EVALUATION ON THE PROCEDURES FOR THE REMOVAL OF ADHESIVES USED FOR FOSSIL SPECIMENS FROM THE 19TH CENTURY EXHIBITIONS AT THE NATIONAL MUSEUMS OF SCOTLAND

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The oldest registered fossil specimen (1812.1.9902, 'petrified vermes') in the palaeontological collection of the National Museum of Scotland (NMS) dates back to 1812. The collection contains thousands of specimens with adhesives used in the 1800s. Today these adhesives have aged badly, having changed color and become brittle leading to some parts of the fossils falling apart, which makes their removal urgently needed. Unfortunately, little information is available on the origin or types of materials used during previous conservation treatments. To shed more light on these adhesives, testing with water, IMS (de-ionised alcohol), acetone, and peroxide were conducted on small areas to identify the best removal technique without damaging the specimens. Adhesives were softened by brushing the area with roomtemperature water and then removed mechanically with a scalpel. In parallel, a set of micro-samples (~1 mg) from several types of adhesives were removed for molecular analysis using Fourier-Transformed Infra-Red Spectroscopy (FT-IR). Samples of adhesive were selected based on their color, physical properties, and how they reacted during removal with water (as several samples displayed effervescence in contact with water). FT-IR analysis confirmed that the main consolidant used was animal glue, although gum, shellac, cellulose nitrate, and natural resin were found too. Former conservation (bothq materials and methods used) should be respected. By studying the materials used, it can help us to understand how they were applied and used in the past. Animal glue was used in the eighties for a reason: reversibility, adhesion to a variety of substances, stress resistant, different colors, easily obtained, flexible and elastic, and safety (as soluble in water). Research has proven that animal glue is lacking other important properties needed in conservation: not archival and it will deteriorate with time. We should be conscious and responsible for our actions as conservators. Future analysis might involve proteomic analysis. This work allows us to better understand how these types of collections were preserved in the past. The combination of conservation work and analytical techniques is particularly useful in identifying degraded organic materials. From the test results, it was observed that water was the most effective removal treatment. In general, the adhesive or consolidant used could be removed with water without damaging the specimens.

PALEO TOOLS VS. THE STONE COMPANY AIR SCRIBES: AN UNOFFICAL USAGE GUIDE

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After the recent acquisition of new air scribes in the preparation laboratory at The Western Science Center, both staff and volunteers have voiced inquiries regarding their identification and maintenance. Despite hands-on training as well as labels applied to drawers and tools, our preparators have sometimes confused tools made by PaleoTools and The Stone Company. This proposed graphical guide is meant to help with identification of the various types of air scribes available from PaleoTools and The Stone Company, as well as to address inquiries regarding their maintenance requirements. PaleoTools and Stone air scribes have the same application, and thus their appearances can be similar except for some important differences: PaleoTools scribes have no regulator attached to the plastic air hose; while, Stone air scribes have a regulator as well as a cloth covered air hose. While these two main brands of air scribes used in paleontological preparation are similar in appearance, they have different maintenance requirements. For example, PaleoTools requires oil be placed into the tool to inhibit rust and prevent seizure of the tool; in contrast, The Stone Company requires the o-rings on the needle as well as the ones located internally to be lubricated and then excess lubrication to be removed before reassembly. If these two maintenance requirements inadvertently get confused it could result in costly repairs or replacement of the tool. Additionally, there are PSI differences between the various tools to address, as well as the various applications for the different sizes of the air scribes. For instance, a Micro Jack (PaleoTools) or HW-322 (The Stone Company) is used for fine detail work, versus an ME-91 (PaleoTools) or HW-65 (The Stone Company) that would be applied when removing large amounts of matrix. This guide will be made available online to all institutions in the hope that it will supplement

essential hands-on training on the proper identification and maintenance of these important tools and the air compressors that power them.

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AN APPROACH TO USE CYCLODODECANE AS PROTECTION FOR MECHANICAL MATRIX REMOVAL OF A THEROPOD TOOTH

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At the Centro Paleontologico de Enciso (La Rioja, Spain), a theropod tooth, preliminary assigned to Carcharodontosauridae, was found half extracted from the matrix. First, a preliminary study of the state of conservation of the tooth was carried out and a proposal for the extraction of the tooth from the matrix was drawn up. The tooth has transverse cracks, so it was decided that was necessary to temporarily protect the tooth for its extraction. Given that the protection of the tooth must be temporary, the use of cyclododecane was proposed. Detailed photographs of the tooth surface were taken using a reflex camera and a Dino-Lite to evaluate the effectiveness of the protection of the tooth. The most effective way to apply cyclodecane was evaluated. Cyclododecane can be applied undissolved using heat or dissolved in an organic solvent. Thanks to the literature, it was possible to check how cyclododecane protects macroporous stone surfaces when it is applied directly with some heat, and dissolved at 80%, 60% and 40%. The tooth shows a low porosity, analysed by a quick test of a surface tension. Considering this feature and the results published in the literature, it was decided to apply cyclododecane dissolved at 40% in the organic solvent (white spirit) and at 60% in the area with the most damage, on Japanese paper to maximise reversibility and add an extra layer of protection. After removal of the tooth from the matrix, a detailed visual analysis was performed again using Dino-Lite to check the correct protection by this method.

EXPLORATORY RETRODEFORMATION METHOD ON COMPRESSED FOSSILS USING SLICED SURFACE CONTOURS: A CASE STUDY ON THE OBLIQUELY COMPRESSED METAPODIALS OF AN EGYPTIAN TITANOSAURIAN SAUROPOD DINOSAUR

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A pervasive issue in paleontology is the degree of preservation the fossil experiences from burial to excavation, including breakage, crushing, and deformation. One type of deformation that has the potential to obscure key anatomical features is compression, where a fossil experiences a reduction in volume and/or shortening along a particular axis or axes. Recent advances in replicating fossils using 3D computer models (e.g., via CT-scanning or photogrammetry), the process of retrodeforming the fossil becomes safely attainable. Retrodeformation on 3D models can be approached in many ways, including localized warping, correction using bilateral symmetry, or the use of landmarks to adjust the model, each seemingly to address specific deformation problems. Here, we explore a computational retrodeformation method for fossils that have undergone drastic compression in their preservation. We aim to see if any conspicuous features may be "decompressed" from the process to better understand the original anatomy.

MB.R.Vb-621-640 is a partial sauropod dinosaur recovered from the Campanian Kharga Oasis, Egypt. The specimen preserves several dorsal vertebrae and various elements from both appendicular girdles. Most recovered elements have been taphonomically compressed. Six metapodials have been recovered and served as our test fossils as these elements have all been obliquely compressed along the long and dorsoventral axes. 3D models were

constructed from CT scan data. Since metapodials tend to be boxlike in their overall morphology, we used the proximal and distal surfaces to approximate the orthogonal plane from the direction of compression. Once the angle of the plane was established, numerous slices of the model were taken in consistent intervals along the long axis to demarcate the original dorsoventral axis and obtain surface contours. We then globally warp the element until these sliced contours were perpendicular to the anchored long axis. From there, these contours can be stretched along the certain axes by different factors to decompress the element. Results revealed previously obscured anatomies such as foramina seemingly more canal-like, subtle ridges seemingly more pronounced, and more curved distal condyles. Overall, this decompression technique yielded augmented metapodial models that are more comparable to other titanosaurians. We plan to apply this method to undeformed specimens to establish biologically relevant baselines for this method.

PREPARATION OF THE NIEUWDONK COLLECTION (BERLARE, BELGIUM): A WINDOW INTO THE LAST GLACIAL AND INTERGLACIAL FAUNAS OF THE FLEMISH VALLEY

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The Nieuwdonk collection comprises a unique and diverse assemblage of Pleistocene mammals from the Flemish Valley. It covers an important part of Belgium's Quaternary fossil record and offers a window into the regional biodiversity of the last Ice Age and Interglacials (10 ka–126 ka). Within the collection, various remains of roughly 10 different taxa are represented, including herbivores and carnivores. Although sampling bias occurred during collecting in the 1970s, it still counts as the most complete Pleistocene collection originating from this classic location within the Scheldt basin. After being privately owned for the last 45 years, the Nieuwdonk collection was recently acquired by the municipality of Berlare (province of East Flanders). This acquisition also encloses the transition from private to public property for which an open-access database and inventory was set up. Prior to the inventorization, a thorough restoration was mandatory for approximately 90 to 95% of all specimens.

As a result of years of poor storage conditions, almost all of the specimens suffered from desiccation and fragile cancellous bone tissue. Another important hazard was the visual propagation of pyrite disease, affecting around 40–45% of all pieces. Some items underwent previous restoration attempts with irreversible products such as epoxy glues, plaster, Arabic gum, and other unknown coatings.

The restoration project was set up during the corona pandemic with restrictions imposed by the Belgian government on daily activities. Because the collection needed treatment on site, a temporary restoration laboratory was constructed in the concert hall of the Cultural Center of Berlare. The restoration was carried out in a way that allowed the restoration team to perform their activities whilst the public could witness live preparation. This unique corona proof setting allowed for large social outreach and interest by local and national press. The Nieuwdonk collection will be accessible for scientific research and permanent museal display in the near future. This project is a small but important step towards the valorization of important paleontological heritage on a regional scale.

APPLICATION OF FULL COLOR 3D PRINTERS TO FOSSIL PREPARATION, RESEARCH, AND COLLECTIONS MANAGEMENT AT THE UNIVERSITY OF WYOMING

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Full-color 3D printers (3D printers that can print photorealistic 3D models) have opened up an exciting set of opportunities to improve and assist in paleontological endeavors including applications to collections management, fossil preparation, and to scientific research. Compared to traditional molding and casting techniques, 3D printing of fossil models in full color eliminates time intensive molding and casting work, eliminates storing molds, eliminates cast painting, allows for easy scaling of specimens to be larger/smaller, and allows for printing in transparent colors for visualizing internal detail. Models suitable for 3D printing can be generated from a variety of scanning technologies including, photogrammetry, structured light scanning, laser scanning, and computed tomography (CT). However, the degree of photo-like similarity compared to the original and the resolution of the model is, in part, dependent on the scanning and imaging resolution as well as scanning type.

The University of Wyoming (UW) Geological Museum has begun utilizing a full color Stratasys J750 polyjet 3D printer housed at the UW Innovation Wyrkshop, part of the Engineering College. The J750 is capable of printing models with over 360,000 colors combinations (CMYK), at up to 14-micron resolution, with water-soluble supports, and at a cost of ~$15 per print hour. Here we present examples demonstrating the used the J750 in paleontological applications with the goal of inspiring other institutions to consider using color 3D printers. We highlight the use of 3D color prints as aids in fossil preparation, particularly where bones are in close association or hidden. The ability to generate a photorealistic print of the specimen at several stages during preparation documents important bone associations that are likely lost during preparation. Furthermore, segmented CT scans of specimens with the matrix printed as clear and bones printed as semi-transparent offers unique insight on preparation and research projects. We provide an example where we generated 3D color prints of bones prior to destructive analysis to capture original bone morphology. Lastly, we highlight the utility of 3D color prints in specimen display, loans, and sharing of fossil specimens between researchers, museum, and institutions.