Return of the Dinomummy

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'Dakota' is back on exhibit! After arriving at the North Dakota Heritage Center & State Museum (NDHC) on a cold day in February of 2008, 'Dakota' the dino-mummy has had a complicated history of exhibition (Person, 2019). The North Dakota Geological Survey (NDGS) has always tried to balance the desire to have 'Dakota' on public display for educational purposes with the ongoing need for additional preparation and research of the specimen. For a specimen to be understood and appreciated, both things must occur, and it is always tricky to balance those opposing goals.

'Dakota' was collected in five jackets of varying sizes that together contain nearly the entire skeleton: a large jacket containing much of the body, two jackets (one large, one small) that contain most of the tail, one jacket containing most of the right arm, and one jacket containing the left foot. Immediately after arriving in Bismarck on that February day from the NASA laboratory in southern California where it was CT scanned, work began on the preparation of the tail (fig. 1). Nearly all of the tail skin was buried under rock that needed to be removed. The very nature of skin adds a wrinkle to the preparation process. Not only is there very little fossilized skin known in the fossil record to compare to, but skin can be wrinkled, it can have folds, and after death can be torn, making it nearly impossible to predict where the skin will be present within the rock. Due to the hardness of the encasing rock and the difficulty of removing it from the skin, preparation work on 'Dakota' is a very tedious and time-consuming process.

Figure 1. Before and after images of the tail of 'Dakota.' The image above was taken during the spring of 2008, shortly after arriving in Bismarck. The image below was taken during the spring of 2020, when final preparation of the tail was taking place.

After removing a great deal of rock from the skin on the tail, it and the right arm were placed on exhibit in the NDHC during the summer of 2008 (fig. 2)(Hoganson, 2008). This would be the first time 'Dakota' was exhibited anywhere in the world. While the tail was being exhibited, work to remove rock from the even larger body block began. In June of 2009 'Dakota' went international and traveled to Chiba, Japan for a special exhibition (fig. 3). All five pieces of 'Dakota' were shipped to Japan for the exhibit, and this marked the first time the entire skeleton was placed on public display. A short three months later, 'Dakota' was back in Bismarck. Not long after that, the tail and right arm of 'Dakota' were back on

Figure 2. The first iteration of the 'Dakota' exhibit at the Heritage Center. This exhibit included the tail and arm sections.

Figure 3. 'Dakota' at the exhibit hall in Japan being arranged for exhibition. The tail can be seen in the foreground, while the body block is being manipulated with a forklift in the background.

exhibit at the NDHC, and preparation work resumed on the body block. For the next four years a small team of talented preparators and paleontologists spent thousands of hours working on the body block. Rock was meticulously removed from the surface of the skin and bones (where skin was not preserved) with air powered tools called air scribes, removing millimeters of rock at a time.

In October of 2012 all of the galleries in the NDHC were closed to prepare for the construction of the building expansion. All of the exhibits were removed and placed in storage throughout the building so work could be done on the four new galleries that would be included in the expansion. Though 'Dakota' is a significant specimen, the design of the new Geologic Time gallery did not include a place for 'Dakota' because at that time it was unknown where the specimen's permanent home would be. Instead, a large spot was reserved for 'Dakota' in the hallway just outside of the Geologic Time gallery under a skylight that would "spotlight" the specimen. While construction of the building expansion began, work continued on the removal of rock from the large body block in the basement of the NDHC.

Figure 4. Arranging 'Dakota' into its resting place in 2013 before the expansion at the NDHC opened to the public. All the pieces of 'Dakota' were arranged anatomically in this exhibit around the heaviest and largest piece, the body block.

In June of 2013, in preparation for the reopening of the NDHC's four new galleries, 'Dakota' was placed on exhibit in the hallway outside the Geologic Time Gallery (fig. 4). All the pieces of 'Dakota' were placed in the exhibit and arranged anatomically, allowing the viewer to see how 'Dakota' looked at the time of fossilization. When the expanded NDHC opened in July of 2014, visitors were in awe of the amount and quality of skin present on the fossil. Over the next few years, hundreds of thousands of visitors stood in amazement at this large block of rock in front of them containing 'Dakota' the dino-mummy.

As more people saw 'Dakota' word began to trickle in that not everyone quite understood exactly what they were looking at. There was no signage or written interpretation of the skeleton which made it difficult for most visitors to even picture in their minds what was on exhibit before them. There were no signs labeling landmark pieces of the skeleton (leg, tail, etc.) so being able to orient the pieces you were looking at in a meaningful way was difficult (fig. 5). This confusion was an unfortunate result of the uncertainty surrounding whether the NDHC would be the permanent home of 'Dakota.' Well-designed exhibits are expensive and require a lot of staff time to develop. With the future, permanent resting place of such a beautiful specimen in question, we were reluctant to spend thousands of dollars on an exhibit that might leave at any time. Thankfully, behind the scenes, negotiations were ongoing to secure the future of 'Dakota.' In December of 2016, an agreement between the Marmarth Research Foundation (the owner of 'Dakota') and the State of North Dakota was reached that transferred ownership of 'Dakota' to the state. That agreement cemented North Dakota, the place 'Dakota' had rested for over 66 million years, as 'Dakota's permanent home.

Once the forever home of 'Dakota' was established, it was time to upgrade the current exhibit. There was a need to tell a cohesive story about 'Dakota,' and to help visitors understand what they were looking at by providing meaningful and understandable signage and interpretation. To do this, we needed to start over and completely redesign the 'Dakota' exhibit. Exhibit design decisions sometimes mean refining the story you want to tell. In the case of 'Dakota,' that story needed to focus on the most important part of the specimen: the skin. 'Dakota' is a type of duck-billed dinosaur called *Edmontosaurus*. There are thousands upon thousands of bones from this dinosaur species recovered by paleontologists over the decades, now spread across the many museum collections around the nation and the world. The skeleton of this animal is very well known and understood. To be fair, 'Dakota' also isn't the first dinosaur to ever be discovered with preserved skin. There are a handful of specimens from a variety of different dinosaurs known with preserved skin, or impressions of skin. There is even one on display at the American Museum of Natural History in New York City that is the same kind of dinosaur as 'Dakota' is, an *Edmontosaurus*. What makes 'Dakota' stand out in a unique way is the quality and amount of skin preserved on the skeleton and what it can tell us about how 'Dakota' looked, lived, and possibly how it died.

Figure 5. The anatomical arrangement of 'Dakota.' The large body block, two sections of tail, the foot, and the arm are all visible in this image.

In October of 2018 the right arm and left foot of ‘Dakota’ were removed from the exhibit so that additional work could be done to remove more rock covering portions of the preserved skin. These two pieces were removed first for two reasons. 1) We wanted to maximize the amount of visible skin on the arm and foot. In order to do that, a great deal of time needed to be spent on rock removal from this part of the skeleton. 2) A special mount needed to be made to display the arm safely. In order to make a custom mount for the arm, a duplicate needed to be made. Due to the fragility and rarity of the specimen, keeping the arm here at the NDHC was the best option. In this case we decided technology was our safest and quickest option to accomplish this goal. We opted to have the arm 3D scanned and printed and then have the custom mount made from the 3D print. This would eliminate the possibility of damage or loss of the specimen during transport or during the mount making process. In November of 2019 all pieces of ‘Dakota’ were 3D scanned in high resolution. Those scans were then used to 3D print a reproduction of ‘Dakota’s’ arm, which was used to make the first version of the specialized mount for the new exhibit.

Early in 2019 the large section of tail was also removed from exhibit. The tail did not require much additional preparation work but would benefit from having small areas of rock removed from the skin and having some fractured areas stabilized. These small areas of rock had been especially difficult to remove when past work had been done and it seemed that the time had come to finally uncover the skin that was beneath. In October of the same year the last piece of 'Dakota' that was on exhibit, the body block, was removed. Weighing more than a ton, the body block was slowly and painstakingly wheeled to its new home in the fossil collections. It is still viewed by visitors on behind-the-scenes tours of the paleontology labs, but this portion of ‘Dakota’ was not included in the new exhibit as it needs much more work before it is ready for permanent exhibit. In December of 2019, less than 10 weeks before ‘Dakota’ was scheduled to go back on exhibit, the right hand was taken to The University of Texas at Austin to receive a CT scan where we hoped to get images of the arrangement of bones in the hand and how they related to the morphology of the skin on the outside.

As we all know, the appearance of COVID-19 throughout the world put everything on hold, including the new ‘Dakota’ exhibit. The exhibit opening was postponed from the spring of 2020 until the fall of 2020, then to the spring of 2021, and finally to October of 2021. Two events were planned for the opening of this new exhibit. A ticketed, evening event meant to be a “sneak peek” at the exhibit that would also include a scientific talk and tour of the paleontology exhibits and labs; and a ribbon cutting event during normal museum hours that would also include scientific talks, tours, and a viewing of a popular children’s movie, The Land Before Time. However, two nights before the scheduled evening event, disaster struck. A large overnight rainstorm covered the Bismarck-Mandan area dropping a substantial amount of rain in a short amount of time. The rain proved to be too much for the roof drainage of the NDHC and a large leak poured gallons of rainwater into the Geologic Time gallery (fig. 6). Thankfully, the 'Dakota' exhibit was not impacted, but plans for the two upcoming events needed to be slightly modified, eliminating any use of the Geologic Time gallery. A few days later the updated exhibit opened to the public as scheduled. This improved exhibit does a far better job of interpreting ‘Dakota’ for the visitor and highlighting what makes ‘Dakota’ so special: the skin (fig. 7).

Figure 6. A cleaning crew uses a high-powered vacuum to remove water from the carpets in the Geologic Time Gallery.

Figure 7. An image of the skin from the tail of 'Dakota.' These scales are approximately the size of a pencil eraser.

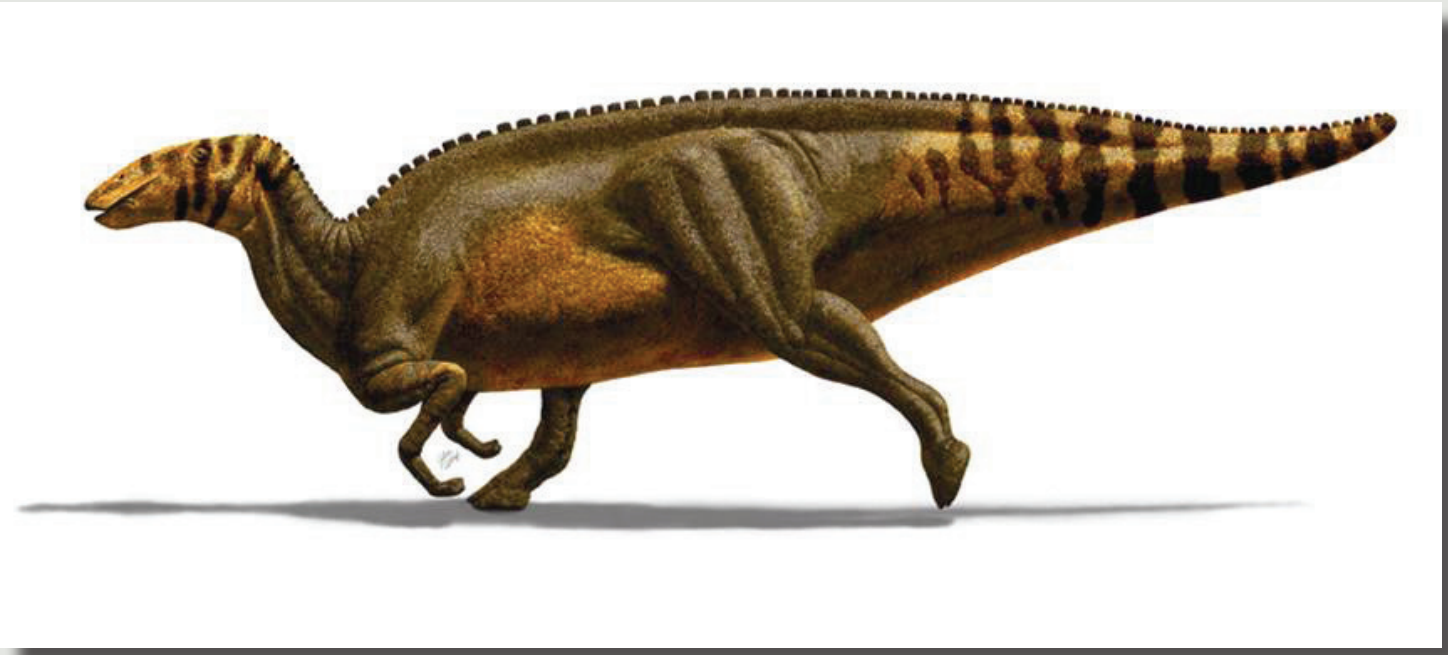

Figure 8a. 'Dakota' by Julius T. Csotonyi

The new exhibit tells a more cohesive story of 'Dakota.' From its discovery and preparation to paleontologists evolving understanding of *Edmontosaurus* and dinosaurs in general. Features on the skin that give us a peek into what the world of 'Dakota' might have been like are illuminated and discussed. There is even an opportunity to touch 'Dakota.' A 3D print of the skin from 'Dakota's tail is available to be touched, giving the viewer an opportunity to be as close as humanly possible to know what it felt like to pet a dinosaur. If you live in the area or are passing through Bismarck, I highly recommend stopping by the museum to view this truly unique specimen.

Artwork plays a significant role in the exhibition of fossils. Humans depend heavily on their vision to understand the world around them. Good artwork helps the viewer to understand exactly how an animal looked and what its environment was like. Even if there are no modern analogs to compare them directly to, when trying to explain extinct animals paleontologists can take

Figure 8b. 'Dakota' by Alain Beneteau

Figure 8c. 'Dakota' by Jessica Rockman

similar parts of different animals and put them together into a kind of paleontological chimera; in this case, an animal we call *Edmontosaurus*. 'Dakota' has been the focus of artwork from at least 5 different artists over the years. The first artist to illustrate 'Dakota' was Julius T. Csotonyi (fig. 8a). This artwork was used in the early exhibition of 'Dakota' at the NDHC. That artwork

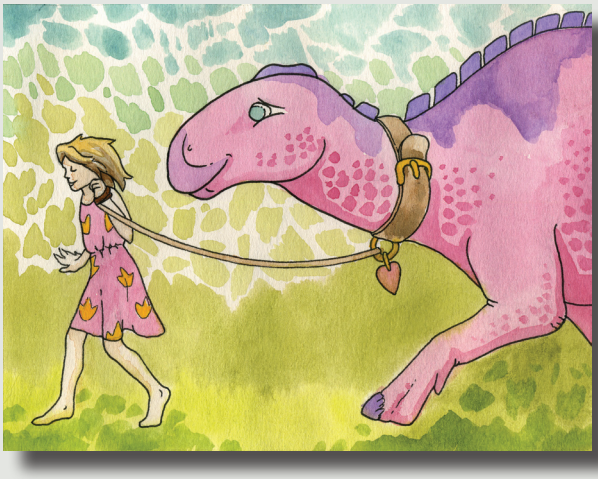

Figure 8d. 'Dakota' by Becky Barnes

was followed by Alain Beneteau who placed 'Dakota' in a reconstructed environment, making the animal seem more realistic (fig. 8b). After 'Dakota' was removed from exhibit in 2018 a placeholder image for 'Dakota' was created by NDHC digital artist Jessica Rockman (fig. 8c), letting visitors know where 'Dakota' had gone and when it would return. An NDGS publication was written and illustrated by NDGS paleontologist Becky Barnes and was meant to promote and educate the public about 'Dakota' (Barnes, 2020) (fig. 8d). This publication was intended to be published in time to be distributed for 'Dakota's improved exhibit opening, then scheduled for early 2020. A second set of illustrations was also created by Barnes and will be used in an upcoming scientific publication by Drumheller and others, explaining the preservation and fossilization of 'Dakota.' The final artist to focus on illustrating 'Dakota' is Natee Puttapipat, who created a reconstruction of 'Dakota' for use in the new exhibit. That image incorporates all of the most recent knowledge about 'Dakota' and can be seen at the NDHC, both on the interpretive panels around the exhibit and also on a banner next to the exhibit that is scaled to the size 'Dakota' was when it died (fig. 8e).

'Dakota' has proved to be an important specimen, not only for the NDGS and the NDHC, but for North Dakota and the science of vertebrate paleontology. 'Dakota' has highlighted the importance of the fossil record of North Dakota in interpreting the Late Cretaceous time in North America, and it has brought visitors and scientists from around the world to see and study this amazing specimen. The full impact that 'Dakota' has had on us is yet to be fully understood, but over time I hope future generations will appreciate all that 'Dakota' has helped to illuminate.

References

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Figure 8e. 'Dakota' by Natee Puttapipat