MONTANA GEOLOGY

Monte Dolack©

AGE OF DINOSAURS
(Cretaceous Period—80 million years ago)

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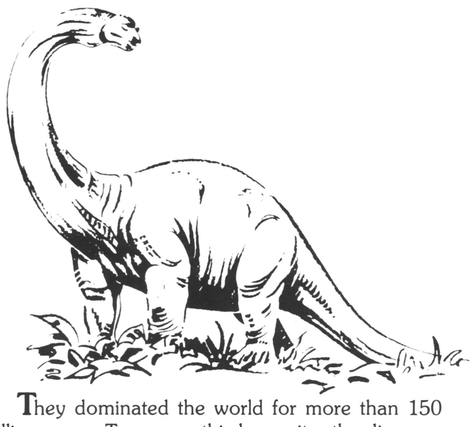


AGE OF DINOSAURS

by John R. Horner
Museum of the Rockies
Bozeman, Montana

They dominated the world for more than 150 million years. To ensure this longevity, the dinosaur relied on an amazing array of adaptations. Some found safety in speed, some grew horns, while others were shielded in armor-like skins; shear size and ferocity also provided a competitive edge against predators.

The word dinosaur comes for the Greek language and means "terrible lizard". Some were in fact ferocious meat-eaters, but many were slow-moving, non-aggressive plant-eaters. They are classified as reptiles and evolved from amphibians some 235 million years ago. Hundreds of different species have been discovered in almost every part of the globe. By any standard, the dinosaurs were among the most successful animals that ever lived.

Along the eastern front of the Rocky Mountains, about 80 million years ago, there existed groups of dinosaurs and other animals. Their habitat was a coastal plain that extended from the mountains to the shores of the Cretaceous sea, a vast expanse of water that covered the center of North America from about 140 to 65 million years ago. The eastern (lowland) region of the plain was green and swampy, dominated by large rivers that meandered through a subtropical landscape onto vast deltas. The western (upland) region of the plain was semiarid, containing numerous small streams and alkaline lakes. Conifers, cycads, ferns, sedges and a wide variety of flowering plants (including fruit-bearing bushes) bordered these bodies of water. Animals that inhabited this environment included other reptiles, birds, clams, snails and certain groups of amphibians.

Primarily through episodes of faulting, the Rocky Mountains were undergoing uplift and slowly becoming a prominent feature of western North America. This mountain-building period is called the Laramide orogeny. It occurred between 100 and 55 million years ago. In what is now Montana, sediments eroded from the mountains were deposited in stream channels and on the adjacent plains. Those sediments deposited in the upland plain have been named the Two Medicine Formation; those deposited in the lowland plain are called the Judith River Formation. The Two Medicine Formation consists of 2,000 feet of greenish-gray to red mudstones with sparce tan-colored channel sandstone lenses and lacustrine silts. Interbedded ash beds within the formation attest to volcanic activity. During the period of time that the Judith River Formation was being deposited in central and eastern Montana, the western deposits of the Two Medicine Formation were more than 200 miles from the shores of the sea.

A variety of vertebrate fossils has been collected from the Two Medicine Formation. One of the more productive sites, located west of Choteau in Teton County, not only yielded unique remains, but also provided evidence of dinosaur behavior and new insights into their social structure. In 1978, paleontological excavations conducted near a place called Egg Mountain made the first discovery in the Western Hemisphere of intact dinosaur eggs found in nests, and the first embryos and baby dinosaurs found anywhere in the world. The most common species found was a duckbilled dinosaur called *Maiasaura peeblesorm*. The average adult size was 25 to 30 feet long and probably weighed 2 to 3 tons. Evidence from Egg Mountain indicates that the herbivorous *Maiasauras* nested in large colonies near shallow alkaline lakes and cared for their nest-bound young. When the babies reached about one and a half meters in length, they left their clutches and joined huge herds that most likely migrated back and forth along the range front foraging for food.

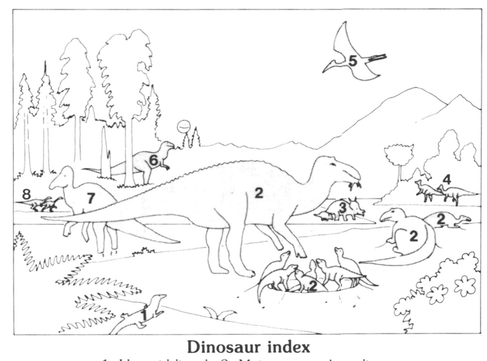
Other dinosaurs that also nested in groups and traveled in herds, included another duckbilled species called *Hypacrosaurus*, the horned dinosaur *Styracosaurus*, and the small bipedal hypsilophodontids named *Orodromeus makelai*. Predatory dinosaurs such and *Daspletosaurus* and *Troödon* were most likely active hunters that preyed on the young, as well as nesting adults.

The painting of *Age of Dinosaurs* illustrates some of the dinosaurs and other animals that existed along the Rocky Mountain front during Late Cretaceous time. In the foreground, resting on a log, is a Varanid lizard (1). These animals ate the eggs of nesting dinosaurs. To the right are three adult *Maiasauras* (2), two guarding their eggs, and one bringing food to its young. The babies will remain in their nests for about one month after hatching. Standing by the stream on the far bank are adult and juvenile members of the horned dinosaur *Styracosaurus* (3). In the distance are two adult crested, duckbilled dinosaurs that are related to *Corythosaurus* (4). Flying overhead is the gigantic reptilian pterosaur, *Quetzalcoatlus* (5). In the conifer forest beyond is the large carnivorous dinosaur, *Daspletosaurus* (6), a close relative of the massive *Tyrannosaurus*. Standing in the stream is an adult *Hypacrosaurus* (7), one of the crested, duckbilled species. To the far left are two members of *Troödon* (8), small speedy predators that hunted in packs.

During Late Cretaceous time, land-dwelling animals were undoubtedly involved in life and death struggles against natural disasters. For example, at the Egg Mountain digs, a boneyard of an estimated 10,000 dinosaurs was discovered—the largest en-masse collection of vertebrate remains found anywhere in the world. Studies of the position and condition of the fossil bones indicate that the herd was trapped and buried by an enormous mudflow.

The era of the dinosaur ended about 65 million years ago. The cause of their demise has provoked much debate and is yet unsolved. Some theories of catastrophic events, such as intense volcanic activity that produced suffocating ash clouds and hot gases, may be plausible explanations. The most dramatic speculation is that giant meteorites, some perhaps several miles in diameter, may have bombarded Earth. The environmental consequences of such occurrences could have produced tremendous tsunamis (tidal waves), or caused prolonged dust clouds to be raised in the atmosphere that would block sunlight and inhibit the process of photosynthesis in plants. Disease, altered food chains, a cooling climate and diminished habitats have also been discussed.

Did the dinosaurs really die out quite suddenly in a mass extermination as many believe? Some scientists suggest that the dinosaurs may have been warm-blooded, and through evolutionary processes that took millions of years, became manifested in the modern bird. The principal linking evidence for this theory is thought to be the fossil *Archaeopteryx*, the oldest known bird which lived 140 million years ago. This specimen provides confirmation of two kinds of animals in a transitional form—the skeletal frame of a dinosaur with accompanying features of teeth, wings and feathers.



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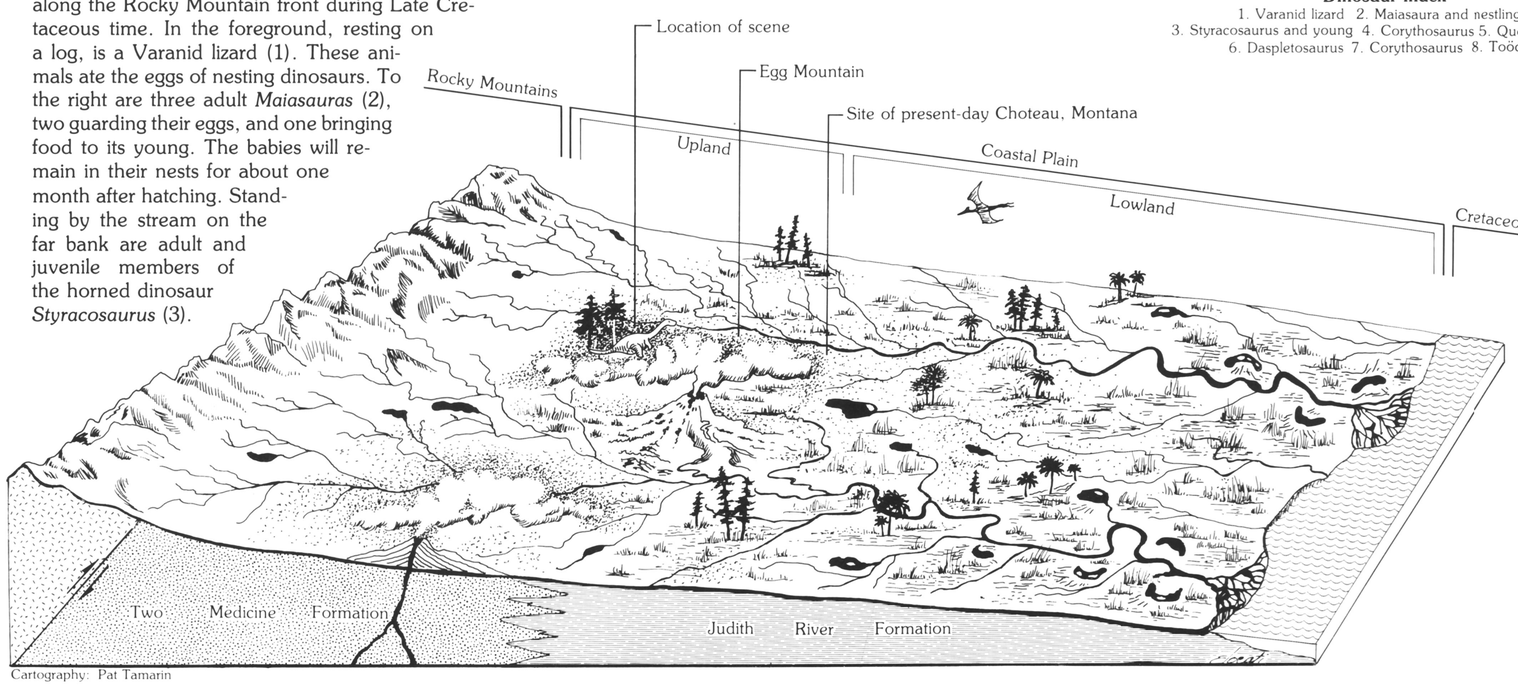
3. Styracosaurus and young 4. Corythosaurus 5. Quetzalcoatlus
6. Daspletosaurus 7. Corythosaurus 8. Toödon



Cartography: Pat Tamarin

Generalized block diagram illustrating geologic environments along the Rocky Mountain front during Late Cretaceous time.

MONTANA BUREAU OF MINES AND GEOLOGY

Room 200, Main Hall
Montana Tech
Butte, Montana 59701

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Charter, Scope and Organization

The Montana Bureau of Mines and Geology (MBMG) was established in 1919 as a public service agency and research entity of the Montana College of Mineral Science and Technology. The Bureau Director serves as the State Geologist and represents Montana in the Association of American State Geologists.

Enacted by Legislative Assembly of the State of Montana (Section 75-607, R.C.M., 1947, Amended), the scope and duties of the agency are summarized as follows:

- To collect, compile, and publish information on Montana's geology, mining, milling, and smelting operations, and ground-water resources.
- To maintain collections of geologic and mineral specimens, photographs, models, and drawings of mining and milling equipment, and literature on geology, mining, and ground water.
- To conduct investigations of Montana geology, emphasizing economic mineral resources and ground-water quality and quantity.

In accordance with the enabling act, the MBMG conducts research and provides information, but has no regulatory functions. To carry out its duties most effectively, the Bureau operates in five divisions: Geology and Mineral Resources, Hydrology, Administration, Analytical and Information Services.

Selected Publications on Montana Geology

Special Publication 89—Profiles of Montana geology: A layman's guide to the treasure state, David D. Alt, 1984, 168 p., 180 figs. $12.00

Special Publication 94—Belt Supergroup: A guide to Proterozoic rocks of western Montana and adjacent areas, Sheila M. Roberts (*ed.*), 1986, 311 p., 175 figs. 11 tables, 10 color plates $25.00

Special Publication 95—Guidebook of the Helena area, west-central Montana, compiled by Richard B. Berg and Ray H. Breuninger (*eds.*), 1987, 64 p., 20 figs., 1 table $5.00

Special Publication 100—Guidebook of the central Montana alkalic province: Geology, ore deposits and origin, David W. Baker and Richard B. Berg (*eds.*), 1991, 201 p., 103 figs., 17 tables $18.00

Special Publication 102—Coal geology of Montana, Mark A. Sholes (*ed.*), 1992, 157 p., 134 figs., 5 tables, 1 appendix, 2 sheets. $25.00

Reprint 6—Gold placers of Montana (2nd edition, *revised*), Charles J. Lyden, 1987, 120 p., 23 figs., 22 maps $10.00

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