2012 Preparator's session abstracts

FEATHERING DINOSAURS

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Recent fossil discoveries have amplified our knowledge of varied dinosaur integument. Preserved scales, filaments and feathers have supplied a wealth of reference that artists endeavor to incorporate into reconstructions of new specimens. A variety of techniques have been employed to create sculptural flesh-models with unusual integumentary coverings. Coats of fibers and feathers can be sculpted in relief, creating hard models of these soft features. Alternately, feathers, hair, flocking, and other delicate mixed media such as acetate sheets and nylon monofilament can be used to create the coverings for a life reconstruction. A survey of the methods and materials currently used by a variety of artists and technicians will be presented.

FROM DISCOVERY TO PUBLIC OUTREACH: A NEW VISITOR ORIENTATED FOSSIL QUARRY AND FOSSIL PREPARATION LAB OPENS AT THE BEN REIFEL VISITOR CENTER AT BADLANDS NATIONAL PARK

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In May of 2010, a specimen of Hoplophoneus was discovered by a visitor at Badlands National Park. The collected elements include a complete skull and five cervical vertebrae. This specimen is one of the most superbly-preserved examples of Hoplophoneus collected from the White River Group, owing in part to the calcareous cement of the Middle Scenic upper sandstone interval of the Brule Formation. However, the mandible was incomplete, and the medial section of the left side was totally absent. Realizing the significance of this find, the park partnered with the South Dakota School of Mines and Technology to assist in the digital reconstruction of the mandible, including recreating the missing segment and adjusting the model to counter the effects of deformation. The resulting data were used to generate: 1) a rapid prototype of the skull, allowing study of the specimen without incurring damage to the original; and 2) the mass production of scaled casts. The importance of this specimen was realized during preparation, when several puncture wounds in the skull were observed, consistent in size and depth with that of another nimravid. This new knowledge motivated a preliminary survey of the area, producing a fairly diverse faunal list, including a marsupial (Herpetotherium); a leporid (Palaeolagus); rodents (Eumys, Ischyromys); perissodactyls (Mesohippus, rhinoceratids); artiodactyls (Merycoidodon, Leptomeryx); reptiles; and trace fossils. The diversity and unique preservation of these fossils led the park to open both a visitor-oriented research quarry and an interactive, fossil preparation lab, inside the adjacent Ben Reifel Visitor Center in June of 2012. Inserting a fossil preparation lab into a historic structure, utilized daily for interpretive education and visitor outreach, presents unique challenges. Concerns related to noise levels, safety, and preservation of the historical structure all had to be carefully addressed while ensuring that specimens are handled, prepared, and secured according to the highest standards. Since construction of a traditional viewing lab was impermissible, a workstation was fabricated that allows specimens to be viewed by the public while also providing a sealed work space to contain fossil preparation byproducts. For the first time in park history, visitors will be able to observe and interact with scientists at a fossil quarry, a fossil preparation lab, and a visitor center, all in an easily accessible area. With continued excavation and research, via expanded paleontological facilities and partnerships with

universities, Badlands National Park plans to continue alternative, non-destructive methods of preparation and cast reproduction, in hopes of further preserving fossils for future generations.

INTRODUCING C.O.D.I. (THE COMPREHENSIVE OLDUVAI DATABASE INITIATIVE): AN ELECTRONIC REPOSITORY OF TERRESTRIAL VERTEBRATE FOSSILS FROM THE PLIO-PLEISTOCENE OF OLDUVAI GORGE, TANZANIA

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Olduvai Gorge was first brought to the attention of paleontologists in 1913 and has since provided tremendous insight to the last two million years of vertebrate evolution in East Africa. Thousands of fossils have been recovered from this site over the almost 100 years of field work, including numerous type specimens and records of first and last appearance dates. However, due to the long history and multiple investigators, the material is scattered across numerous museums, personal collections, and countries with no comprehensive database of the material. We have developed the Comprehensive Olduvai Database Initiative with the goal of creating an electronic repository of information about these fossils that includes bibliographic information, photographs, element identification, stratigraphic context, and current repository. As of April 2012, 20 monographs and other scientific publications dating from 1934 – 1990 had been entered into the database (approximately 3,700 specimens). Data entry from published work and visits to museums holding collections are underway, including the inventory of fossils held returned to the National Museum of Tanzania, Dar Es Salaam, from the Kenyan National Museums in 2011. With the launch of the CODI website at www.olduvai-paleo.org we have initiated the second phase of the project. This relies on scientific crowd-sourcing--to draw on the knowledge of other vertebrate paleontologists to identify unpublished or underpublished material. In our presentation we will introduce the audience to the on-line database, demonstrate some of its unique features, and request assistance recovering information about fossil material from Olduvai Gorge, calling for the scientific community at-large to work collaboratively to record this information before it is lost to the passage of time.

IMPROVING CURATION AND CONSERVATION STANDARDS AT THE VERTEBRATE PALEONTOLOGY LABORATORY THROUGH INTERDISCIPLINARY COLLABORATIONS

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The history of the collections at the Vertebrate Paleontology Laboratory (VPL) of the Texas Memorial Museum spans more than one hundred years. This history is tied to both famous names in vertebrate paleontology and the histories of many other institutions. Preventing and mitigating the loss of archival data, historic documents and photographs, as well as the specimens themselves are the focus of recent conservation efforts by the VPL collections staff. Although interest in preserving documents, photographs, and digital data related to the fossil collections is high, the small permanent staff of VPL faces a number of constraints familiar to most natural history curators and conservators – limited time, staff and training. Our approach over the past year has been to exploit the resources from our larger campus and museum community. We have targeted resources on our own university campus by first defining our collections care priorities. The photographs and documents at VPL are a hidden archive resource. However, this archive has only recently been organized. Documentation within the VPL collection itself is another source of hidden archival riches. However, these documentary materials (as well as the specimens) have suffered from gross variations at all levels in storage conditions and treatments. Field notes and photos are critical to interpretation of fossil materials; likewise, documentation of the provenance of specimens is crucial to collections management. By stressing to our students, faculty, and staff that the documentation of specimen treatments are essentially part of the specimen, we are improving this situation. VPL curatorial staff found willing partners in our conservation efforts through the University of Texas at Austin's Harry Ransom Center and School of Information. By working with these campus units, we have found not only a wealth of opportunity for expanding our own expertise, but also potential funding and qualified personnel. Our retrospective effort to conserve archives is informing our present curatorial practices and procedures. Documentation of the collections is expanded to include conservation methods and materials. Materials and practices for storage are more consciously considered. These efforts are also receiving greater emphasis among the students who are the most frequent users of the VPL.

METHODOLOGY AND RESULTS OF A COMPREhENSIVE SPECIMEN CONSERVATION CONDITION SURVEY OF AN ACTIVE BONE BED AND STORAGE COLLECTION AT THE MAMMOTH SITE OF HOT SPRINGS, SD, INC.

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The Mammoth Site of Hot Springs, SD (MSHS) poses unique challenges for collections management, conservation, and preservation in that it is both an active, on-going paleontological excavation site and a research collection. Discovered in 1974, the development of the site and the museum has paralleled the growth and development in the field of museum conservation. Over the past two decades the MSHS has applied conservation methods and materials used in the stabilization and preservation of the specimens. The museum has also undergone various assessments of its operations, developed a long-range conservation plan, and acted on the recommendations of the assessors. The comprehensive specimen condition survey, an object by object survey, is the most detailed conservation assessment available. The assessment consists of visual and tactile observations of individual specimens and recording ordinal numerical rankings of specimen and matrix condition and treatment priority. The ranking system was developed by the conservator (Storch) in collaboration with the MSHS staff (Potapova and Wilkins). The amount of time in hours required for conservation treatments (e.g. stabilization, cleaning, reversing improper treatments, etc.) were also estimated. The bone bed and collections storage specimens were assessed in two on-site visits of ten days each. Eight hundred and thirty individual bones were assessed and results tallied for the three metrics mentioned above. Condition assessment reports were filled out for each specimen and will be added to the more detailed collections specimen records. Images of representative conditions for each ranking were taken and are included in the final project report. In the bone bed, 12% of the specimens are in the poor to fair condition categories, 68% in good, and 20% rated as excellent. The condition of the "poor/fair" specimens, and many of the elements in the "good" ranking, is due to the presence of darkened and aged cellulose nitrate and polyvinyl butyral polymer resins applied as preservatives and consolidants to the bone surfaces and matrix. Results are similar for the specimens in storage. The final project report summarizes the results within a conservation risk assessment framework of ten agents of deterioration including disassociation, or the separation of provenience information from the specimen. The project also applied the condition rankings to the specimen location information in ArcGIS for the site as an additional mapping layer so the in-situ exhibit specimens can be highlighted by condition ranking for identification and preservation work planning.

DIGITAL DEVELOPMENT AND MOUNTING OF AN ALAMOSAURUS SKELETON FOR THE PEROT MUSEUM OF NATURE AND SCIENCE

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Three different specimens were used to develop the first skeletal mount of the giant titanosaur from the late Cretaceous of North America, Alamosaurus. The individual elements of all three skeletons were laser scanned, creating digital files of all of the bones necessary to develop a complete skeleton. The individual bones were then manipulated by scaling for size, and if the opposite side was missing a mirror image was made. Once the complete skeleton was digitally developed, it was physically created using 3D printers and a 5 axis router. The specimen from University of Texas, Austin was originally collected in 1973 and consisted of the bones of a single specimen, including femur, humerus, hip and articulated dorsal series through to the first cervical. It had only been partially prepared. in all, 13 unprepared blocks consisting mainly of the hip and dorsal series were prepared for this project. The specimen from the Smithsonian was collected in Utah in 1946. It consists of approximately 30 articulated caudal vertebrae and a front forelimb. The Perot Museum specimen was collected in 1997, and consists of nine articulated cervical vertebrae. Each specimen preserves elements that overlap with the other specimens, and that could be scaled for the reconstruction of the skeleton. The sheer size of the skeleton ruled out 3D printing of the entire skeleton from the original scanned data, due to the restrictive size of the 3D print envelope. The point cloud data generated by laser scanning had to be transferred to CAM files so tool paths could be created for a 5 axis router to carve out the replicated bones from two-pound density polystyrene blocks.

COMBINING MECHANICAL PREPARATION AND X-RAY COMPUTED TOMOGRAPHY TECHNIQUES TO VISUALIZE OBSCURED MORPHOLOGY IN A BASAL SAUROPODOMORPH DINOSAUR

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The use of X-ray computed tomography (CT) in the study of fossil material has increased significantly in the last decade, and has augmented or even supplanted conventional mechanical preparation techniques in vertebrate paleontology laboratories. CT is dependent upon X-ray contrast between matrix and fossil material, and allows paleontologists to study otherwise unobservable morphological features in specimens. The articulated left forearm and manus of the basal sauropodomorph dinosaur Sarahsaurus aurifontanalis presents a unique opportunity to combine CT and standard laboratory techniques. This specimen, found in the Kayenta Formation of Arizona, represents the third described basal sauropodomorph taxon from North America. Standard mechanical preparation was performed until further preparation would have required the disarticulation of the specimen. This left several phylogenetically informative characters obscured by matrix on the palmar surface of the manus, including the presence of collateral ligament fossae, the angular offset of distal condyles, and phalangeal formulae. Because the specimen was left in articulation, articular surfaces of the carpus, metacarpus, and phalanges were also obscured. The specimen was scanned at The University of Texas High Resolution X-ray Computed Tomography Facility (UTCT) and volumetric CT data was processed by digitally removing the mudstone matrix from each individual bone surface. Digital surface files were then generated for each element and printed in acrylic and water-soluble wax by a 3D prototyper at Innovation Park at The University of Notre Dame. These high-quality 3D replicas of the individual bones of Sarahsaurus reveal detailed articular surfaces of the elements in the manus, allowing thorough description of the entire specimen and aiding interpretations of the extent of taphonomic mediolateral compression of the fossil. Finally, the individual replicated elements were molded and cast using standard techniques, a process that would have been impossible with the original articulated specimen. Although pouring plastic casts is currently less expensive than digitally prototyping replicas, the cost of this technology is decreasing, and it

is possible that future fossil preparation laboratories may have the capability to generate wax, plastic, or even bronze replicas of important fossils. Most importantly, the complementary nature of CT and mechanical preparation techniques may increase specimen longevity and avoid destructive disarticulation of specimens that can involve the loss of valuable morphological and contextual information. Similarly, these methods allow an opportunity to verify interpretations of previously ambiguous or unobservable character data.

THE USE OF HIGH-RESOLUTION XRAY CT TO INTERPRET MATRIX VARIABILITY AND GUIDE FOSSIL PREPARATION

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The process of fossilization is complicated and can be influenced by a multitude of geological, biological, and chemical factors. Because of this, variable patterns of sediment sorting, mineralization, and cementation are often found at the scale of an individual specimen. Such variability potentially complicates mechanical and/or chemical preparation, and may require different techniques to be applied to different regions of a fossil. The differences in preservation may also have taphonomic significance (e.g., evidence of bioturbation, preserved soft tissues), the context of which -or even the information in its entirety- is lost during conventional preparation. Commonly used for visualization of anatomical structures, CT scanning is a powerful tool that can often reveal variations in sediment sorting, cementation and mineralization, in addition to physical damage to specimens, and thus serves as a useful guide during preparation. Here we present CT data showcasing the convoluted taphonomic histories of a variety of specimens ranging from the Paleozoic to the Quaternary. While these data illustrate a spectrum of preservational situations, they also demonstrate some commonalities in the fossilization process (e.g., predictable loci for cementation, and predictable patterns of sediment dispersal) that can inform specimen preparation. These data also serve as a caution against over-preparation, as there may be valuable information preserved in the matrix encasing a fossil. CT technology can be effectively used to develop a preparation or conservation strategy for a specimen that increases efficiency and minimizes information loss.

USING A GLYCEROL-WATER SOLUTION TO CONTROL RELATIVE HUMIDITY IN A CLOSED ENVIRONMENT

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Glycerin is a tri-hydric alcohol that is water-soluble, viscous, and hygroscopic. Consequently, it has many industrial uses in areas such as pharmaceuticals, food and beverages, textiles, paper and printing, among others. The hygroscopicity of glycerin (also called glycerol) is its ability to take moisture from the atmosphere and hold it. In order to achieve a desired relative humidity in an enclosed environment, a given amount of water can be added to a glycerin solution which achieves evaporative equilibrium with the enclosed atmosphere. To slowly dry fossils, we utilized glycerol's properties to incrementally lower the relative humidity over extended time periods. Prior to this use of glycerol solutions, wet Pleistocene fossils from Saltville, VA were tested using other methods to control the rate of water evaporation. The fossils were dried at different rates (quick dry, 1 month, 3 months, and 6 months), attempting to control the rate of drying by slightly opening or adding damp towels to closed containers housing the fossils. We had remote sensors that recorded temperature and relative humidity inside each of these closed containers. A uniform decrease in relative humidity from wet (98%) to the relative humidity in collections (47%) was calculated to use as a standard for each of these time frames. Trying to match this calculated rate of drying without using glycerin was very difficult. The original method resulted in large variations in relative humidity, while the glycerol method enabled us to

precisely control the relative humidity of the environment. We used a food grade glycerol product (vegetable glycerin 99.9%) for a three-month test. Glycerol placed in a beaker with no added water in a closed container equilibrated to a relative humidity of about 20% after several days. We then added water to create a solution that equilibrated with the closed atmosphere to a relative humidity of 98%. At this point we added the wet fossil to the container and incrementally added glycerol in order to reproduce the calculated three-month drying curve. Use of glycerol solutions has been successful in controlling the rate of drying inside the containers housing the Saltville fossils.

COMPARING IMPRESSION MATERIALS FOR DENTAL MICROWEAR ANALYSIS IN A SMALL FOSSIL MAMMAL

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Casting is a common procedure for making high-quality replicas in order to conduct microwear analysis. The goal of this project was to determine the best impression material to create high resolution casts that preserve the pits and scratches present on the original specimen. A range of molding materials was chosen that differed in viscosity and age to determine the effect of these variables in producing a faithful mold. The molding materials used in this study include Coltene Putty, President-jet MicroSystem Light Body, and President-jet MicroSystem Regular Body (a batch from 1999 and another from 2011) polyvinylsiloxanes; Rhodia's RTV 4410 Platinum and RTV 4420 QC food grade silicones; Bluestars V-SIL 1062 silicone; and Reflection Patterson Super Hydrophilic Vinyl Polysiloxane Putty. All eight molding materials were used to mold a partial dentary with p4-m3 (USGS 7788) of the primitive primate Microsyops latidens from the early Eocene of the Bighorn Basin, a small (but not tiny) mammal (m2 length = 3.8 mm). A shearing facet on the m2 was imaged in the original specimen, and in epoxy casts made using the various molds. Images were taken using JEOL-5000 scanning electron microscope (SEM) and microscopic features were manually counted in Microware 4.0 software. The quality of dental surface replication was assessed by comparing the percent features visible in the cast relative to the original enamel surface. The values range from 73.17% for V-SIL1062 to 34.15% for Coltene Regular body from 1999. Age of the material was found to have an effect, with Coltene Regular Body from 2011 producing a better quality replica (46.34% visibility of microwear features). Viscosity also had a significant effect. The least viscous molding compound used (V-SIL1062) provided the best resolution, and the Light Body President jet material more faithfully represented microscopic features than the more viscous Regular Body, although the molds made from the Light Body material were quite fragile, so that they were unsuitable for repeated casting. The most commonly used molding material for microwear studies, Coltene Regular Body, performed comparatively poorly, although major pits and scratches were preserved, suggesting that it may nonetheless be possible to use casts produced with this impression compound to make general statements about diet.

TECHNIQUES AND MATERIALS FOR MICROFOSSIL PREPARATION: MAXIMIZING SUCCESS AND MINIMIZING STRESS

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Microfossil preparation is probably the most difficult and stressful job a preparator can undertake. Although successful microfossil preparation requires considerable skill, dexterity and patience, no level of these attributes can overcome the powerful influences of using poor equipment, techniques and materials. On this scale, even minor errors in judgment or execution can result in disastrous loss of data. By optimizing our tools, techniques and materials we can maximize successful outcomes. Proper tools include a stereo microscope with zoom capability and quality optics, a variety of light sources, a stable work-holding stage

or jig (a ball-mount), precision preparation tools that provide maximum control (carbide) and minimum damage (polished points of various shapes, insect needles, porcupine quills), hand/arm support that provides optimum positioning and support, and ergonomic seating. Useful materials include various reaction and solution adhesives, specimen supports (polyethylene glycol, cyclododecane) and temporary positioning aids (waxes, plastiline). Techniques include using light of various wavelengths or color temperatures to help differentiate between matrix and bone, enhancing visual perception by preparing through and within water-droplets and using capillary action to apply adhesives, among others. Technique is the most difficult category to describe precisely because, as is true in all other aspects of preparation, each situation encountered will demand a new or significantly modified technique. Work station setup that provides a stable base or mount for the microscope and work stage, a method of minimizing the possibility of fragment-loss, arrangement of tools
and maintaining work area cleanliness all contribute to the quality of microfossil preparation and may be the difference between a job well-done and a specimen essentially lost to science.

MAPPING AND LAB PREPARATION OF A CRETACEOUS (CENOMANIAN) TURTLE FROM THE WOODBINE FORMATION OF NORTH TEXAS: THE UNUSUAL CHALLENGES OF THE FLYING TURTLE PROJECT

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In the Fall 2010 field season, a complete turtle carapace and plastron, along with disarticulated postcrania, was discovered by a local student, excavated, and removed. This discovery comes from the Arlington Archosaur Site (AAS) which is a diverse fossil locality from the Late Cretaceous (95 Mya) Woodbine Formation of north Texas. The AAS occurs in an ancient delta plain that was situated along the southeastern interior seaway. The AAS preserves fossil components of a coastal ecosystem that includes: lungfish, crocodyliforms, dinosaurs (ornithopod and theropod), carbonized logs, and turtles. This specimen was embedded in a matrix of hardened, stratified peat with gypsum and carbonized wood integrated throughout. During transport to the fossil lab at the University of Texas at Arlington (UTA), this turtle, wrapped in a plaster jacket but not secured to the truck bed, was ejected (launched) from the bed of the transporting truck landing ‘pancake’-style on the roadbed below. The turtle was substantially damaged, but recovered and returned to the UTA lab. This incident became known as the ‘Flying Turtle.’ Once safely located in the lab at UTA, the plaster jacket was removed and an assessment of the external damage could be started. Due to the impact, several fissures had been opened on the exposed shell that demonstrated a downward and outward separation. The right side of the specimen, which possessed pre-discovery crushing damage, was further compromised and shattered. It was determined that the criteria for preservation should be systematic, accurately plotted, and completed with a goal of reconstruction of all of the elements of the specimen. Four planes of reference were established: the carapace, internal skeletal, plastron, and surrounding matrix. Lacking sophisticated equipment, the project proceeded using hand tools and dedicated volunteer effort. The resulting grid-coordinate mapping method devised for each plane as well as the fossil sorting and storage using commonly available materials represents a creative approach to preserving smaller complete specimens.

LOST AND FOUND: THE CHALLENGES, OPPORTUNITIES AND SIGNIFICANCE OF A FOSSIL RHINOCEROS SPECIMEN FOUND DURING A STORAGE CLEANING EVENT

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Museums and other institutions frequently have specimens hiding in field jackets for decades on back shelves in storage rooms. The collection facilities at the University of North Dakota (UND) are no exception, but have some extra challenges to overcome. First, UND has no staff fossil curator, which means this responsibility falls to the main paleontology professor and student volunteers. Second, is the lack of space for large vertebrate fossils, both in terms of cabinet space and jacket storage. As a result, specimens are stored in numerous places throughout the building. Third, UND has a history of hiring invertebrate paleontology faculty, which can result in vertebrate fossil specimens receiving less attention. These factors led to the peculiar situation of an Oligocene rhinoceros (UND-PC 16162), collected in 1966, being rediscovered in the North Dakota Geological Survey (NDGS) Wilson M. Laird Core and Sample Library in 2012. UND-PC 16162 is from the Brule Formation, White River Group, Stark County, North Dakota. Some elements of the specimen were collected with partial field jackets, while other elements were simply wrapped in newspaper. The specimen was placed into two wooden crates, brought back to UND and never prepared. The specimen was moved to the NDGS Core Library during the mid-1980s. The specimen remained in storage, with no record of the move, until 2012, when the crates were rediscovered in a cleaning effort at the NDGS Core Library. Once rediscovered, the search began for any field notes in order to determine the specific geographic location and stratigraphic horizon of the specimen. During this time, preparation of the fossil was undertaken with limited vertebrate fossil preparation equipment. To overcome the lack of equipment, a local orthopedic clinic was contacted and a surgeon volunteered the use of a spare cast cutter. A few UND paleontology students prepared the specimen and were able to involve one of the orthopedic doctors from the clinic in the process. Once prepared, the goal is to create a display with the specimen at the orthopedic clinic in order to promote paleontology, and positive interactions between the public and the paleontology program at UND. The rediscovery of the rhinoceros specimen is fortuitous in that the specimen represents Diceratherium tridactylum, which prior to this study was known in North Dakota only from specimens from the Arikaree Formation. UND-PC 16162 is the first D. tridactylum specimen recovered from the Brule Formation of North Dakota and could assist with refinement of the biostratigraphic zonation of the Brule Formation in North Dakota.

THE COLLABORATION OF INSTITUTIONS, AGENCIES, AND VOLUNTEERS FOR A “PAINLESS” EXCAVATION OF A LARGE GLYPTOTHERIUM FROM THE LATE BLANCAN OF ThE SAN SIMON VALLEY IN SOUThEASTERN ARIZONA

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In 2010 a partial carapace and associated skeletal elements of the glyptodont Glyptotherium texanum were discovered in the late Blancan fossil beds of southeastern Arizona. Glyptodonts are very common megafauna found in these highly productive fluvio-lacustropaludal deposits, yet the variable nature of their occurrence means that each excavation can present unique problems requiring novel solutions. This new specimen provided the opportunity for a highly successful excavation combining the skills and energies of many institutions, organizations, and individuals from across the state. The fossils were found in a relatively flat area near an unimproved road, allowing vehicle access. They were partially excavated, covered with a protective plaster cap, and reburied during excavations over the previous two years in preparation for a final large-scale extraction in March of 2012. For the final extraction, volunteers were assembled from the Southwest Paleontological Society, Northern Arizona University’s Geology Department, Museum of Northern Arizona, Bureau of Land Management, and local community. The division of labor was such that work was available for volunteers

of all skill levels, including pick-and-shovel digging, jackhammering, structural carpentry, and plaster jacketing. The first priority was to remove the backfill dirt and rock that had been used to conceal the Glyptotherium from view. Then, the depth and width of the trench surrounding the large (6' x 5' x 3') block were increased,
creating a navigable workspace and a ramp for vehicular access. Lumber and custom-bent rebar were incorporated into the plaster jacket to bolster its strength. A cradle/sled built from 4" x 4" and 4" x 6" lumber was set beneath the jacket through cross-tunnels and the block was locked into place with lumber shims. The sled facilitated removal of the pedestal and eliminated the need to flip the jacketed block. Matrix exposed from the pedestal removal was covered with plaster belly bandages slung along the underside to prevent material from falling out of the bottom of the block. An A-frame gantry was erected and fitted with a chain hoist, and the sled-borne block was carefully lifted away from the ground in preparation for final loading. Local volunteers donated their time and a semi tractor-mounted forklift to lift the block up and out of the pit, and onto a flatbed truck for transportation to the Arizona Museum of Natural History. Upon arrival at the paleontology laboratory, the two-ton block was lowered onto a custom-made metal-wheeled dolly with an industrial fork-lift.

STATE-OF-THE-ART DIGITAL DATA COLLECTION OF PALEONTOLOGICAL RESOURCES: COMPARING METhODS OF CAPTURE AND QUANTIFYING RESULTS OF 3D POINT CLOUD DATA
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During the last decade there has been a marked increase in the use of 3D data capture for the purpose of documentation, evaluation, and preservation of paleontological resources. Subjects can vary from an isolated tooth to an entire bonebed or from a single fossil footprint to an entire tracksite. The most notable methods for capturing 3D data of paleontological subjects are LIDAR and photogrammetry. Photogrammetric point cloud data (PPCD) contain both the exterior physical dimensionality of a subject and a high quality image texture registered precisely for each data point (x,y,z r,g,b file). Excellent results can be achieved from photogrammetry when the software solves for a robust camera calibration and when overlapping photographs are taken with proper geometry. Resulting PPCD can easily achieve submillimeter precision and be used to produce accurate rapid prototypes. Because of the computational power of the new generation of photogrammetric software, hundreds of photographs can be processed at once and stitched together allowing for the documentation of subjects "in the round." Advances to software and cameras allow this technique to be used on paleontological specimens of all shapes and sizes in the field, lab, and collections. Relatively low-cost and even free online services allow curators, collections managers and preparators to document material in their collections for research, management, and preparation purposes. Three-dimensional image datasets provide a permanent digital record of paleontological resources and is a non-destructive method to obtain 3D data assessment and can support the creation of a worldwide 3D digital data archive. These data can also lead to better science–based management decisions, which require that state-of-the-art methodologies be used in the documentation of paleontological resources in accordance with current paleontological legislation (PRPA). In addition, open source software is available for manipulating, scaling, and comparing point cloud data. This not only makes it affordable to use and compare 3D data obtained from various sources, but also makes it possible to conduct scientific evaluation of paleontological subjects. Several studies have been conducted comparing LIDAR and photogrammetry methods. Recent comparisons demonstrate that photogrammetric point clouds can be generated at a level that meets (or exceeds) the instrument specifications for the LIDAR unit used in the comparison. Once a PPCD is generated, analytical tools support direct 3D

comparison of anatomical features, such as individual skull bones or tracks within a trackway. Virtually every paleontologist has the basic equipment (i.e., scale bar and camera) necessary to successfully create paleontologically useful PPCD.

VERTEBRATE PALEONTOLOGICAL PREPARATION CORE COMPETENCIES AND TRAINING CURRICULUM: RESULTS FROM THE 2012 AUSTIN WORKSHOP

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A number of organizations responsible for the care of fossils call for preparation by individuals with specialized training (e.g., Society of Vertebrate Paleontology, National Park Service). At present, there is no consensus as to what constitutes a trained or qualified preparator. A writing workshop at The University of Texas at Austin (UT) Vertebrate Paleontology Laboratory was organized to address this gap between policy and practice. The goal of the workshop was originally to produce preparation standards documents and a curriculum for training and evaluating preparators. In practice, such a project exceeded the time constraints imposed by the one week available to the authors, thus the aim was shifted to defining the trained preparator and creating a model syllabus for teaching basic paleontology laboratory practices. Through this workshop, a team of five preparators drafted a competencies document encompassing the fundamental knowledge, skills, and abilities that typify capable fossil preparation and conservation. Fourteen competencies were identified and elaborated upon, covering areas such as: Critical Thinking, Understanding of Conservation Principles and Ethics, Understanding and Aptitude in the Use of Preparation Tools and Techniques, and Understanding and Use of Adhesives. The competencies were subsequently used to create a model syllabus for an introductory course in fossil preparation. The course is designed to provide students with an overview of the methods commonly encountered in paleontology laboratories, including preparation, conservation, molding, and casting, exposure to a range of tools and techniques, as well as an introduction to the relevant literature. The syllabus can be easily modified and adopted by other institutions and ensures that students are grounded in the basics of good preparation. The syllabus was also designed to be scalable, any element of it (e.g. molding) can be individually expanded to constitute a short workshop or fill an entire semester. This framework can then function as a broader curriculum for formal or informal training in paleontological preparation. Discussions during the workshop highlighted the need for continuing work toward training programs and standards in preparation. These competencies will provide a foundation for this continuing discussion of standards and best practices in vertebrate paleontological
preparation. The core competencies and syllabus may eventually be useful as a basis for certification of vertebrate fossil preparators, as well as provide guidance for hiring officials when writing job descriptions or evaluating applicants for preparation positions.