SOUTH DAKOTA ICE AGE MAMMALS

What Was The Ice Age?

Since the time of the dinosaurs some 70 million years ago, the earth has been gradually cooling down. About 2 million years ago a series of glacial cycles began that covered with ice much of the northern continents, including nearly all of Canada as well as eastern South Dakota. This time interval is called the *Pleistocene Epoch* of the *Quaternary Period* by geologists. The *Ice Age* brought drastic changes to plants and animals alike. But large *mammals* thrived under these conditions, and many of them became giants. Some, like ground sloths and giant beavers, were native to North America while others, like grizzly bears and *mammoths*, came from Asia over the *Bering Land Bridge*. The *Ice Age* of North America has been compared to modern Africa for its diversity of large *mammals*. Table 1 lists some of the extinct *mammal* species that once lived in what is now South Dakota.

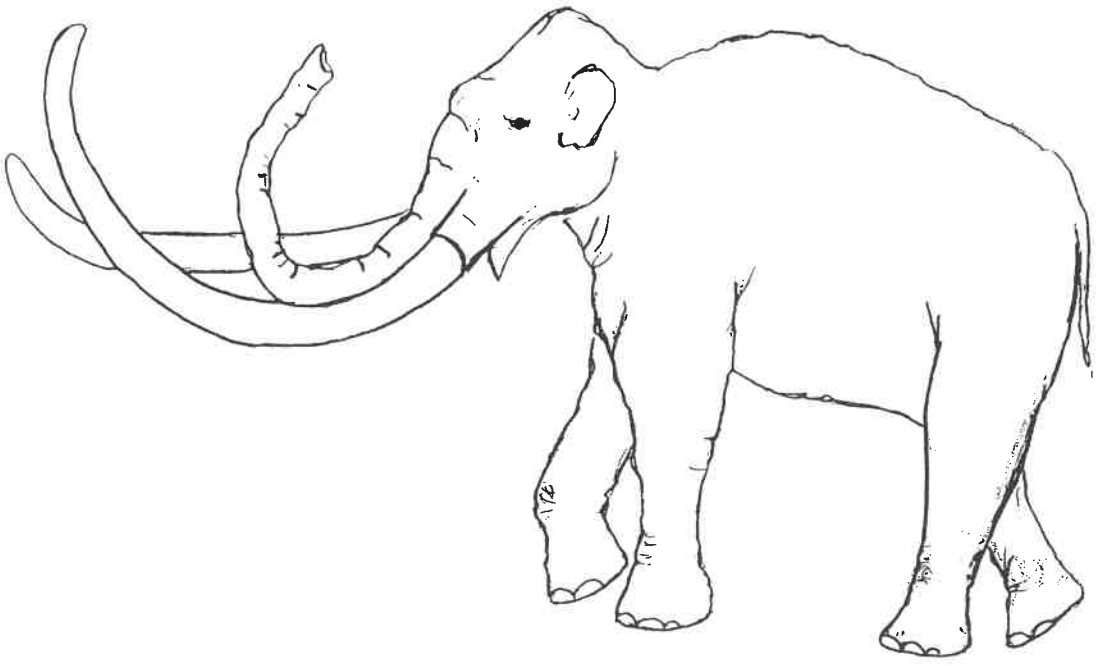

Figure 1. Columbian Mammoth, *Mammuthus columbi.*

Table 1. Selected South Dakota Mammal Species That Became Extinct at the End of the Ice Age.

Common Name	Scientific Name
Jefferson's Ground Sloth	*Megalonyx jeffersonii*
Shasta Ground Sloth	*Nothrotheriops shastensis*
Harlan's Ground Sloth	*Glossotherium harlani*
Short-faced Skunk	*Brachyprotoma obtusata*
Dire Wolf	*Canis dirus*
Short-faced Bear	*Arctodus simus*
Saber-toothed Cat	*Smilodon fatalis*
American Lion	*Panthera atrox*
American Cheetah	*Miracinonyx trumani*
Giant Beaver	*Castoroides ohioensis*
Mexican Horse (small)	*Equus conversidens*
Western Horse (large)	*Equus occidentalis*
Flat-headed Peccary	*Platygonus compressus*
Yesterday's Camel	*Camelops hesternus*
Large-headed Llama	*Hemiauchenia macrocephala*
Diminuitive Pronghorn	*Capromeryx minor*
Shrub Ox	*Eucerotherium collinum*
Harlan's Muskox	*Bootherium bombifrons*
American Mastodon	*Mammut americanum*
Columbian Mammoth	*Mammuthus columbi*

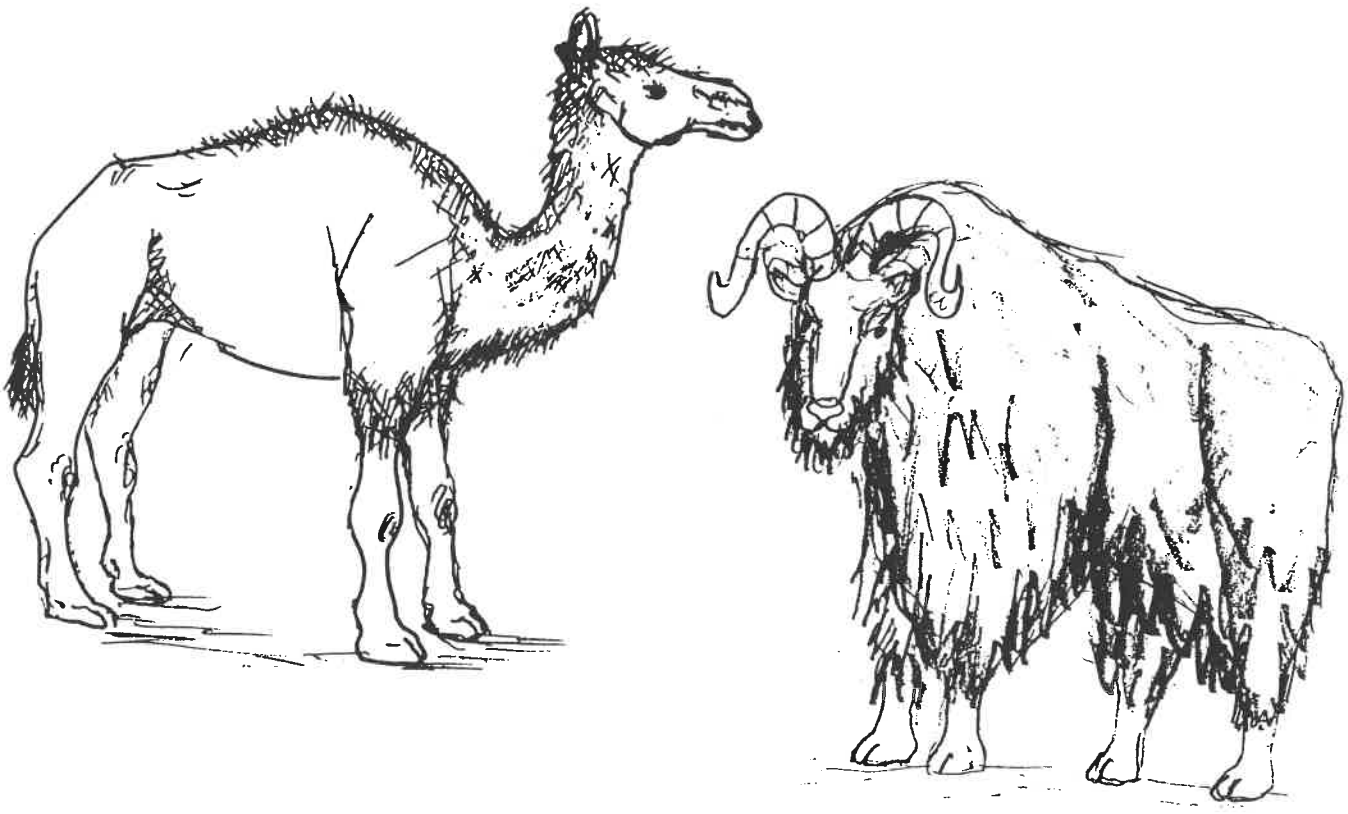

Figure 2. Yesterday's Camel (*Camelops hesternus*); **Shrub Ox** (*Eucerotherium collinum)*

Where Are Ice Age Fossils Found In South Dakota?

Fossils only form under special conditions where a carcass is buried or otherwise preserved quickly after death. South Dakota is famous for its *fossils*, though most are far older than the *Ice Age*. Nevertheless, many *Ice Age fossils* are found across the state.

The most famous locality is the Mammoth Site of Hot Springs, which is now housed under a major museum facility and is open to the public. Excavations at the site continue during the summer months. This *fossil* deposit is unusual in that it trapped *mammals* while they were alive. The mammoths ventured into a water hole where they became mired and subsequently drowned or starved to death (death and burial were simultaneous). The water hole was created and fed by a warm artesian spring. More than 100 Columbian *mammoths* became entombed at this site about 26,000 years ago. Other *fossil mammals* discovered at the site include species that still live in South Dakota, such as wolf, coyote, mink, and several rodents as well as other extinct species, such as giant short-faced bear, American camel, and shrub ox.

Many sand and gravel deposits across South Dakota also contain *Ice Age fossils*. These were deposited by sediment-laden rivers coming from the Rocky Mountains. During the early part of the *Ice Age*, before glaciers entered the state and disrupted the drainage, these rivers flowed eastward all the way to eastern Canada where they reached the Atlantic Ocean. Animals who died in or near these rivers were sometimes entombed in the constantly-shifting *sediments*. Notable *fossil* localities of this type have been found near the towns of Burke, Chamberlain, Deerfield, Delmont, Fort Pierre, Irene, Java, Midland, Oral, Pickstown, Potato Creek, and Yankton. Most of these *fossils* are found during gravel excavation for road construction.

South Dakota has a number of other *Ice Age fossil* localities. These include the Lange/Ferguson site near Oglala where *mammoths* were killed by prehistoric people, a site near Mina where a *mammoth* skull was found in glacial sediments, and the Ree Heights locality where *Ice Age* fish and plants have been recovered from a lake deposit.

How Are these Fossils Preserved and Dated?

Generally only the hard parts of an animal, such as its shell or bones, become preserved because the soft tissues decay too rapidly. Also, most *fossils* are petrified, meaning that the hard tissues have been replaced by stone. But, the majority of *Ice Age fossils* have not undergone this type of preservation. Because they are not very old geologically speaking, most are still composed of the original bone. Bone can only be preserved for thousands of years when buried underground or preserved in some way.

Original bone contains carbon that was ingested by the living animal, and this makes it datable by the radiocarbon method. Most of the carbon that is taken in by plants and passed on to animals in their food is stable carbon-12. But in the atmosphere cosmic rays continually create a small amount of carbon-14, which is radioactive. This means that it decays becoming nitrogen through a spontaneous process that takes place in the atomic nucleus. It is impossible to predict when a given atom of carbon-14 will undergo decay. But because even a tiny bone fragment contains trillions of carbon atoms, scientists can determine very accurately how long it takes for a tenth or a fourth of the carbon-14 atoms to decay. Decay rates of radioactive atoms are generally reported in terms of their half-life, meaning the time it takes for half of a large sample to decay. The half-life of carbon-14 is 5730 years. The radiocarbon age of a bone is determined by comparing the ratio of carbon-14 to carbon-12 in the sample with the ratio in the atmosphere. For example, if the ratio in the bone is half that of the

atmosphere, then the bone is reported to be 5,730 years (one half-life) old. If the ratio in the bone is one fourth that of the atmosphere, then the bone is reported as 11,460 years (two half-lives) old.

The latest glaciers reached their maximum size about 20,000 years ago, and the *mammals* that entered North America can be studied using radiocarbon dating. Bones older than 50,000 years old contain so little carbon-14 that it is difficult to measure, so the technique is not useful beyond that point. Recent advancements in radiocarbon dating of bone deal mainly with pre-treatment techniques. Bone can contain carbon in different molecules, some of which are much more prone to contamination (and therefore inaccuracy) than others. When the molecules least subject to contamination are used for dating, the date is much more reliable.

Figure 3. Saber-toothed Cat, (*Smilodon fatalis*) .

What Caused So Many Species To Go Extinct?

There are many interesting events to study concerning *Ice Age mammals*, such as the proliferation and *evolution* of numerous rodent species. But nothing has attracted more attention than the *extinction* of most of the large *mammals* that dominated North America during the *Ice Age*. The latest remains of most of these species have been radiocarbon dated at about 10,000 years old. What could have caused so many large species to go extinct in such a short time? No one knows for certain the answer to this question, but scientists have two main hypotheses.

One hypothesis is that the great climatic changes (warming and drying) that took place at the end of the *Ice Age* killed off these animals. Some large *mammals*, such as *mammoths*, are known to have evolved characters such as long hair for dealing with the cold *Ice Age* conditions. Perhaps such animals found the warmer climate less favorable, or perhaps a dryer

climate offered less food. Even many surviving *mammals*, such as caribou and wolves, had their *ranges* drastically reduced at the end of the *Ice Age*.

A second hypothesis is that early human hunters drove the large Ice Age *mammals* to *extinction*. The close time correlation between the *extinctions* and the entry of humans into North America (both 10,000-12,000 years ago) makes this possibility inescapable. But this proposal has its problems. Except for a few possible *mammoth* kill-sites, the only animal that is known to have been hunted extensively by early Americans is the bison, and it still survives. Paleontologists are still trying to unravel the mystery of the *Ice Age extinctions*.

Conservation Measures

Many vertebrate *fossils* are found on private land and are not protected by law. Fossils found on public lands require a collecting permit from the administering agency, and these are generally given only to museums or other public institutions so that the *fossils* will remain part of the public trust. When significant *fossils* are found, it is best to bring them to the attention of a scientist at a nearby university or museum so that their potential can be properly assessed. The scientific value of a *fossil* is greatly reduced when the exact location and context of its discovery are not known.

Glossary

Bering land bridge - a wide land bridge that connected Alaska with Siberia (where the Bering Strait is now located) during the Ice Age when sea level was lower than today.
Evolution - the change in a species over time.
Extinction - the death of all members of a species.
Fossil - the bodily remains or trace (including footprints, burrows, etc.) of a prehistoric organism.
Glacier - a mass of ice so large that it flows under its own weight.
Ice Age - a cool period in earth history when glaciers covered extensive areas of the high latitudes.
Mammals - warm-blooded vertebrates that grow hair and produce milk for their young.
Mammoth - a large extinct mammal closely related to the living elephant but with larger tusks, sometimes covered with a thick coat of fur.
Pleistocene Epoch - the term scientists use for the last Ice Age which lasted from about 2 million to about 10 thousand years ago.
Quaternary Period - the time period of the Cenozoic Era extending from about 2 million years ago through the present. It includes the Pleistocene and Recent Epochs.
Range - the land area over which a given species lives at a particular time.
Sediment - rock material that is carried by streams or other geologic agents and deposited, sometimes entombing bones and other fossils in the process.

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