students enroll in online lab safety courses lasting ~4 hours. A one-hour, in-lab safety course follows before work is allowed in the lab. In addition to the lab SOPs, easy to understand “How-to” manuals were written for students to both read in advance and to use as reference sheets while doing basic lab tasks, including using and troubleshooting pneumatic tools, using B-72 (both application and removal), unpacking and documenting fossils brought from the field, rock trimming, and data management.

A training sheet, composed of 20 tasks, is used to monitor training progress. Each introductory task takes approximately 2 hours to master, with variable levels of difficulty. Soft brushes must be mastered before metal tools. Pneumatic tools are the last tools they train on, removing pebbles from well-lithified conglomerate. Once they have shown mastery of that process, they are given a “sacrificial fossil” that they can practice on. This is usually a common bivalve. Eventually they are able to prepare their own fossil from field jacket to museum drawer.

IT'S NOT CHILD'S PLAY – UTILIZING CHILDREN AS FOSSIL PREPARATORS

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Paleontology continues to be one of the most popular of the natural sciences, and museums and universities are always experimenting with new ways to engage the public. At the Wyoming Dinosaur Center, children are encouraged to participate in the preparation of specimens collected from various sites outside Thermopolis, WY. Children can substantially contribute to preparation without causing damage to specimens being worked. This is accomplished by taking the necessary steps before children are brought into the lab. These steps include 1) identifying appropriate specimens that are abundant, stable, and have "workable" matrix, 2) making all staff aware of specimens chosen as "prep projects," and 3) placing specimens at designated stations with the appropriate tools. and safety equipment. Once children are brought into the lab, they are seated at a station and received instruction and a first - hand demonstration on how to use the equipment. They remain under direct supervision during the entire preparation program and are rotated between stations based on their proficiency with the preparation process. By doing this, fossil preparation gains greater exposure and is exposed to new audiences. The public engages in a unique and memorable activity with a personal investment that translates to long-term support by providing a special visitor experience.

RETHINKING CONSERVATION BEST PRACTICES AT THE RTMP

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Conservation concerns at the Royal Tyrrell Museum of Palaeontology (RTMP) usually derive from physical forces and inherent vice. Proper housing and preventive conservation approaches are used to mitigate agents of deterioration, however some cases can provide new challenges. Specimens with soft tissue preservation such as feathers, skin impressions, or other organic material have caused RTMP collections staff to rethink storage strategies. Researchers are employing analytical techniques such as mass spectrometry to study fossilized soft tissues, necessitating an awareness of potential contamination of specimens by storage materials, preservatives, and handling. Other conservation concerns include possible destruction of carbonized feather impressions through contact with water, and the introduction of contaminants from molds and casts into enclosed storage environments.

After a review of the available literature, storage guidelines at the RTMP have been updated to state that any molds, casts or reproductions will be stored in separate cabinets from original material and sealed in HDPE bags. This will reduce the potential for degradation products to interact with other specimens. Specimens with delicate carbonized structures, such as feathers, will be housed in waterproof containers (cabinet or specially designed crate) to prevent potential water damage. Specimens with soft tissue preservation will require the use of nitrile gloves when handling, and no preservatives or labelling materials will be applied to samples earmarked for analysis. Aluminum foil and glass are ideal materials for storage of samples, as they are chemically inert. Adopting these measures will help protect the integrity of the RTMP collection and any research derived from it.

DATA CONSERVATION OF *IN SITU* DINOSAUR QUARRIES IN ALBERTA, CANADA: RESOLUTION AND SITE PRESERVATION OF A PREVIOUSLY LOST 1964 HADROSAUR QUARRY THROUGH SLEUTHING, TRASH ANALYSIS, AND PHOTOGRAMMETRY

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Pre-1950, the recording of the exact location of dinosaur quarries was imprecise: “3 miles below Morrin, rt. bank, 100’ above river” was acceptable. Erosion makes the quarries ever harder to find. Not knowing where the older specimens came from creates issues for modern dinosaur biostratigraphic studies, necessitating finding new ones with data properly recorded. However, old unidentified sites can still be resolved from garbage analysis, historic photographs, bone left on site, and paper records. Older sites often had poor site data, but one from the 1960’s was resolved in 2017. A large unidentified quarry yielded a hadrosaur caudal centrum and fragmentary ilium and ribs. Filter-tip cigarette butts suggested post WW II age. Plastic packaging for food freezer bags had Imperial measurements, indicating pre-Metric product labelling (1975). Clothing and hairstyle of a woman on the packaging looked late 1950’s to 1960’s vintage. A digitized newspaper search revealed the exact same packaging in a 1966 advertisement. The only field crew collecting in this area/time was the University of Alberta on the “Betty Tolman quarry”, a hadrosaur site long lost. A landowner recalled a dinosaur found by his sister had been quarried near there; her name: Betty! The old quarry was UALVP 1861, worked in 1964; the new site data now shared with that institution. The specimen itself is a mystery. Catalogue data say “whole hadrosaur”; an SVP News Bulletin implies more will be collected in 1965; a queried UALVP paleontologist in the area/time said nothing significant was found; and Betty indicated “one 2’ bone with a joint” and many scraps were found on discovery. This matter needs to be resolved as there is more in situ bones now exposed. Stratigraphic context suggests this is either *Hypacrosaurus* or *Saurolophus*, both are rare in Albertan museums. A 3-D photogrammetry model of the quarry was created from 398 site photos, marking the first such attempt in Canada. It is useful for a variety of purposes, one being the training of the next generation of field workers on how to recognize these old, but still data-valuable sites. This case reinforces the need to properly record site data.

3-D SITE CHARACTERIZATION USING UNMANNED-AIRCRAFT PHOTOGRAMMETRY AND GROUND PENETRATING RADAR (GPR): EXAMPLES FROM THE ARIKAREE GROUP IN WESTERN NEBRASKA

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Site documentation is a fundamental task in paleontological field work. In addition to the basic locality information, a detailed characterization of the strata is essential to site interpretation and scientific utility of the specimen. Without the contextual data, the specimen becomes nothing more than a pretty rock.

In the past few years, rapid advances in unmanned aircraft systems (UAS) and photogrammetry techniques have made possible the 3D modeling of complex objects from photographs. In this study, we combine UAS photogrammetry with GPR to produce detailed 3D models of outcrops and subsurface strata immediately adjacent to those outcrops.

The Arikaree Group in western Nebraska was deposited between 30-19 million years ago and contains many fossiliferous units. These strata contain enigmatic, deeply incised, fluvial channels filled with locally-derived, pebble to boulder conglomerates. Outcrops exist in vertical or overhanging cliffs ~10 m in height, making it difficult to map sediment bodies and reconstruct the characteristics of the fluvial system. Using more than 2,300 UAS photographs, 3D point clouds were generated for 1,400 linear m of outcrop. GPR was collected behind the cliffs where access was possible. Numerous accretion surfaces were mapped in detail. Point clouds were used to reconstruct the 3D architecture of sedimentary facies as well the dip angle and direction of dip of the accretion surfaces. GPR imagery reveals inclined reflections commensurate with the accretion surfaces present in outcrop.

This study shows that UAS photogrammetry can be combined with GPR to characterize large, complex sites. The 3D models reveal characteristics that were not observable using traditional techniques. These techniques can be applied in other areas to document fossil localities. These models can be used when mapping localities, tracing out bone levels, and provide guidance when prospecting for additional sites. This data can serve as a quick and easy reference for future expeditions.

DEVELOPMENT OF AN INFOGRAPHIC FOR SAFE AND ERGONOMIC MICROSCOPE SETUP

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Paleontological preparation labs require high quality stereoscopic microscopes for preparation. Long durations of use without breaks lead to visual and physical strain, resulting in sloppy specimen preparation and handling, increasing the likelihood of damage to the specimen. In addition, poor ergonomic conditions result in an increased susceptibility to musculoskeletal disorders (MSDs), specifically chronic pain of the neck, upper and lower back, shoulders, and arms. Users can rapidly become fatigued by an improperly set up workspace. Laboratories may reduce the potential for developing MSDs by providing highly adjustable, ergonomically designed equipment; yet this is not effective if the user does not know how to properly adjust it.

At the University of Texas Vertebrate Paleontology Preparation Laboratory, novice preparators (e.g. students and volunteers) often have little to no previous experience in using stereoscopic microscopes. While the proper use and adjustment of a scope is covered during training, bad habits sometimes persist, i.e. poor posture, inadequate forearm support, and long working times without breaks. Verbal corrections by staff can be supplemented and reinforced by laboratory signage near the workspace.

An infographic was created to serve as a visual aid for proper ergonomic microscope setup and use. Following OSHA recommendations, this infographic lists easy adjustments that can minimize eye strain and physical fatigue, including but not limited to: use of chairs providing ample back support; microscopes and chairs adjusted so that the back is straight and the head is in an upright position; elbows close to the sides, resting on padded supports; feet firmly supported, never dangling. Microscope use should be spread throughout the day with frequent breaks. Close eyes or focus on something in the distance every 15 minutes. Workers should walk around and stretch every 30-60 minutes.

Supplemental signage in the lab reinforces safe, ergonomic practices for microscope use. By breaking bad habits early in a preparator's career, one can minimize the risk of developing MSDs in the future, as well as increase the quality of preparation produced.

A CASE STUDY FOR THE USE OF POLYETHYLENE GLYCOL AS A FIELD SURFACE CONSOLIDANT

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Polyethylene glycol (PEG) is a water soluble organic compound which is a waxy solid at room temperature and has a low melting point. It is often used in fossil labs for temporarily mounting small specimens for preparation under a microscope and temporarily filling gaps while making molds. The purpose of this case study was to determine the best method of application of PEG 3350 as a temporary field stabilizer at a site that has delicate fossil eggshell. Three different approaches were used on site, all utilizing PEG 3350 as a melt. In the first method, PEG was melted in a metal spoon and dripped directly onto the egg material. The second method was to apply PEG melt by directly dripping it onto the egg material using a preformed “candlestick” of PEG 3350. The third approach was to apply PEG in powder form to the egg material and use a small, refillable butane torch to melt it in place. Of the three methods, melting applied powder with the torch was the most effective and least disruptive to the delicate eggshell material. The “candlestick” and direct drip methods had the same problems as the application of standard solution consolidants such as Butvar B-76 and Paraloid B-72. When a liquid is applied to the light, delicate eggshell, the shell tends to lift from the surface and float in the liquid until absorption, evaporation or solidification occurs. When a powder is applied and then heated, the eggshell does not have the opportunity to float and is held in place until the PEG is later dissolved or reheated in the laboratory. This allows for the safe stabilization and jacketing of fossil material in the field

ROCK 'N' ROLL STORAGE JACKETS

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The two-sided storage jackets developed at the Smithsonian have found enthusiastic application across the prep community. These fiberglass and plaster jackets provide large specimens with 360° of support and enable users to flip them to view either side without removing the fossil. "Clamshells" have been used on specimens as large as proboscidean pelvises and Triceratops skulls.

But the larger and heavier the specimen, the more difficulty flipping the jacket, sometimes requiring three or four people and a hoist. We have come up with a solution that minimizes (hu)manpower and eliminates any hardware assist.

Fossil proboscidean skulls are fragile and often infilled with matrix or filler, making them heavy. They are also essentially egg shaped, with more mass and weight at the posterior end. We constructed rockers on that heaviest end on which to pivot the jacket, exposing either the dorsal or ventral side as needed. The rockers – and other support structures like feet and ribs -- are added to the jacket after several initial layers of fiberglass and plaster have been applied. We carved the rockers out of polyethylene foam plank, 2-3" thick. They were covered and joined to the jacket with the final layers of (FGR95) plaster and fiberglass veil. Built on both sides of the jacket, the rockers form a contiguous arc from one side to the other and serve as feet when the jacket is at rest.

We made our trial jacket for the type skull of *Stegomastodon arizonae*. After some trial and error we achieved a successful proof-of-concept: the massive skull and jacket are easily flipped by two people. The design has been subsequently used and improved upon on mastodon and pygmy mammoth skulls.

These jackets are labor intensive. But they work on proboscidean skulls, and it is quite conceivable the concept could extend to other big, heavy specimens such as whale skulls and large long bones.

A 30-YEAR CASE STUDY FOR PREPARATION METHODS IN BLACK SHALES: MARINE VERTEBRATES FROM THE LATE DEVONIAN (FAMENNIAN) CLEVELAND MEMBER OF THE OHIO SHALE FORMATION, OHIO, USA

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Since its incorporation in 1920, the Cleveland Museum of Natural History (CMNH) has amassed a substantial collection (n ~8,000) of Late Devonian (Famennian) marine vertebrates from the Cleveland Member of the Ohio Shale. The collection contains arthrodires, including multiple specimens of the iconic placoderm *Dunkleosteus terrelli* ranging from small hatchlings to full-sized adults, paleoniscoid fish (e.g. *Kentuckia*), and some of the oldest complete chondrichthyans in the world (e.g. *Cladoselache*).

Placoderms are typically found in blocky shale, cone-in-cone limestone concretions, or shale concretions, and may contain mushroom-like pyrite nodules growing out of cancellous bone tissue and across the bone surface. Sharks are almost exclusively preserved within dense shale concretions (this may reflect historical collecting bias) with little to no pyrite crystallization. These preservational circumstances necessitate utilizing careful preparation techniques for extracting varying specimen types, from massive, bony placoderm plates to the delicate features of shark gill arches.

Although variation in Cleveland Member lithology complicates preparation, trial and error testing of a variety of methodologies by CMNH staff and volunteers has established specific step-by-step techniques for fossil preservation conditions. Preparation begins with a flex-shaft hand grinder fit with a silicon carbide abrasion wheel. Bulk shale is gradually worked down in a blasting cabinet with the aid of a microscope until the first specks of black bone appear in the dark gray matrix. Next, dolomite abrasive media is used with an air abrasion unit to remove the remaining fine layer of shale. Air scribes fitted with dull carbide steel tips are utilized to remove masses of the minerals barite and pyrite.

Employing these basic steps, each group of marine fossils can be safely extracted from their rocky matrix. In addition to revealing the Konservat-Lagerstätten preservation of soft tissue and gut contents in sharks, this procedure has recently led to the discovery and description of the first definitive cartilaginous postcrania from the Late Devonian apex predator, *Dunkleosteus terrelli*.