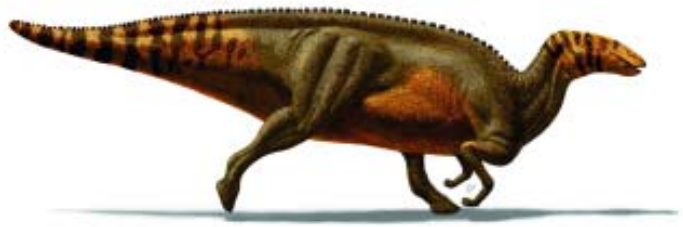
DAKOTA: A MUMMIFIED DINOSAUR

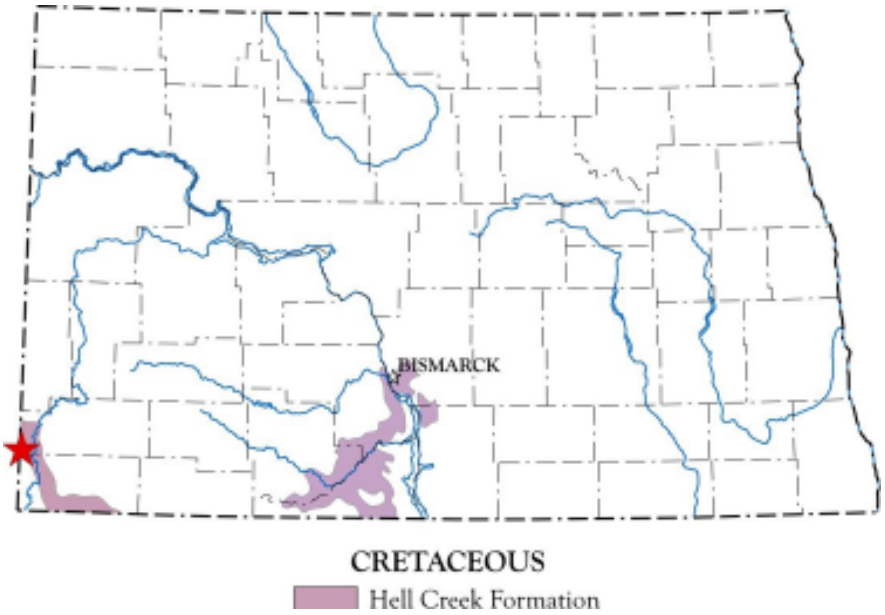
By John W. Hoganson

In 1999 Tyler Lyson, a 16-year-old high school student and budding paleontologist, discovered a paleontological wonder on his uncle's ranch near Marmarth, North Dakota. Tyler had found the nearly complete skeleton of a duck-billed dinosaur known as *Edmontosaurus*. Remarkably, this skeleton was "mummified" - its skin was fossilized. Preservation of skin occurs rarely and only a few mummified dinosaurs have ever been found. Tyler found a few vertebrae weathering out of the Late Cretaceous (about 67 million years old) Hell Creek Formation sandstone during this initial discovery. He realized that this could be an important find but was not prepared to launch a major excavation at the site until 2004 when he, and a team of volunteers, spent 8 weeks excavating the skeleton. In 2005, Tyler established a research partnership to study the fossil with paleontologist Dr. Phillip Manning at the University of Manchester in England. The excavation was completed in 2006 with financial support from National Geographic. The dinosaur was named Dakota.



Painting of Dakota by, and courtesy of, © Julius T. Csotonyi.

It was at that time that I was visiting Tyler regarding another matter and he said that he had something to show me. We drove to the rugged badland area west of Marmarth where Dakota was discovered. Dakota was there, already wrapped in a massive plaster field jacket, ready for transport to Marmarth. Tyler was beaming. It was my first glimpse of what was has become one of the most significant Hell Creek dinosaur fossils yet found. I thought back about the time that I first met Tyler when he was a young boy, and I was collecting fossils in the Marmarth area. Many children have a fascination with prehistoric animals, particularly dinosaurs, but I realized at that first meeting that Tyler had more than a passing interest in fossils. Ranse and Molly, Tyler's parents, had already converted the family garage to a paleontology laboratory with fossil preparation tools and a microscope to cultivate Tyler's interest. Tyler is now a doctoral student at Yale University studying paleontololgy.



Map of North Dakota showing the Hell Creek Formation and location of Dakota discovery. Graphic by Brian R. Austin, SHSND.

Dakota lived in western North Dakota during the Late Cretaceous when western North Dakota was a vast deltaic coastal plain. Sediments eroding from the rising Rocky Mountains were carried by rivers and streams and deposited in that area. These sediments, now turned into sandstone, siltstone, and mudstone, are called the Hell Creek Formation. At that time, North Dakota's climate was warm-temperate to sub tropical. The woodlands, ponds, and swamps that existed here provided abundant habitats for many kinds of plants and animals, including several species of dinosaurs. The Hell Creek Formation is the only rock formation in North Dakota that contains abundant dinosaur remains. The fossils of about 14 species of dinosaurs, including *Triceratops*, *Tyrannosaurus rex*, and *Edmontosaurus*, have been recovered from the Hell Creek Formation in North Dakota.

Excavation of Dakota from the Hell Creek Formation near Marmarth. Photo by Doug Hanks

The duck-billed (hadrosaurid) dinosaur *Edmontosaurus* was one of the common herbivores that inhabited North Dakota at the end of the Cretaceous. Hadrosaur snouts were elongated and flattened and the front of their jaws had no teeth resembling the bill of a modern duck, hence the popular name "duck-billed dinosaur." *Edmontosaurus* was one of the largest hadrosaurids, growing to forty feet long and weighing about four tons. Dakota was slightly smaller than this and was likely a sub-adult. It had pillar-like legs, powerful ankles and bony tendons along its backbone that helped support the animal as it walked. Each foot possessed three broad, widely spaced toes ending in hoof-like nails. Its arms, with three fingered hands, were much shorter than its legs, and it was bipedal.

The jaws of *Edmontosaurus* contained batteries of hundreds of small interlocking teeth, which formed grinding surfaces for eating coarse vegetation. These teeth acted like a rasping file and could pulverize plant material, such as conifer needles, twigs, and cones. Worn teeth were continually replaced by new ones throughout the life of the animal. The horny keratinous beak on the front of its jaws enabled *Edmontosaurus* to crop the tough vegetation before being processed by its teeth. It is likely that *Edmontosaurus* was prey of *Tyrannosaurus rex* and perhaps other meat-eating dinosaurs because *Edmontosaurus* bones have been found with bite and gnaw marks. An incredible *Emontosuarus* skeleton in the Denver Museum of Natural History has a healed bite mark on its tail that has been attributed to *T. rex* - it apparently escaped its attacker.

In North Dakota, fossils found on private property belong to the land owner. I am pleased to write that Tyler's uncle, Mike Sonsalla, donated Dakota to the Marmarth Research Foundation. The Marmarth Research Foundation, a non profit organization, was established by Tyler for the excavation, preservation, and study of dinosaur and other fossils from the Marmarth area. In December 2007, Tyler and I met to discuss the possibility of housing Dakota at the North Dakota Heritage Center in Bismarck. Tyler wants to keep Dakota in North Dakota for study and display. We arranged that Dakota would be prepared, that is, the rock matrix removed from the fossil; at the NDGS Johnsrud Paleontology Laboratory at the Heritage Center and that the fossil would also be displayed at the Heritage Center until an exhibit facility is built in Marmarth. When that happens Dakota will be sent home to Marmarth. Dakota will be on exhibit in the Heritage Center for at least three years, but may travel to other institutions for temporary display.

Dakota arrived in Bismarck in February 2008 in a semi-trailer. The skeleton was excavated in three large blocks - one containing the tail, one containing an arm, and one containing the rest of the skeleton. The blocks were shipped to us from Canoga Park, California where they had been CT scanned at the huge Boeing/NASA CT scan facility. Ordinarily airplane and space shuttle parts are scanned there. Two of these blocks, the tail and skeleton, were on the truck. The arm was being prepared by Stephen Begin, with the Marmarth Research Foundation, in Wisconsin. The tail block weighed 1,700 pounds and the block containing most of the skeleton weighed 8,000 pounds. Needless to say I had to rent the largest forklift I could find in Bismarck to lift the blocks off the truck and move them into the Heritage Center. We hired two people, Amy Sakariassen and Amanda Person, to work with NDGS paleontolgists Jeff Person and Becky Mink, on the fossil. Stephen Begin and Doug Hanks, also with the Marmarth Research Foundation, have visited the Heritage Center to help with preparation. The preparation work has been funded by National Geographic and the NDGS.

CT scanning the skeleton of Dakota encased in Hell Creek Formation sandstone at the Boeing/NASA CT scan facility in Canoga Park, California. Photo by Phil Manning

Preparing the tail of Dakota at the NDGS Johnsrud Paleontology Laboratory at the North Dakota Heritage Center. Photo by Brian R. Austin, SHSND.

Phil Manning, with Tyler Lyson, has assembled a multidisciplinary team of scientists to study this important fossil. It has already been determined that the tail of this species of dinosaur was about 25% larger and that it could run faster, perhaps up to 28 miles per hour, than previously thought. One of the most fascinating attributes about Dakota is the well-preserved skin, which exhibits scales of varying sizes. The research team is currently analyzing the CT scan data. Skin structure and morphology, "soft-tissues" analysis, search for biomolecules, isotope analysis, etc. is also under way. Refinement of Dakota locomotion studies is also being worked on. Several manuscripts based on research being done on Dakota have already been submitted for publication. Two books by Phil Manning about Dakota have already been published: the children's book "Dinomummy, the life, death, and discovery of Dakota, a dinosaur from Hell Creek" and "Grave secrets of dinosaurs: soft tissue and hard science." A National Geographic documentary about Dakota called "Dino Autopsy" was released a few months ago and can be seen occasionally on the National Geographic channel. This documentary is being revised and will include images of the skin revealed here at the Heritage Center. That documentary will air later this year.

On June 14, 2008, an exhibit featuring Dakota was unveiled at the North Dakota Heritage Center in Bismarck. The State Historical Society of North Dakota and the NDGS collaborated on this exhibit effort. The State Historical Society exhibit team, Chris Johnson, Genia Hesser, Adam Bradshaw, and Brian Austin, as with the other prehistoric life exhibits that we have worked on with them, did an outstanding job of providing a visually striking and understandable exhibit for public viewing. Roger Johnson, North Dakota Commissioner of Agriculture, gave the keynote presentation at the ceremony. Other speakers included Merl Paaverud, Superintendent of the State Historical Society of North Dakota; Al Jager, North Dakota Secretary of State; Diane Larson, State Historical Society Board; Lynn Helms, Director of the Department of Mineral Resources; Ed Murphy, State Geologist of North Dakota; Barbara Moffet, National Geographic; Doug Hanks, Marmarth Research Foundation; and John Hoganson, North Dakota State Paleontologist. The ceremony was followed by a day-long symposium featuring Dakota team researchers, led by Phil Manning, speaking about various aspects of their studies. Throughout the day, children's activities were provided by the education division of the State Historical Society. Book signings by Phil Manning and John Hoganson completed the day. The event was an overwhelming success with over 1,200 people visiting the Heritage Center that day. Beth Campbell, as usual, did an outstanding job coordinating the event.

Ribbon-cutting ceremony for the Dakota dino mummy exhibit. Photo by Brian R. Austin, SHSND.

People examining the Dakota dino mummy exhibit.