



EARTH

Fossils: Vertebrates

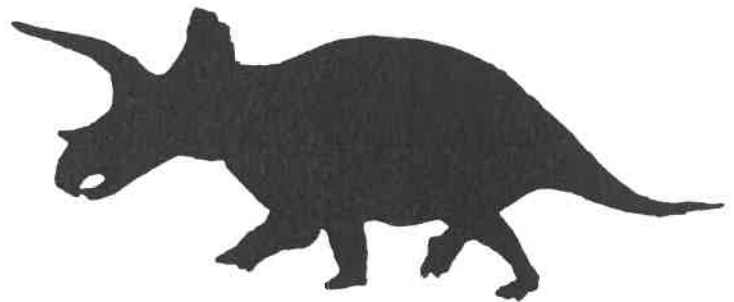
TRICERATOPS

(*Triceratops horridus*)

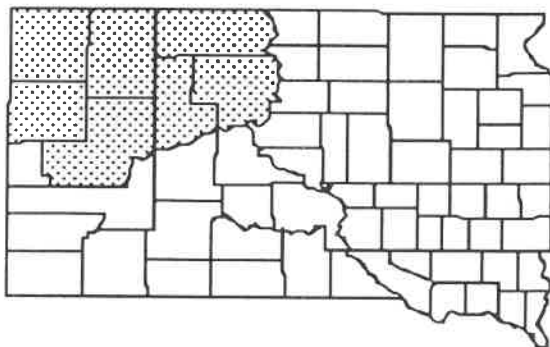
State Fossil of South Dakota

Description

This dinosaur species was first known from a single partial horn, which Marsh named *Bison alticornis* in 1889. John Bell Hatcher, a collector in Marsh's employ, traced the original horn to eastern Wyoming and proceeded to collect many skulls for Marsh. Marsh, Hatcher and Lull wrote a book in 1907 on all horned dinosaurs known at that time. Today, that book remains an important document for those studying horned dinosaurs. The current scientific name, *Triceratops*, means three-horned face.



The three distinctive facial horns and the frill-like fan on the back of the skull make this dinosaur species one of the most widely recognized fossils. The animal's large size - up to 8.7 yards (8 meters) long and about 8,800 to 11,000 pounds (4,000 to 5,000 kilograms) in weight for adults - combine to make this dinosaur fossil quite impressive.



Fossil Distribution

Distribution

Triceratops is known from eastern and western Wyoming, eastern Montana, southwestern North Dakota, central Colorado, Alberta and Saskatchewan in Canada, and northwestern South Dakota. In South Dakota, *Triceratops* specimens have been found in Harding, Perkins,

Corson, Dewey, Ziebach, Meade, and Butte counties.

This species is known by at least 50 complete or partial skulls and some partial skeletons. The skulls demonstrate a wide range of features, which is in part due to individual genetic variation, the oddities of preservation, and, perhaps, sexual differences. No *bonebeds* have been found and juvenile material is not common.

How Old Are Triceratops Fossils?

The South Dakota *Triceratops* fossils have been found in rocks from the Hell Creek Formation in the northwestern part of the state. These fossils are from late in the *Cretaceous* Period, and are about 66 to 68 million years old.

Natural History

Our knowledge of the natural history of fossil creatures comes from the study of the geological deposits in which the specimens were found and from analyses of the anatomical structures of the fossilized remains.

The *sedimentary* rocks that preserve the bones of *Triceratops* are typical of coastal lowlands similar to that ranging from the present southeastern Atlantic Coast and the Gulf Coast of the United States. Bald cypress and sequoia-like conifers, ferns, *cycads*, palms, and many shrubs of flowering plants dominated this environment. The shrubs and ferns may have been the primary sources of food for *Triceratops*.

The *Triceratops* skull was very distinctive, with two brow horns and a single nasal horn. The latter was considerably shorter than the brow horns. The eye socket was very large, suggesting that sight may have been an important sense to the animal. The eyes were directed to the sides of the animal to widen the field of view.

In adults, the back of the head had a fan-like frill of very thick bone that served to protect the neck and give the animal the appearance of being much larger when viewed from the front. Powerful jaw-closing muscles may have attached to the frill as well. The neck *ligaments* and muscles were attached to the base of the frill above the opening for the spinal cord. The outer edge of the frill had small triangular bones to give the frill a saw-toothed appearance. Skulls ranged in size from very small baby skulls up to adult skulls 2.7 yards (2.5 meters) in length.

The beak, or mouth, of the animal was very well developed to aid in the attachment of a tough turtle-like beak material. This tough beak permitted *Triceratops* to snap off tough vegetation. The cheek teeth were crowded together to form a scissor-like structure that could slice most vegetation that the animal encountered.

These animals had 10 neck *vertebrae*, 12 *vertebrae* between neck and pelvis, 10 *sacral vertebrae*, and perhaps as many as 50 tail *vertebrae* (see Figure 1). The tail probably was held up off the ground.

Triceratops were obligatory *quadrupeds*, that is, their anatomy was such that they needed to use all four legs in order to walk. The front legs were not completely drawn under the body, but the rear ones were. The front feet had five toes each. The *pelvis* was a massive structure, firmly attached to 10 *sacral vertebrae*. The hind legs were very robust, longer than the fore legs, and each hind foot had four functional toes.

Significance

Triceratops is one of the most famous species of dinosaurs known, and skeletons of the species are found in most *paleontology* museums. A nearly complete *Triceratops horridus* skull was found in Harding County, South Dakota in 1927. However, the species was not proclaimed the State Fossil of South

Dakota by the legislature until February 14, 1989. The Harding County specimen is on display in the Museum of Geology at the S.D. School of Mines and Technology in Rapid City.

Conservation Measures

Fossils are documents of the past and are valuable to museums for current and future study, and as a resource for the public. People are encouraged to participate with museums in protecting South Dakota's fossil heritage. Often, much of the valuable information about a fossil is lost if the specimen is removed from the rock deposit before accurate records are made. In addition, amateur collectors could inadvertently damage specimens when trying to remove them from sur-

rounding rock and soil. If you locate any significant fossil deposits, contact the S.D. Museum of Geology, before disturbing the site (see address below).

Collectors must have permission from landowners in order to look for and collect fossils from private land. It is illegal to collect fossils from Tribal lands without permission from the Tribal authorities. For permission to fossil hunt along highway right-of-ways, contact the nearest Department of Transportation Office (see the Rose Quartz fact sheet for addresses). Regulations on public lands vary. People always should contact the land manager before disturbing geological formations.

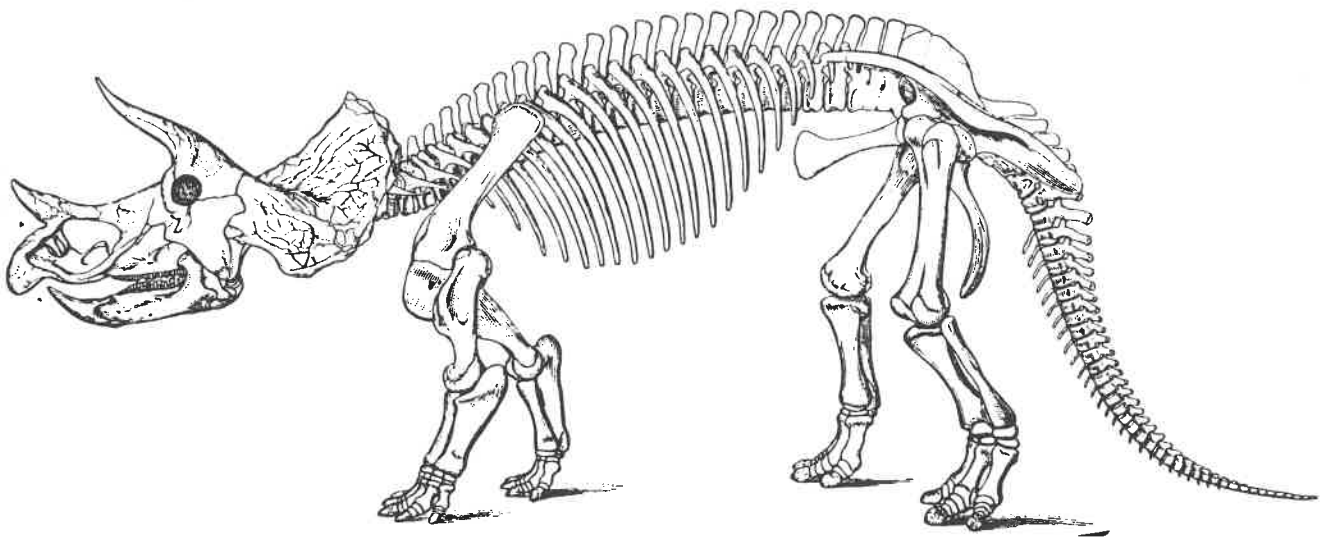


Figure 1. Skeleton of *Triceratops horridus*.

Glossary

Bonebeds - an accumulation of numerous bones in a single sedimentary layer, and often dominated by one species.
Cretaceous - the geologic period that ranged from about 135 to 65 million years ago.
Cycads - large tropical plants resembling a palm and having fern-like leaves.
Ligaments - connective tissue that attaches bones to one another.
Paleontology - the scientific study of fossils.
Pelvis - the bones of the hips.
Quadrupeds - animals that walk on all four legs.
Sacral - the vertebrae that attach to the hips to insure solid support of the body by the back legs.
Sedimentary - rocks formed generally in one of three ways: by solidification of eroded rock fragments i.e. sandstone; by precipitation from a saturated water solution, i.e. rock salt; or by the secretion of organisms, i.e. coral limestone.
Vertebrae - the bones of the backbone; they protect the spinal column.

References

Hatcher, J.B., O.C. Marsh, and R.S. Lull, 1907. The Ceratopsia. U.S. Geological Survey Monograph 49: 1-300 pp.
Weishapel, D.B., P. Dobson, and H. Osmolska, ed. 1990. The Dinosauria, University of California Press, 733 pp.

Selected Resources For Teachers

Dinosaurs of North America by Helen R. Sattler, 1981. Lothrop, Lee and Shephard Books, NY.
Illustrated Encyclopedia of Dinosaurs by David Norman, 1994. Crescent Books. This volume has excellent pictures of skeletons and reconstructions.
Museum of Geology Field Paleontology offerings are available to teachers for credit and high school students for no-credit each summer. Participants spend one to two weeks working at a fossil dig. For details and costs contact the Museum of Geology for a brochure.
The Dinosaur Society Dinosaur Encyclopedia by Don Lessem and Donald Glut, 1993. Random House, New York. This book is great for information relating dinosaurs and world geography.

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