



Diversity of life in Dinosaur National Monument's dry landscapes gets a boost from the rivers and streams protected as Congress enlarged the park over the years. NPS



Bighorn sheep are so adept at negotiating steep rock and narrow ledges that mountains protect them simply by being inaccessible to most predators. © Larry Angier



This is the only national park area set up to protect a historic dinosaur quarry. The great diversity of plant and animal fossils here allows us to describe its ancient environment. NPS



The Yampa is the last naturally flowing river in the 15-river Colorado River system. The Yampa's natural flow patterns sustain at least three endangered fish species. © Robin Mitchell

Many Meanings and Even More To See and Do

Earl Douglass discovered the dinosaur quarry as he hunted fossils for the Carnegie Museum in 1909. The quarry opened the world's best window on Late-Jurassic dinosaurs. And saving it from looters ended up preserving far more. The 80-acre Dinosaur National Monument created in 1915 now includes 210,844 acres of scenic river canyons, mountains, basins, and archeological sites. Twenty-three exposed geological strata, the National Park System's most complete such record, combine with elevation and topography to create the many habitats that support the startling diversity of plant and animal life.



NPS

John Wesley Powell (left) ran the Green and Colorado rivers and the Grand Canyon in 1869 and in 1871. He helped map the Colorado Plateau, directed the U.S. Geological Survey, and set up the Bureau of American Ethnology in the Smithsonian Institution. Powell had lost an arm at the Battle of Shiloh in the Civil War.

Much More than Dinosaurs The dinosaur quarry lies in the rock layer geologists call the Morrison Formation. Sites in this formation offer fossils deposited in many environmental habitats, so scientists can reconstruct the look of this area 150 million years ago. Rivers carved today's deep canyons, providing many habitats, including shaded ones, for life to exploit. Canyons also shelter archeological sites, and the record here of human occupation and cultural development is one of North America's most complete. From earliest times people valued the diversity of life so closely linked to geology here.



Porcupine
©Gerald and Buff Corsi
California Academy of Sciences

Montane



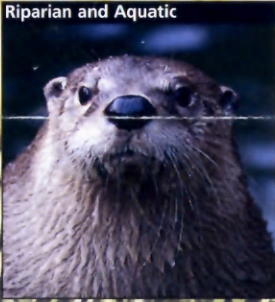
Cliff and Ledge
Canyon wren
NPS



Riparian
Yuma myotis bat
©Martin D. Tuttle
Bat Conservation International



Riparian
Bighorn sheep
©Carolyn Fox



Riparian and Aquatic
River otter
©Tom and Pat Leeson

Riparian

Aquatic



Bonytail chub
J.M. Rinne, US Forest Service

LIFE COMMUNITIES

Montane



Hermit thrush
©Bill Horn

Montane

Elevation makes this moister than all communities but the aquatic and riparian. Chickadees and warblers feed on insects and nest in summer here. Cold and snow drive most animals lower down.

Mountain shrub

Fall fruits and berries are important fuel for migratory birds and elk preparing for winter's snow. Small mammals abound, and mule deer summer here. Sage grouse and lazuli buntings breed in this community.

Pinyon-juniper

Pine nut and juniper berry attract Clarks nutcrackers and pinyon jays. As snow gets deep higher up, this is crucial large-mammal habitat for daytime shelter from wind and predators.

Desert shrub

Hot summers, cold winters, alkaline soils, and low precipitation: plants minimize water loss here. Mule deer, coyotes, prairie dogs, and badgers live amid sagebrush and greasewood.

Cliff and Ledge

Shaded, north-facing canyon walls harbor bighorn sheep and birds that do not usually tolerate dry country. Flight lets birds exploit several communities from cliffs. Bighorns lamb on ledges predators cannot reach.

Riparian (stream-side)

Green ribbons of vegetation along waterways, riparian communities are highly productive. Their plants and animals must have continual access to water—but cope with changing water levels.

Aquatic

Streams and rivers and the riparian zones they create are Utah's most biologically productive areas. Birds eat aquatic insects. Mammals come from benches and canyon walls to drink from streams daily.

Beyond the Quarry There is so much to see here besides the dinosaur quarry and dinosaur fossils—you may want to reconsider and revise your travel plans. This bird's-eye-view map suggests the dramatic canyon scenery you see on the two auto tours highlighted on the map.

More Information:
Dinosaur National Monument
4545 E. Highway 40, Dinosaur, CO 81610-9724
970-374-3000
www.nps.gov/dino
Also visit the National Park Service website: www.nps.gov

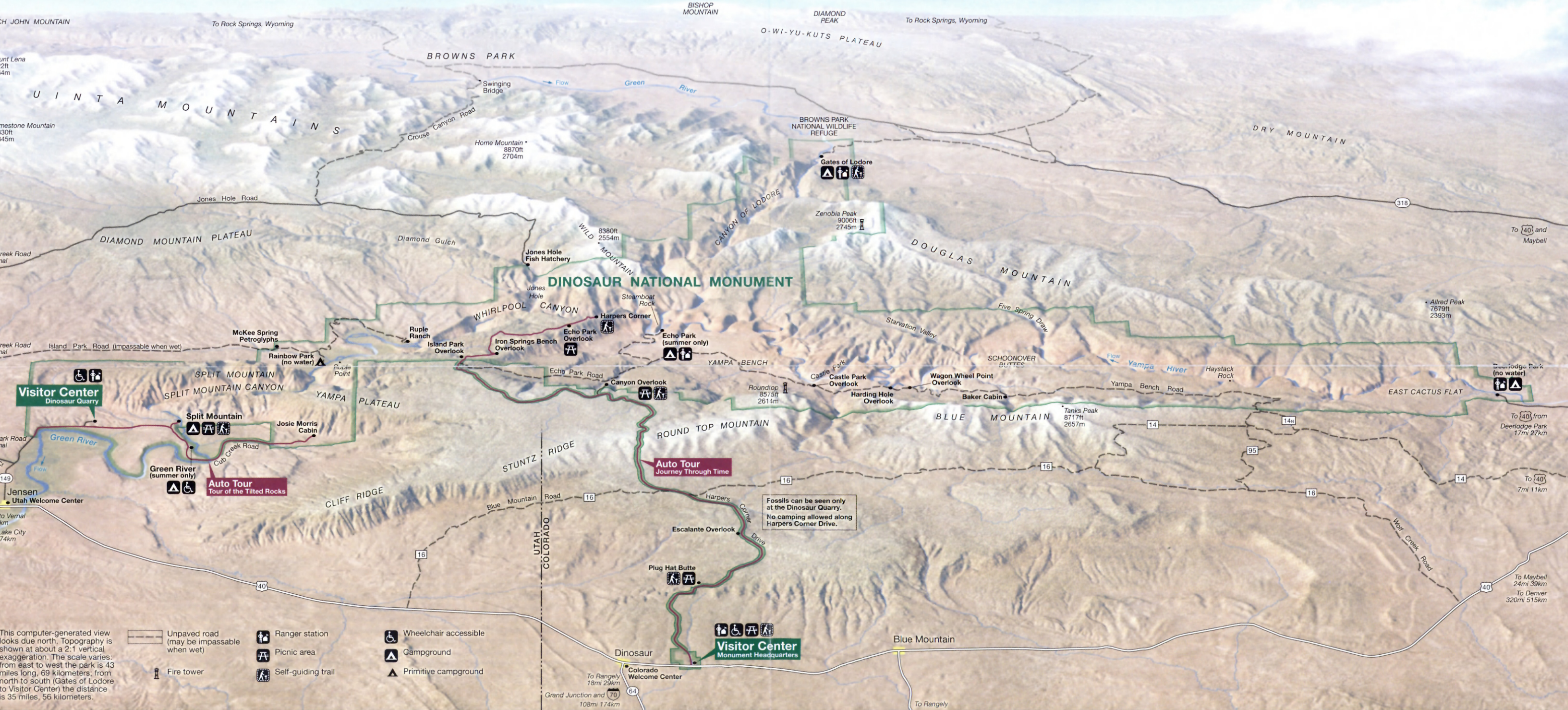
Dinosaur Quarry The Quarry Visitor Center, seven miles north of Jensen, Utah, is the only place in the park to see dinosaur bones. It is open daily except Thanksgiving, December 25, and January 1. A shuttle bus runs between the main parking lot and the quarry in summer.

Headquarters Visitor Center Two miles east of Dinosaur, Colo., this visitor center is the canyon country gateway. It is open daily in summer but weekdays only in winter. Fossils are not on display. Exhibits and an orientation program introduce the park. Check at a visitor center for a schedule of summer programs and for information about hiking, fishing, river running, and campgrounds.

Canyon Country The four-hour, round-trip Harpers Corner Drive shows you canyons from its overlooks. Walk the trail to stunning canyon views at Harpers Corner. Other scenic areas reached by paved or well-graded roads are Gates of Lodore, Deerlodge Park, and Jones Hole. Rougher roads, including to Echo Park and Island Park, may be impassable when wet and may require high-clearance vehicles. Ask for current information at a visitor center. Gas, food, lodging, or supplies are available in nearby towns. None are available in the park.



Safety and Regulations Summers are hot with cool nights and thundershowers in July and August. Carry and drink plenty of water to prevent dehydration and heat injuries. You can protect this park by following these regulations: Do not collect or disturb any rock, fossil, plant, or artifact. Do not feed, hunt, trap, or injure wildlife. Pets must be physically restrained at all times and are not allowed in public buildings, on trails or rivers, or in the backcountry. Firearms and weapons must be unloaded and stored in a vehicle in a way that will prevent their ready use. Off-road driving is illegal. Please camp or picnic only at designated sites. Backcountry permits are required for backcountry overnight trips.
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Snapshots in Stone

The 23 rock formations exposed in Dinosaur National Monument (below) represent extinct ecosystems and are windows into the area's past life.



Future Earth
in 50 million years



Earth Today
present

12,000 Years and Counting . . .

The Thinnest of Human Veneers If Earth's age as geologists count it were a football-field long, human time would be grass-blade thin at the goal line. Archeological data goes back 12,000 years here—for one of North America's most complete records of cultural development: from Paleoindian to Archaic, Fremont, and modern Ute. The area's water sources and diverse plants, animals, and rocks provided food, fuel, fiber, and tools. People could garner the resources for living within a two-day walk. The horse, reintroduced from Spain by 1776, greatly changed Ute culture.



Weapon Evolution

Paleoindians used stone spear points. Archaic peoples used atlatl throwing sticks. They and Utes after them made corner- and side-notched points from chert, quartzite, and obsidian. In historic time, Utes traded for metal arrow points.

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Earth itself shows the great change through time that characterizes other forms of life. Our planet's crust, even below oceans, is a series of great plates moving by fits and starts. The globe today merely shows their present position. Experts in crustal structure, or plate tectonics, can predict a future globe—see the top one—and reconstruct earlier ones (below).



Today's park environment is mostly semi-arid. Plant communities range from the cold desert shrub to several forests at various mountain elevations. Riparian communities along streams are more lush and biologically diverse.

Petroglyphs (right), rock art of the Fremont Culture



A basket (left) and pottery (right) of the Fremont Culture



Josie Bassett Morris chops wood near her cabin at age 80.

A Landscape of Extinct Ecosystems

Since 1990 the thrust of science at Dinosaur National Monument has shifted from just quarrying dinosaur fossils to reconstructing what the ecosystem was like 150 million years ago (mya). We can do this because the Morrison Formation produces so many fossils—besides dinosaur bones—that were deposited in diverse environmental settings. In fact, all 23 of the geologic formations exposed here represent extinct ecosystems. And ecosystems—arid land today but fern-filled once or covered by an ocean or freshwater

Ecosystem = the sum of all communities here and the physical environment.

Biological diversity or Biodiversity = the variety of life forms, the ecological roles they play, and the genetic diversity they contain.

lakes—change through time. Such story-rich geology both records the diversity of past life and enhances diversity today. Geologic formations weather to become soils to whose chemistry plants may adapt. Big wild buckwheat, for example, grows *only* in the soil from Mowry Shale, and park rockcross lives *only* in the soil from Weber Sandstone. Even the extinct ecosystems contribute to the park's biodiversity. Who are we to disrupt life's complex links by making some of them extinct?

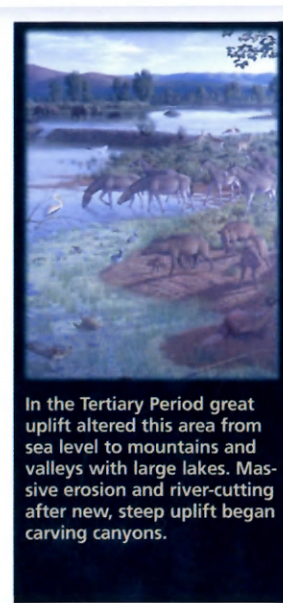
Evidence of Things Unseen: Oceans Give Way to Land

Rivers Mold the Landscape Ecosystems change through time. Dinosaurs went extinct 65 million years ago. By five million years ago grasslands spread in a climate cooler and drier than in dinosaur days. Horses and rhinos prospered. In recent geologic time rivers preceding the Green and Yampa cut into the mountains. Today's rivers still shape the land. At scenic Harpers Corner Overlook (see map on other side) you stand on fossils of ocean life that now rest 2,700 feet above the Green River. The river may one day cut through Steamboat Rock (see photo, far right).

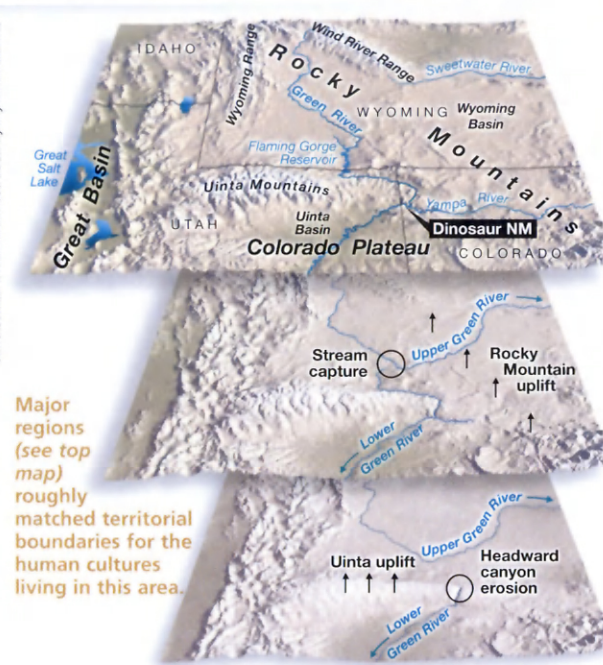


Tertiary Earth
at 10 mya

During the Tertiary Period—66.4 million years ago to two million years ago—the continents moved close to their present positions. What is now the park lay roughly at today's latitude and longitude. The Rocky Mountains had begun their rise here as the Tertiary Period began.



In the Tertiary Period great uplift altered this area from sea level to mountains and valleys with large lakes. Massive erosion and river-cutting after new, steep uplift began carving canyons.



Major regions (see top map) roughly matched territorial boundaries for the human cultures living in this area.

Wandering Rivers, Converging Regions

The ancestral Upper Green River once flowed east to the North Platte River (see bottom map). Eventually headward erosion of the ancestral Lower Green River and the uplift of the Rocky Mountains (see middle map) caused the drainage to flow southward, as it does today.

At Dinosaur National Monument three major regions converge (see top map, the landscape today). The Colorado Plateau, middle Rocky Mountains, and Wyoming Basin meet here and, with Great Basin influences to the west, enrich the biological diversity of the park's ecosystem.



Path of Least Resistance

Will the Yampa and Green rivers cut through the long fin of Steamboat Rock (see photo) like they did the knob to its left? A great conservation struggle defeated a dam proposal here at Echo Park in the 1950s and saved the Yampa—now the only naturally flowing river in the entire Colorado River system.

The Mesozoic Era: The Age of Dinosaurs

A Glimpse of Late-Jurassic Dinosaurs

A gold rush-like quest for dinosaur bones swept America's West in the late 19th and early 20th centuries. Rock of the Morrison Formation has yielded a wealth of dinosaur fossils. Laid down from 147 to 155 million years ago, outcroppings of this rock occur in eight western states. The Dinosaur Quarry is in the Morrison Formation and has produced fossils from all four major Late-Jurassic dinosaur groups: plant-eating sauropods, stegosaurs, and ornithomimids and flesh-eating theropods. Fossil pollen and spores now identify 250 species of plants from the Morrison ecosystem. The 34-ton *Apatosaurus* ate ferns, the dominant plants then. Fossils show that dinosaurs lived at the same time as clams, snails, algae, ostracods, crayfish, insects, salamanders, frogs, lizards, turtles, crocodiles, and small mammals. Their fossils tell us more about the Morrison ecosystem than do dinosaur fossils. New fossil finds continue to help us reconstruct the ecosystem that was here 150 million years ago.



Jurassic Earth
at 200 mya

Pangea, the single supercontinent, started to break up during the Triassic and continued throughout the Jurassic. The rift developed first between Europe and North America and then between South America and Africa—and began the opening of the North Atlantic.



Ferns dominated the landscape 150 million years ago. This area lay 400 miles farther south then and was mostly semi-arid to arid, perhaps with seasonally abundant water.



©Frank Pennington/Unicorn Stock Photos

Camarasaurus

Look for this neck and skull (left) of a *Camarasaurus* (its name means "chambered lizard") in the bone wall in the Quarry Visitor Center. Below, a *Camarasaurus* is attacked by *Allosaurus*, the most common predator in the Jurassic Period of North America.



©Richard Dobbs



Mudstone of the Morrison Formation

Tooth (right, actual size) from a *Torvosaurus*, which may have been similar to the meat-eating *Allosaurus*



Allosaurus tooth (actual size)

Allosaurus

Allosaurus was a formidable meat eater, probably both a predator and scavenger. Its enormous mouth held sharp, recurved teeth serrated on both edges. If sauropods herded and migrated, *Allosaurus* may have followed the herds, hunting alone or in packs.

Allosaurus claw of hand (actual size)



Plants of the Morrison Ecosystem

The Morrison ecosystem climate was warm. *Araucaria*, pine-like trees growing up to 150 feet tall, were the dominant trees, with ginkgos, tree ferns, horsetails, cycads, and mosses. Ferns were the principal vegetation and proba-

bly the major food for plant-eating dinosaurs. Horsetails are one of the Jurassic plants that are still found here today.



Belemnites

Belemnites were invertebrates ("no backbone") with an interior skeleton. Their fossils show that there was an ocean here before the terrestrial Morrison ecosystem developed. Belemnites are relatives of the modern squid (see drawing below).



How Stegosaurus Has Been Reconstructed Over Time



What did *Stegosaurus* look like? These three drawings show, chronologically from left to right, how paleontologists have answered this question. Compare how the drawings show the plates on this dinosaur's back. Fossil evidence for these plates

was not good until several recent finds produced fairly intact plates in two, alternating rows. Maybe the plates were protective armor or were used in mating or territorial displays or to inspire fear in predators. Maybe the plates helped regulate body

temperature—by radiating excess body heat or collecting needed heat from the environment as jackrabbit ears do. The plates likely served several functions. Its spiked tail no doubt helped this vegetarian defend itself from potential predators.



Paleontologist = one who studies fossil remains. **Earl Douglass** (below) discovered the dinosaur quarry while working as a paleontologist for the Carnegie Museum, Pittsburgh, Pa.

Special Collections Department
J. Willard Marriott Library, University of Utah

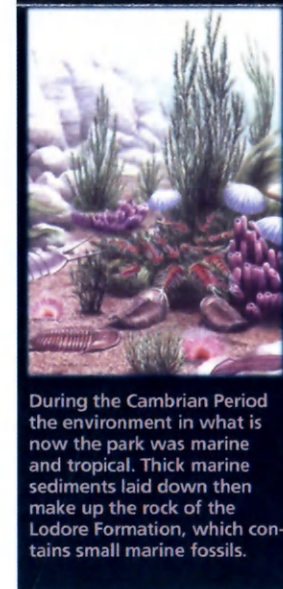
Deep Time: Origins of Life in the Story of Modern Science

Fossil Journeys Through Deep Time

Earth's age—4.6 billion years—boggles the mind. Permanent rocks did not form until 3.9 billion years ago. Single-celled life forms appeared 3.5 billion years ago. Multi-celled forms did not proliferate and diversify until 570 million years ago (mya), in the Cambrian explosion (see bottom black band). By 500 mya marine animals developed shells and skeletons that readily fossilized. Life moved onto land 400 mya, with early vascular plants, followed by insects and amphibians. Reptiles developed from amphibians, and dinosaurs appeared about 233 mya. The first mammals developed from reptile forms 200 mya and then flourished after the extinction of dinosaurs 65 mya.



Cambrian Earth
at 570 mya



Narrow strips of crust exposed above the ocean surface had begun to expand as continents 3.5 billion years ago. Most continents were in tropical latitudes during the Cambrian Period, when large pieces of present continents can first be plotted.



Cambrian Life

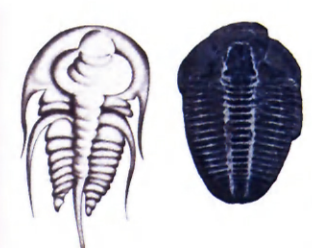
Forms of life diversified so quickly in the early Cambrian that this time is known as the "Explosion of Life." Life had not moved onto land, but many complex organisms had evolved and were well adapted to the environment. Many later went extinct, for

reasons not well understood. By Cambrian times some animals had developed hard shells or external skeletons that fossilized readily. Primitive members of the group *Chordata* were forerunners of vertebrates and, eventually, mammals.

From Earth's Formation . . . to You

To understand the graph shown along the black band below, you need to think of the history of the Earth as though it were the width of this sheet of paper. At such a scale, humans have inhabited the planet for less time than the thickness of this paper. See how long it took,

after the Earth formed, for life to arise . . . and then for multicellular life to arise. This park introduces you to many very complex ideas. Be sure to ask questions of park rangers and attend the programs they offer. We hope you find enough ideas here to engage you for life.



Rock from the Lodore Formation

Trilobites (drawing and fossil) were marine organisms with lobes in three (tri-) parts down their backs.