ROADLOG GUIDE

for the

NORTH & SOUTH UNITS

THEODORE ROOSEVELT NATIONAL PARK

Text by
Edward C. Murphy
John P. Bluemle
N.D. Geological Survey

and
Bruce M. Kaye & Staff
Theodore Roosevelt National Park

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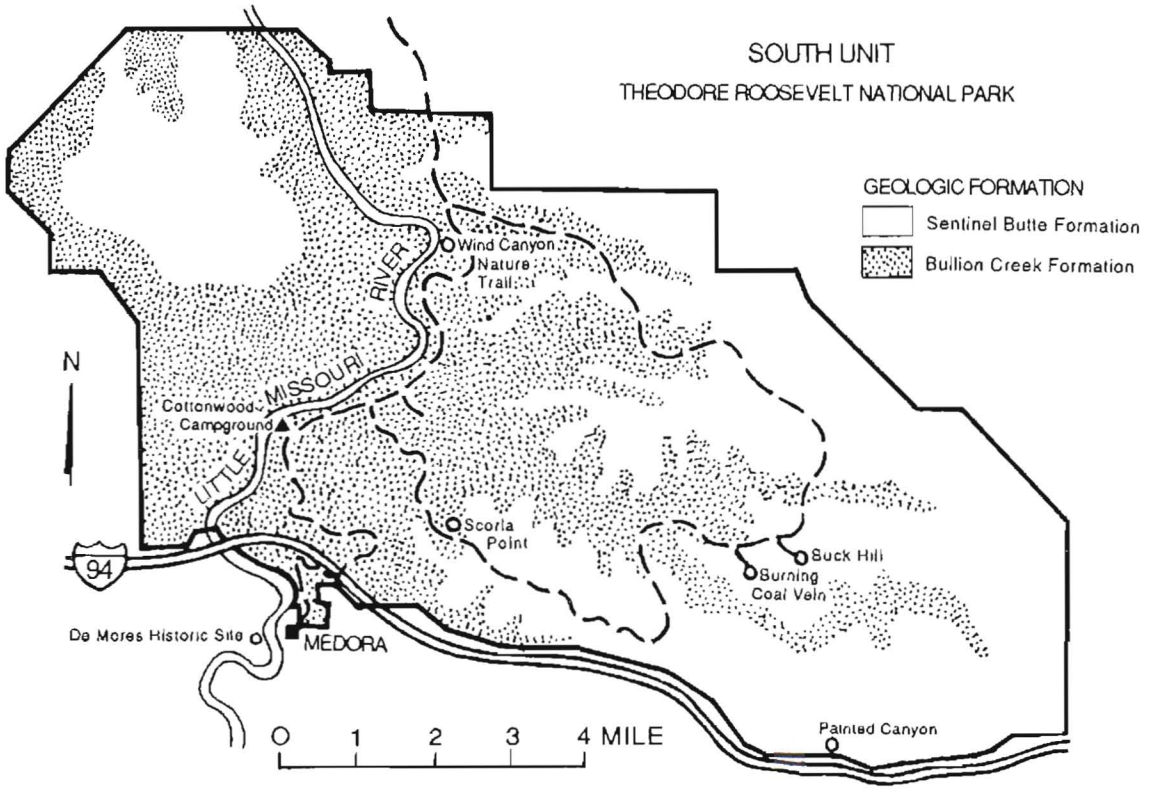
John P. Bluemle, State Geologist


SOUTH UNIT
THEODORE ROOSEVELT NATIONAL PARK
GEOLOGIC FORMATION
Sentinel Butte Formation
Bullion Creek Formation
N
MISSOURI RIVER
LITTLE
Wind Canyon
Nature
Trail
Cottonwood
Campground
Scoria
Point
Buck Hill
Burning
Coal Vein
94
De Mores Historic Site
MEDORA
Painted Canyon
0 1 2 3 4 MILE

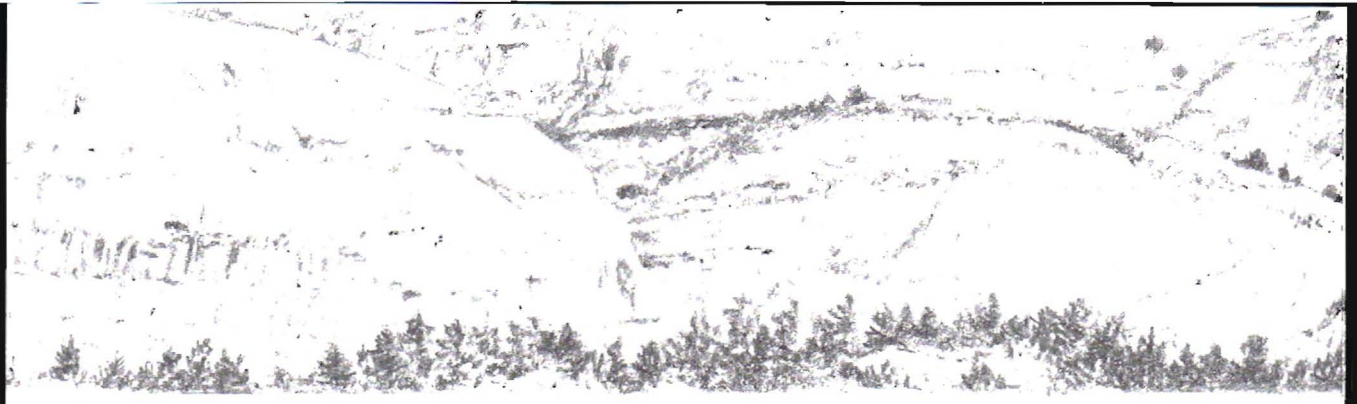
INTRODUCTION

On first viewing the strange shapes of the badlands, a person might be led to believe that some great natural catastrophe has torn the earth apart, ripping it open and exposing its interior. But the hills and valleys of these badlands were formed by agents more relentless than earthquakes or volcanoes. This land, which Theodore Roosevelt found "fantastically beautiful," was carved by rain and melting snow, wind, frost, other forces of erosion and the waters of the Little Missouri River.

The various layers of rock that can be seen in the park were deposited between 55 and 60 million years ago by large river systems flowing from the rising Rocky Mountains across a near-level plain of lakes and swamps during the Paleocene Epoch (fig. 1). These sediments, which consist of sand, silt, clay and lignite coal, are part of the Fort Union Group and cover the western half of North Dakota as well as portions of adjoining states and Canadian provinces. The presence of fossilized tree stumps and plant-leaves, skeletal remains of crocodiles, turtles and fresh water clams and snails plus lignite coal indicate that the Paleocene climate was subtropical to warm temperate—quite a contrast to the continental climate in North Dakota today!

The Little Missouri Badlands is the result of ancient geologic deposits interacting with today's climates, plants, animals and geography. It's important to realize that this process is ongoing. Eventually, this interaction will transform the park into a much different setting than we see today. That's the best thing about studying the earth—its different parts are constantly changing, interacting and developing.

The Sioux Indians referred to the badlands as "mako sica" ("land bad"), and early French explorers translated this to "les mauvais terres a' traverser" ("bad land to travel across"). Today, modern roads make the area easier to travel through.



This guide is only a prologue to what can be found here. Opportunities for a more in-depth look at the park abound. The person who has the time to see the park, to hike or ride horseback through the badlands may experience some of the same feelings experienced by the Plains Indians, early explorers and ranchers. This roadlog includes descriptions and explanations of many of the physical and natural resource characteristics found here. We hope it will add to your enjoyment of the park and that you will both see and understand why this land is part of the National Park System. Explore and enjoy.

Brown milepost markers located along the right side of the road show the cumulative mileage from the entrances to the South and North Units. Periodic checks of the markers will make it easier to follow along with this guide.

DRIVE WITH CAUTION. BE ON THE LOOKOUT FOR WILDLIFE ON THE ROAD OR THAT MAY DART FROM ROADSIDE COVER. BUCKLE UP.

ROADLOG FOR SOUTH UNIT

Mileage

The South Unit scenic loop drive is 36 miles, returning to the park entrance. This paved road provides a kaleidoscope of views for this 46,158-acre unit of the park.

Medora South Unit Visitor Center. Information and travel services, museum, theater, publications outlet (books, posters and maps) as well as programs are available. Open daily except for some winter holidays. Tours

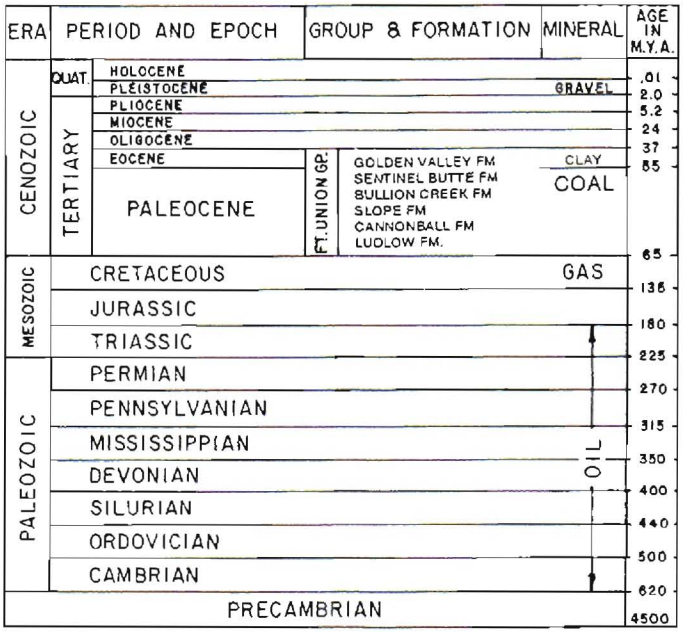


Figure 1. Stratigraphic column of North Dakota. Shaded area shows rock units that are exposed at the surface in the park.

of the Maltese Cross Cabin, Theodore Roosevelt's first home in the Dakota Territory, are available. Obtain a map of the park if you don't already have one.

The horizontal layers in the cliffs near the visitor center are beds of fine-grained sedimentary rocks. Largely siltstone and claystone, they were deposited in lakes, ponds and swamps adjacent to ancient, extinct streams that flowed here during the Paleocene Epoch.

The beds of sedimentary rocks you will see throughout the park form part of the Fort Union Group*. This Group can be further subdivided into several formations, which differ somewhat from one another in content and appearance. Two such formations can be seen in the park (map). They are the Bullion Creek Formation, which forms the cliffs here at the visitor center, and the Sentinel Butte Formation, which you will see later.

Medora Overlook. Notice the landslide at the base of the cliff across the road from the turnout. The Fort Union Group contains considerable clay that loses its strength and becomes slippery when wet. This sediment slumps on steep slopes, resulting in frequent landslides and mudflows.

The sharply defined ledges visible in the cliff faces here are the more erosion-resistent rock layers that were cemented by minerals carried in solution by water seeping through the sediment.

Interstate Highway 94 has been constructed in a valley that was formed by Sheep Creek.

Prairie Dog Town. Vegetation in the town is generally much shorter than in surrounding areas. The black-tailed prairie dogs have cut down taller grasses to make it more difficult for their natural enemies to approach undetected. At the same time, this encourages the growth of forbs and other succulent plants, which are staples of the prairie dog diet. A prairie

*Guide uses North Dakota Geological Survey terminology.

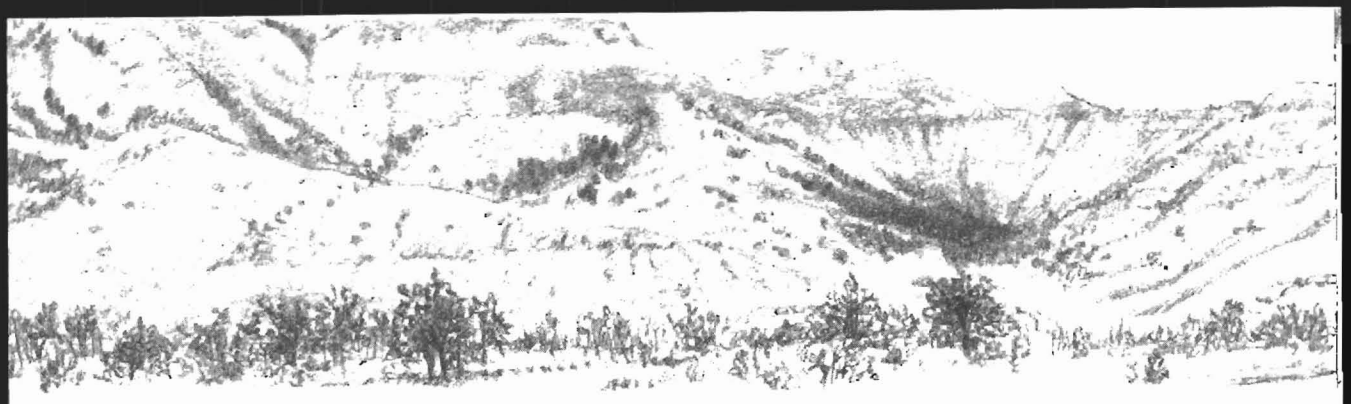
dog town is a web of life for a variety of animals including coyote, badger, burrowing owl, magpie, sharp-tailed grouse, golden eagle, black widow spider, bullsnake and prairie rattlesnake.

You may notice some prairie dogs with what appears to be black or dark coats of fur. These prairie dogs probably burrowed into a lignite coal seam and the black color is coal dust.

Skyline Vista. The flat area on which this overlook is located is a remnant of the landscape that existed here before the Little Missouri River began to carve the badlands. This late Pliocene-age plain extended over all of western North Dakota and eastern Montana about 3 million years ago. The terrain was interrupted by a few scattered buttes, such as those on the skyline. The river valley was shallow, with more gentle slopes than today, not at all like the modern rugged scene.

The carving of the badlands began about 600,000 years ago when the Little Missouri River was diverted by glaciers about fifty miles north of here, causing it to flow eastward (fig. 2). Prior to the diversion, not only the Little Missouri River, but also the Yellowstone and Missouri Rivers flowed north into Canada and then northeast to Hudson Bay. In its new course and direction, the Little Missouri River flowed over a shorter, steeper route. Because of its increased gradient, the river cut rapidly downward, causing extensive erosion and the unfolding of the badlands.

River Woodland Overlook. Notice the different ecological zones and the habitats they provide. Cottonwood and willow trees grow close to the river. Wildlife, such as white-tailed deer and a variety of birds, generally seek cover in this area. The open sagebrush flats provide space for certain song birds and hawks as well as mule deer. Sheltered drainages are dominated by green ash. This hardy and persistent tree is one of the last trees to leaf out in the spring and first to drop its leaves in the fall. Throughout the park this tree often grows in coulees (ravines) along with boxelder, chokecherry and wild plum, providing refuge for a variety of animals.



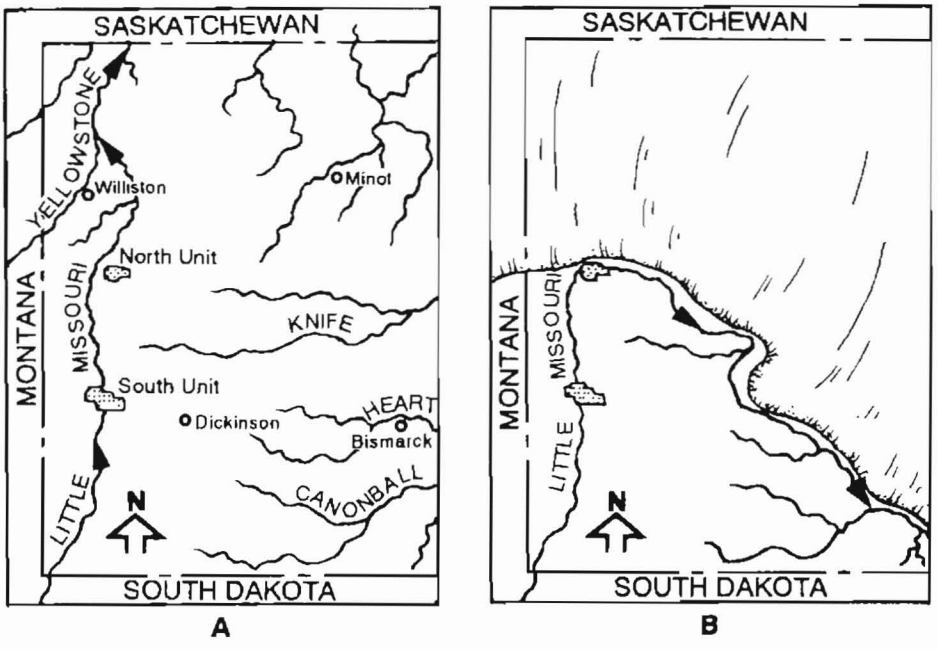
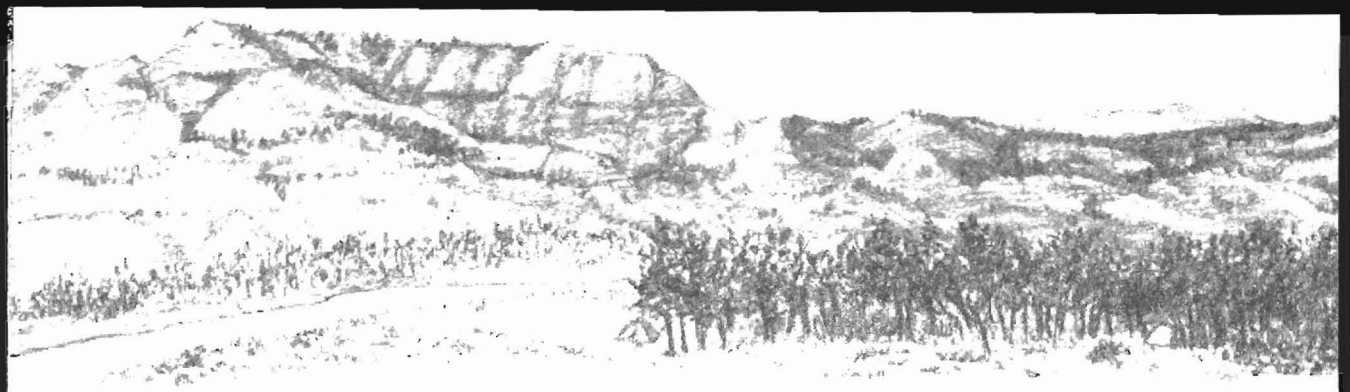


Figure 2. A. The preglacial drainage of North Dakota. **B.** The glacial diversion of the rivers to the southeast. The diversion or rerouting of the rivers occurred approximately 600,000 years ago.

Notice how Rocky Mountain juniper trees and other plants grow in horizontal bands on the hillsides. Vegetation grows best along moist sediment layers. Water flows through the looser, more permeable rock layers, known as **aquifers**, and comes to the surface wherever the layer is exposed.

Cottonwood Campground entrance. An 80-site campground that is open year round (pit toilet and one all-season water spigot in winter).

Lignite seam on the right, halfway up the slope (fig. 3). Lignite is a soft coal consisting of carbonized plant fragments. Plants that formed lignite grew in



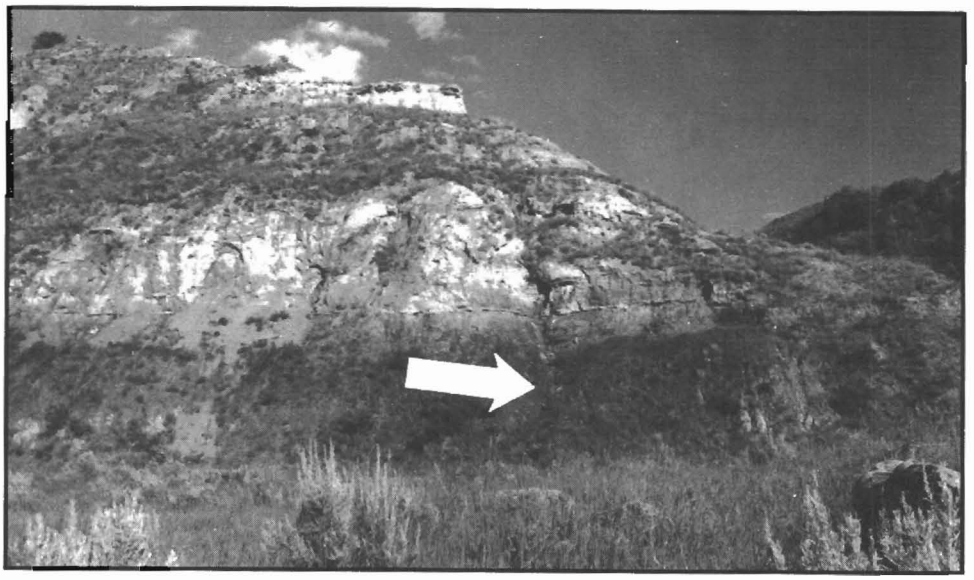


Figure 3. This lignite bed (see arrow) is typical of those which can be found throughout the park.

ancient swamps when the climate was much warmer and more humid than it is today (fig. 4). As the plants died and fell into the water, they began to decay. However, before plants could be completely decomposed, bacterial action stopped because the bacteria "committed suicide" by filling the stagnant swamp water with their body poisons to such an extent that they died. When the streams changed course, they deposited sand on top of the partially decomposed vegetation, burying it and allowing coal to form.

Across the river, over the entire river bottom area, the yellow-flowered leafy spurge has taken hold. This exotic species is causing significant ecological disruptions by replacing native plants; infestations throughout the park have grown from 32 acres in 1972 to perhaps several thousand acres today. Control actions, including herbicide application (away from water) and

biological control with use of insect species that are natural predators of spurge in Eurasia, are being used to combat this serious problem.

6.6 Begin loop section of drive. Continue on road to right (counterclockwise) to follow this roadlog. Turn left on East River Road for Peaceful Valley picnic area and ranch (trail rides). The East River Road is kept open year round while a 18-mile section of the drive ahead may be closed at this junction in winter due to snow and ice.

8.8 Turnout on left. The heavy juniper stands in this area are generally confined to the cooler, moist north-facing slopes where snow tends to accumulate. South-facing slopes, which receive more sunlight during both summer and winter, are much drier as much of the precipitation is evaporated before it can be absorbed into the ground.

9.3 **Scoria Point Overlook.** The reddish rock layers of "scoria" are composed of sediment that were baked by burning lignite. The term "scoria" is a misnomer, for true scoria is of volcanic origin. The scoria-like material found throughout this park is more correctly termed clinker, but since the word scoria is used locally, it will be used along with clinker in this roadlog.

Figure 4. In Paleocene time, large rivers, lakes and swamps with lush vegetation covered this area.

Scoria commonly contains fragments that look as though they have melted. According to one theory, this rock formed when the material overlying a burning coal bed collapsed, plunging into the "furnace" to be heated to exceptionally high temperatures until melted. Openings often developed during this process and after cooling, became convenient places in which animals live and are favorite localities for prairie rattlesnake dens.

The color of the scoria varies from pink-red to orange, yellow and even purple. Color may be determined by the mineral composition or grain size of the material that was baked, or it may depend on the temperature reached at different localities during the baking process. The red color is due to the presence of the mineral **limonite** which is iron oxide or common rust. Iron is oxidized more easily at high temperatures, so when the sediment is heated, hematite forms.

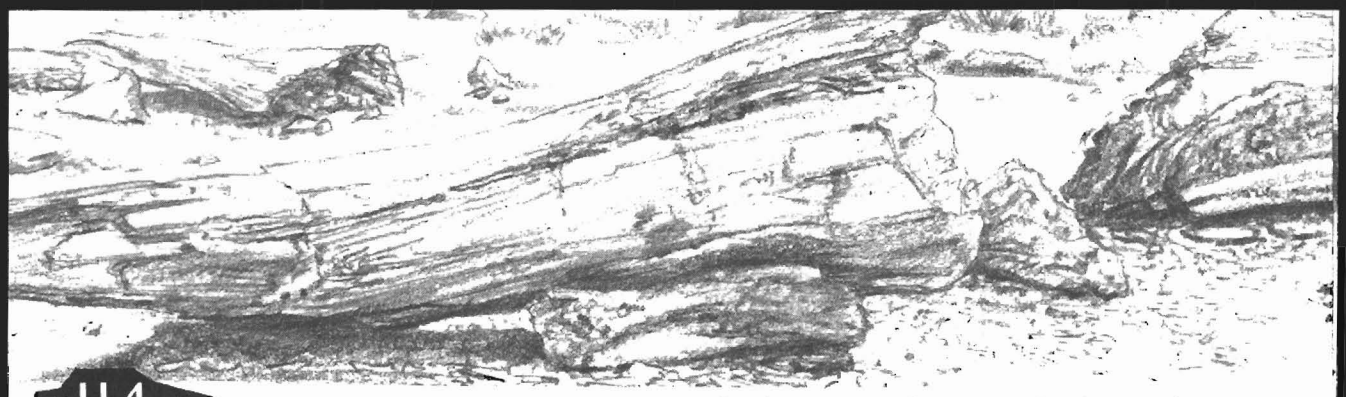
Lignite beds have been ignited in various ways including range fires, lightning and spontaneous combustion. Some of the scoria is now found at elevations where the water table is too high for lignite to burn. This scoria probably formed at a time when the climate was drier and the water table was lower than it is today, a warm, dry period of time that lasted from about 7,000 years ago until about 4,000 years ago.

The lignite bed that burned here at Scoria Point is known as the HT Butte Lignite or the HT Butte Bed. It is named for a ranch south of Medora where it is well exposed. HT Butte Scoria is formed from this coal.

Until now you have been traveling in an area in which the Bullion Creek Formation is exposed. As you drove up the hill to Scoria Point, you passed into the Sentinel Butte Formation.

Buttes and conical shaped hills in the badlands are often capped with scoria or sandstone which are more resistant to weathering, resulting in pyramid-looking peaks.

Ridgeline Nature Trail. This self-guided nature trail is a moderately easy, 0.6 mile walk leading through typical North Dakota Badlands terrain.



11.4 **North Dakota Badlands Overlook.** Horizontal layers in the Sentinel Butte Formation are visible on the hillside across the valley behind the sign. The layers are made of several different types of sedimentary rocks. The bluish gray layers are beds of siltstone and claystone. Brownish gray sandstone layers have orange, iron-rich bands a few inches thick. The black beds immediately above the bluish beds are lignite.

The red scoria capping the tops of buttes in the distance is the HT Scoria, the same bed seen at Scoria Point. The HT Butte Bed marks the contact between the lighter colored, more yellowish Bullion Creek Formation below, and the darker gray and brown Sentinel Butte Formation above.

From the newly-formed Rocky Mountains, Paleocene rivers and streams flowed swiftly east carrying large amounts of coarse materials such as gravel. When the rivers flowed from the mountains out onto the plains, they immediately lost much of their carrying power and dropped the coarser gravel and sand. The lighter materials, such as clay, silt, and fine sand, were carried farther eastward to the Dakotas and deposited as the Fort Union Group. Deposition here was not uniform and blanket-like, but rather, as the rivers and streams meandered from side to side, they deposited materials in one area and then another.

During this time, many volcanoes were erupting in western Montana and Wyoming. These volcanoes produced large amounts of ash, which was carried by the wind to the Dakotas. This ash collected in watered areas, such as lagoons, and with the passage of time, was transformed to bentonitic clay, the bluish layers here. This claystone is made up of extremely fine particles. It can absorb several times its weight in water and is extremely slick and mobile when wet.

12.0 Note the lignite bed exposed in the gully on the right.

12.3 Petrified tree stump at the left edge of the road. You will be passing through an area of petrified wood for the next half mile (fig. 5). Many of these fossilized stumps have been identified as varieties of sequoia trees. Some of them are as much as 12 feet in diameter. Although the whole area of the

park was probably forested during Paleocene time, the preservation of the wood and stumps required that the trees be rapidly buried by sediments to escape decay. This might have happened when a stream changed course or flooded its banks, depositing sand or silt on the trees, or perhaps ash blown here from volcanoes to the west covered some of the ancient forests.

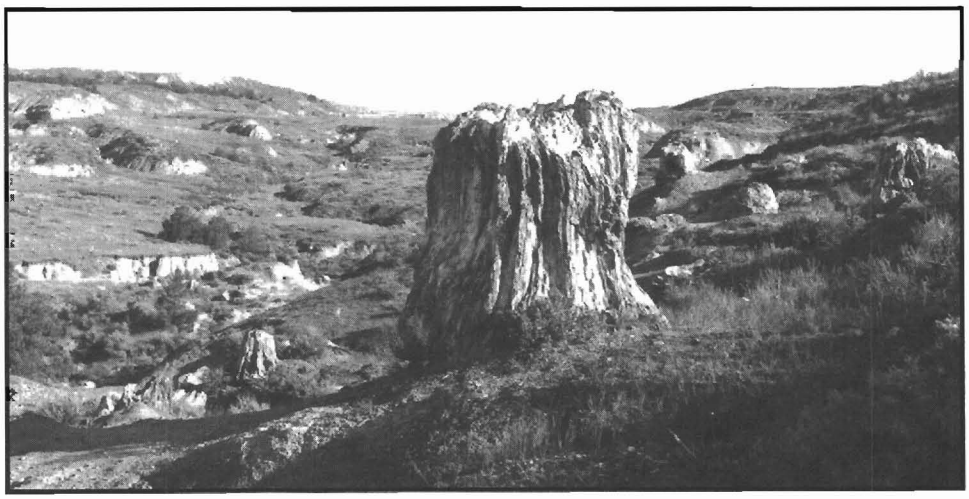
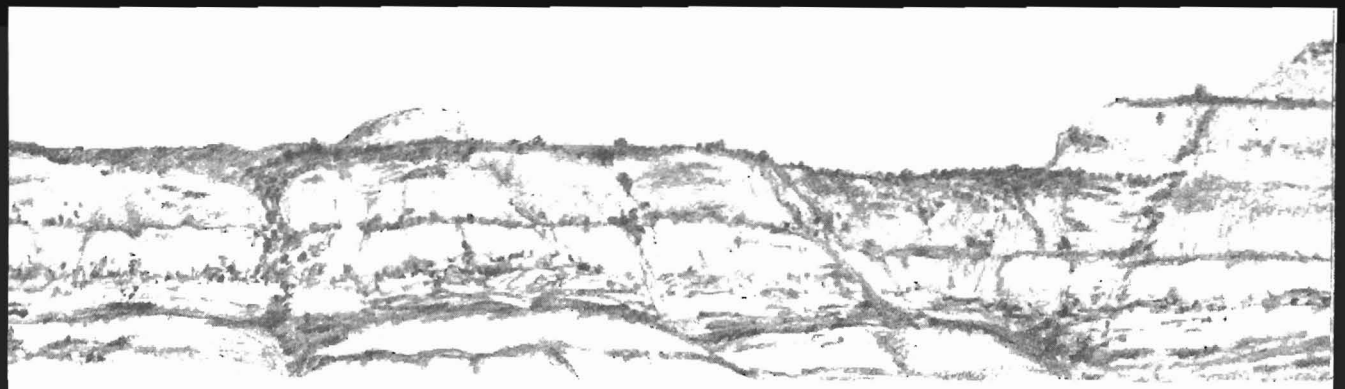


Figure 5. This petrified stump is typical of petrified wood found in several locations in the park. Stumps such as these tend to protect the underlying sediment from erosion and, as a result, many of them rest on a small, table-like pedestal.

After a tree was buried, ground water began to circulate through it. With the help of bacterial action, water dissolved out the wood's softer cellulose material. The water also carried dissolved minerals. Silica molecules were deposited in the spaces left by the dissolving plant tissue. This replacement process was gradual; a molecule of plant tissue being simultaneously replaced by a molecule of silica. In this way, the original cellular structure of the wood was preserved so that, in many cases, petrified stumps look exactly like old wood stumps except that they are stone. The petrified wood is mostly very light brown or cream colored, not the highly colored variety that is common in some regions. Small pieces of it can be seen along the road and it is more abundant in the Sentinel Butte Formation than in the



Bullion Creek Formation. It is illegal to collect petrified wood or other rocks in the park so that others can enjoy seeing them in their rightful place.

12.9 **Old East Entrance Station.** Federal relief programs such as the Civilian Conservation Corps (CCC) were established during the 1930s to put unemployed people to work and to accomplish needed conservation projects. Projects completed in the badlands by the CCC under the guidance of the National Park Service included the building in the distance, the entrance station to what was referred to as the Roosevelt Recreational Demonstration Area. Roads, shelters and campgrounds were also constructed and became the framework for Theodore Roosevelt National Memorial Park that was established in 1947 to honor our 26th President for his contributions to the conservation of our nation's resources. In 1978, this area obtained national park status.

13.4 Large blocks of HT Butte Scoria are visible along the road in this area. You are now descending from an area in which the Sentinel Butte Formation is visible into an area in which the Bullion Creek Formation is exposed. Notice the change to slightly brighter colors.

14.4 **Paddock Creek Trail.** Parking for this trail and Lower Talkington trail is 150 yards ahead.

15.5 **Coal Vein Trail.** The scoria-surfaced road to the right leads 0.8 mile to an area where a coal seam burned from 1951 until 1977. An easy 0.8-mile self-guiding trail traverses the land that was altered by the burning coal. Scoria is one of the few types of hard rock available in the badlands, and it is therefore valued as a substitute for gravel. Return to the main road and turn right to continue roadlog.

15.8 The road emerges here onto a semi-flat plateau. This flat area coincides with the contact between the Bullion Creek and Sentinel Butte Formations. The contact between the two formations is clearly marked by the presence of the HT Butte Scoria bed, which is seen in several places on the plateau.

16.2 The beds of gray sediments on the left are banded by thin, reddish-brown

stripes that are rich in oxidized iron. These stripes are not related to scoria or to heat produced by burning coal. Rather, they are layers that formed while the sediment was being deposited. Notice that, in places such as where the outcrop is nearest the road, the bands lie at angles that are not horizontal. These bands probably were deformed when the still-soft sediment slumped along the stream that was depositing them. It is not definitely known why the bands are so regularly spaced. This may be the result of seasonal deposition. If so, the amount of sediment between each band (vertical distance) would represent an annual accumulation of Paleocene sediment.

16.4 The rugged landscape, which continues along the road on the right for approximately 0.3 mile, is landslide topography. Notice that many of the trees here grow at angles, rather than straight up. This is because the material they are growing in is creeping downslope.

17.1 **Buck Hill** road. If you turn right and travel 0.8 mile to the top of Buck Hill, you will be afforded one of the most spectacular views of the badlands. A 100-yard foot trail leads to the very top of the hill, the second highest point in the park. Peck Hill, at 2865 feet and located near Painted Canyon, is a few feet higher.

Bands of wild horses might be observed in this area. Another good area to see these free-roaming feral horses is along Interstate 94, east of Painted Canyon. In order to maintain the herd between 50-90 animals, the horses are rounded up every few years, and surplus animals are sold at public auction.

17.5 During heavy rain or snowmelt, this coulee may contain swiftly flowing water, which erodes the soft sediments. Trailhead parking for Lower and Upper Talkington Trails is ahead.

19.9 **Boicourt Overlook**. The thick growths of Rocky Mountain juniper covering the north-facing slopes provide excellent cover for elk that were reestablished in the park in 1985. Elk have done so well in the park's badlands that they must be culled when the population approaches 400 animals to prevent

damage to the resources.

Bison, like the elk, plains grizzly and wolf, to name a few species, were eliminated from the badlands by the close of the nineteenth century. However, in 1956, bison were returned to the South Unit. They thrived on the productive land. Since the optimum bison population in the South Unit is 300 animals, they must be rounded up and culled every few years to lessen their impact on the land and other wildlife.

Looking east (to right of road), one can see oil development outside the

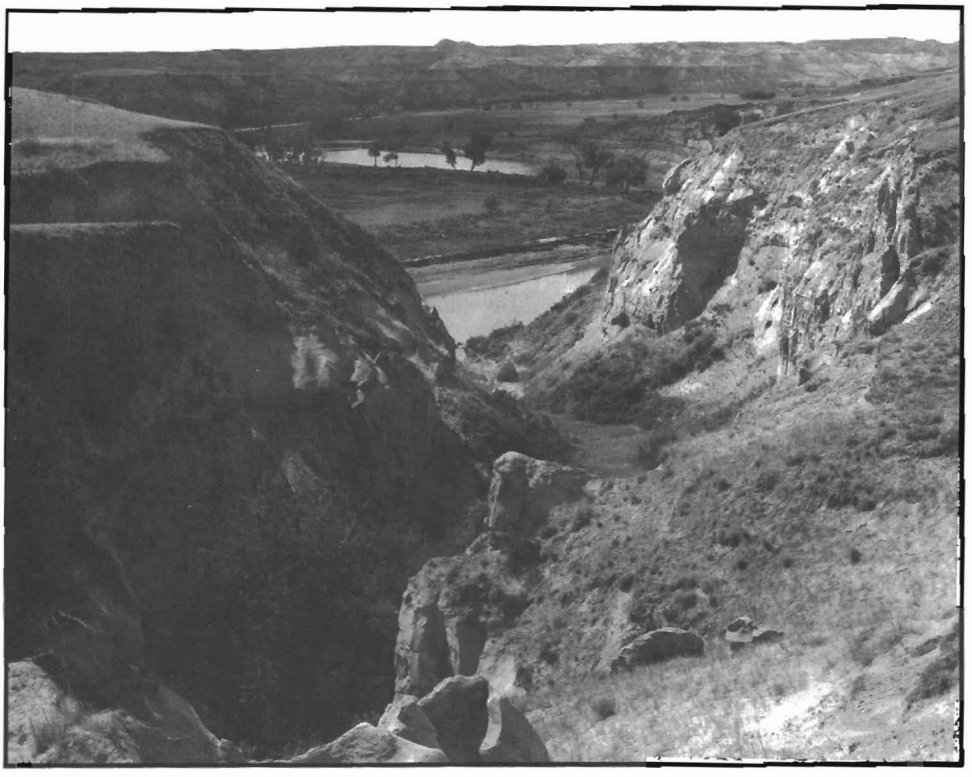


Figure 6. Wind Canyon with the meandering Little Missouri River visible in the background.

park boundary. Park managers spend time mitigating energy development issues so noise, odor and visual intrusions do not impact park resources as well as visitor's experience in a national park.

20.5 Vertical trunk of petrified tree on the right in the distance near the bottom of the valley.

20.9 **Jones Creek Trail**. Eastern terminus of the Jones Creek trail, a 3.7 mile one-way walk bisecting the loop road.

24.8 **East River Road**. Turn left to complete scenic drive and return to Medora. The dirt road to the right leads out of the park, one mile, and provides access to local ranches and the Little Missouri Grasslands that surround the park.

25.1 **Wind Canyon Nature Trail.** Wind Canyon was carved by a small stream, a tributary to the Little Missouri River, that happened to be aligned with the prevailing winds. Strong winds, which are from the northwest most of the year, whip across the broad expanse of Little Missouri River bottomland, picking up sand from the river bars. The wind blows the sand into the canyon, creating a sand-blasting effect that has helped running water carve the rock into smooth, wind-eroded shapes (fig.6). The canyon is eroded into an ancient river channel sandstone.

The park land across the river is in designated wilderness. Only trails provide access to this 10,510-acre section of the park.

25.6 Notice the slumped area on the right with numerous tilted, table-like pedestals called rain pillars (fig. 7).

26.6 **Beef Corral Pullout**. The flat area here is the old floodplain of the Little Missouri River. Be on the lookout for coyotes and badgers as well as hawks and golden eagles hunting for black-tailed prairie dogs.

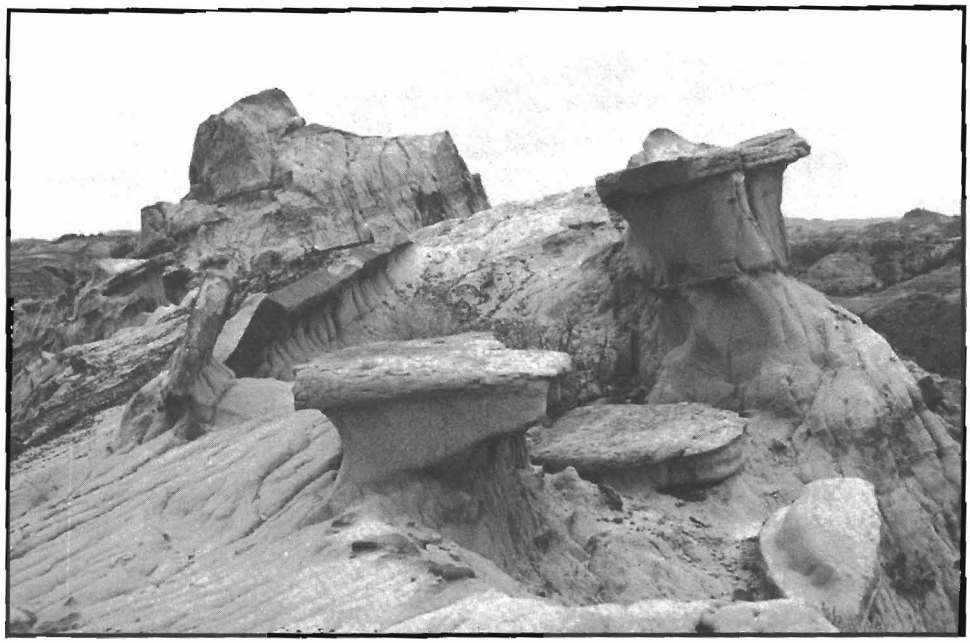


Figure 7. Flat, hard, sandstone slabs shown here have protected the underlying sediments from erosion so that they now rest on pedestals (rain pillars or hoodoos). Eventually, the slabs will tilt or fall off the pedestals, resulting in the unusual configurations seen here.

27.6 **Jones Creek Trail.** Parking area on the left is the western terminus of the Jones Creek trail. The area to the right was the site of one of the CCC camps.

28.8 **Peaceful Valley Ranch.** The road to the right leads to a historic ranch setting. This was a working cattle ranch in the 1880s and, after that, successively, a horse ranch, a dude ranch, headquarters for the area's Civilian Conservation Corps operation, Theodore Roosevelt National Park headquarters and finally, a saddle horse concession that operates today.

29.1 Road junction. End of roadlog. Turn right to park entrance and Medora, 6.6 miles.

ROADLOG FOR NORTH UNIT

Mileage

Welcome to the North Unit of Theodore Roosevelt National Park. This 14-mile road provides sweeping vistas of the 24,070-acre North Unit; 19,410 acres are designated wilderness. The general overview and a brief geologic summary for the entire park is included in the Roadlog's Introduction.

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North Unit Visitor Center. Stop and orient yourself to the park and activities available. Exhibits and audiovisual programs provide a quick look at the cultural and natural resources found in the North Unit. Obtain a map of the park if you do not already have one.

Proceed west on the main road. The road to the left leads to the park housing and maintenance area.

The small tan trailer to the south (left) is a monitoring station. Information on the quality of the air (including acid rain) is recorded here daily along with precipitation. Managers are charged with maintaining the cleanest air possible over the park since this important resource has been given a Class I designation. To do this they must work with local and regional neighbors to mollify impacts from development that could reduce visibility and harm park resources.

Keep a watchful eye for wildlife. Look everywhere—along the road, up on the steep buttes or hidden in cover. Look low as well—bullsnakes, prairie rattlesnakes and frogs may be on the road and cannot avoid a car. Be alert—one may only get a glimpse of a thirteen-lined ground squirrel or

cottontail dashing across the road.

The badlands are home to both mule and white-tailed deer. Mule deer are larger and more abundant and are easier to see since they venture out in the open more often than white-tailed deer. "Mulies" have black-tipped tails and large ears. White-tailed deer flip up their tail to expose the white underneath. Antlers on the males can also be used to identify each species.

The road crosses a series of ravines or coulees that have been eroded into soft sediments. Snowmelt and rainwater have carved these features over the past few decades. They can be important water sources for small mammals and amphibians. Ravines like these can be dangerous places to hike because of their steep, slippery, unstable sides.

The trail post on the right helps mark the Buckhorn Trail, one of several hiking trails in the North Unit. A backcountry guide is available at the visitor center or from a park ranger.

The Little Missouri River forms the east boundary of the park here.

Longhorn Pullout. South of the road is the floodplain of the Little Missouri River. This terrace is covered by river sediments deposited during the last 5,000 years. The predominant silver-gray sagebrush provides food for mule deer and shelter for birds and other small animals. Prairie rattlesnakes seek their shade on hot summer days.

A small herd of free-ranging longhorn cattle may be seen in the morning and late afternoons, but during the heat of the summer, they seek shade under cottonwood trees in the distance.

The fifteen-foot-high outcrop just north of the road is a channel sandstone comprised of sediments deposited in a river about 55 million years ago. The gray silt and sand grains are stained in places by reddish-brown iron-oxide (limonite).

2.5 Service road on the left leads one mile to the park's bison management corrals. Twenty bison from the South Unit were reestablished in the North Unit in 1962. Their reproductive success requires that the herd be rounded up every few years to cull bison numbers to approximately 100 animals so the park is not overgrazed. Park horses are kept here year round to assist with resource management activities. Road may be impassable during wet weather.

2.8 **Slump Block Pullout**. In several of the buttes to the right of the road, the rock layers are tilted, dipping steeply to the north. Layers of weaker sediments sometimes give way due to the weight of overlying rocks. As a result, the rocks above may slide or tumble below the weaker layers. Throughout this section of the park, large, intact blocks of material have broken away from the bluff and slumped downhill. This type of movement is common in the Little Missouri Badlands. Together with the other rocks in these buttes, the sediments tell of changing past environments (fig. 8).

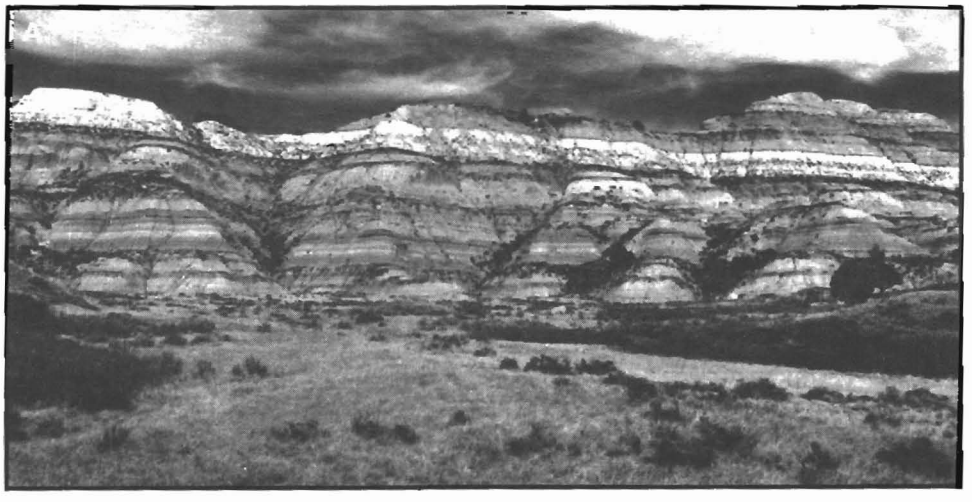
The small, cone-shaped hill to the north of the sign is composed of the reddish-colored rock "scoria" (clinker), that has been altered by the burning of an underlying lignite coal seam (see page 9, mileage 9.3).

3.3 As you travel the next 0.5-mile section of the curvy road, note the difference between the badland buttes on the right and the hill on the left. The buttes on your right face south and appear barren and brown. The hills on your left face north and are dark green, covered with thick vegetation. The south-facing slopes receive direct sun and are therefore hotter and drier. Prickly pear cactus, saltbush and yucca dominate these slopes. Sagebrush lizards and rock wrens can be found here. The north-facing slopes are sheltered from the sun. Junipers, ash and a variety of shrubs thrive in these cooler, moister areas providing food and shelter for a variety of wildlife.

The broken land generates a variety of habitats and thus the biological diversity of the badlands.

4.3 As you drive down the hill, the meandering "Little Mo" can be traced by the tall cottonwood trees growing along the river bottomland.

4.6 **Cannonball Concretion Pullout.** Round concretions such as those weathering out of this cliff were formed by the cementing actions of groundwater. Before the erosion of the badlands began, groundwater seeped slowly through these sediments for millions of years. The water contained minerals which, when they were precipitated out of solution, cemented the sand grains together. As a result, even though these concretions contain the same sized sand grains as does the surrounding sand, they are much more resistant to erosion. The concretions are weathering out of a 30- to 40-foot



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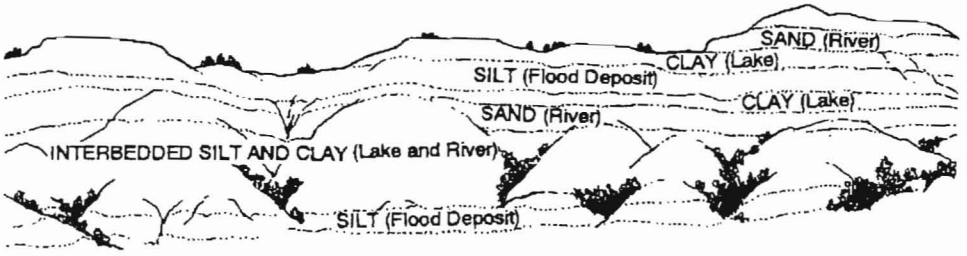


Figure 8. A. The buttes to the north at the Slump Block Pullout. **B.** The general lithology and environments of deposition for the sediments in the buttes pictured. The butte contains 58% claystone, 25% siltstone, 14% sandstone and 3% lignite coal.

thick sandstone bed—an ancient river deposit. If you examine the sand, you will see that it contains layers of clay and a few pebbles.

Except for the concretions, this sand deposit is poorly cemented. Rain and snowmelt easily erode into the sand and create numerous small gullies and ridges called rills. This type of rivulet erosion pattern is common in these sandstones (fig. 9).

Allow natural erosion to take place. Do not carve on the concretions or sandstone cliffs.

Stay on the main road to continue with this roadlog. The road to the left

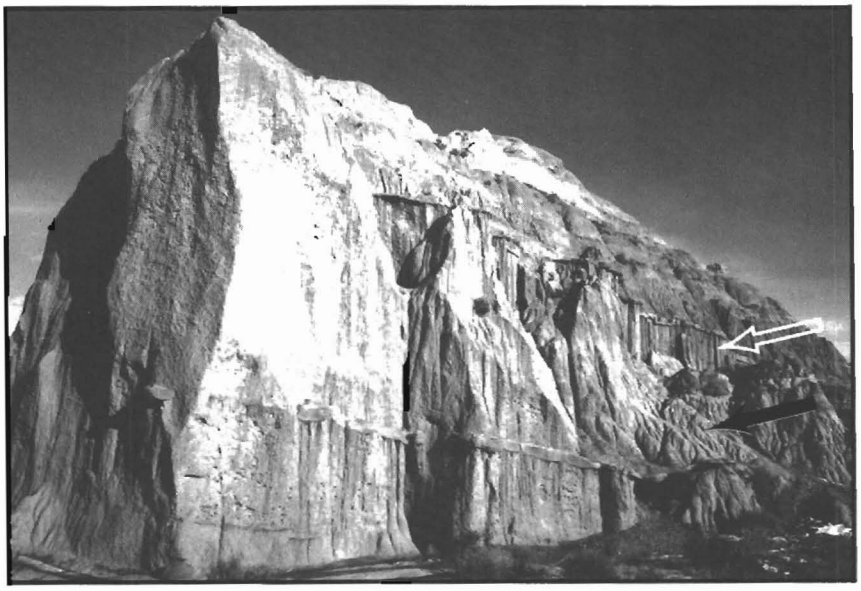


Figure 9. A thick sandstone that was deposited within a river system. The open arrow points to castellate weathering (vertical) and the solid arrow points to rill weathering patterns.

leads to Squaw Creek Picnic Area and Campground (50 sites). The 1.1-mile loop Squaw Creek Nature Trail is located here (a 0.7-mile loop section of the trail is paved).

The park may be divided into four major habitat zones (fig. 10). The lowest (zone 1) is on the level of the river, and includes the surrounding area. Plant life in this zone is thick, providing cover and ensuring a good food source of leaves, twigs, fruit and insects. The main factor in allowing such abundant growth is the availability of water. The high water table enables cottonwood and willow trees to tap into the soil moisture. The shade and cover provided by these plants attract animals such as white-tailed deer, fox squirrels, least chipmunks, wild turkey and numerous song birds.

The small, brown pump house on the left provides water for Squaw Creek Campground. The 400-foot-deep well obtains water from a sandstone layer similar to layers that can be seen at the surface.

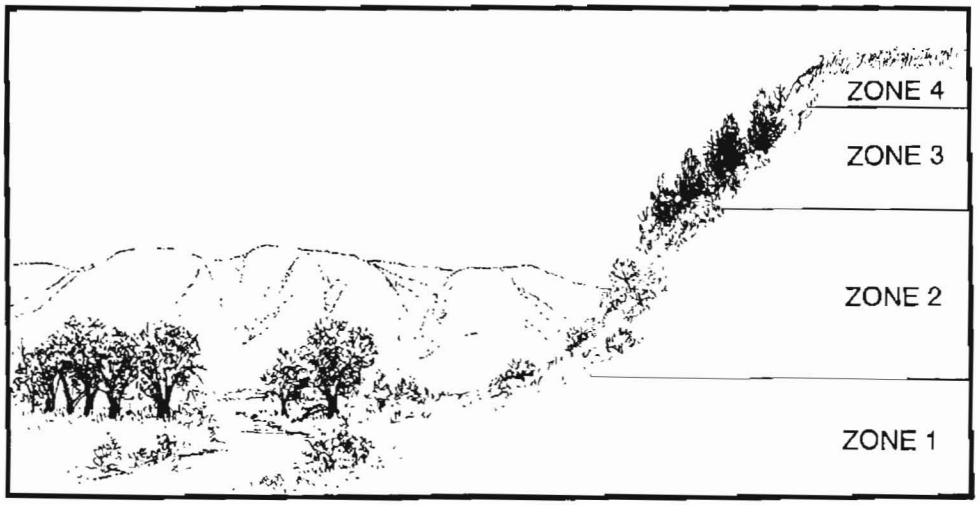
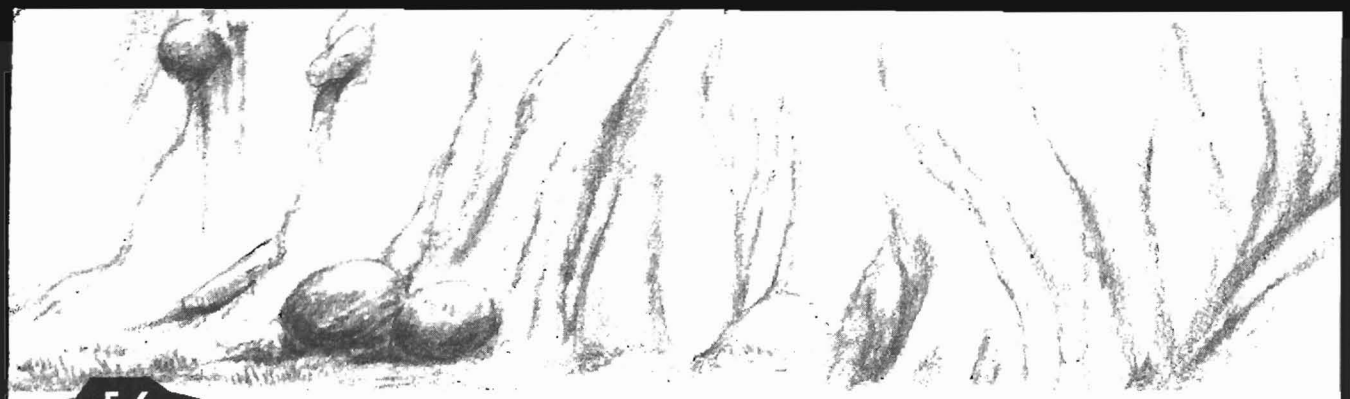


Figure 10. The four major habitat zones within the North Unit



5.6

Long X Trail Pullout. Immortalized in the art of Russell and Remington and written about by Roosevelt, the long dusty cattle drives made the colorful cowboy and wily longhorn forever a part of our western heritage. Starting in 1884, a steady stream of longhorns was driven from Texas through this valley on the Long X Trail to a ranch just north of the park. Today, the North Unit encompasses part of the old Long X Ranch cattle range, operated by the Reynolds Brothers of Texas. One can walk the same route of this famous cattle drive by following this section of the 11-mile loop Buckhorn Trail north through Squaw Creek valley.

On the other side of the road from the parking area, are excellent examples of rivulet erosion in sandstone ledges. This is a favorite spot for photographers.

6.0

Mile marker 6. Since leaving the cottonwood river-bottom habitat, you have been travelling in the second major habitat zone of the badlands (zone 2 - fig. 10). An elevation change of only 10 or 20 feet makes a big difference in the interactions of geology, climate, plants and animals. The lack of water-loving plants indicates that water is more limited here. Rocky Mountain juniper, silver sage and grasses dominate this zone.

6.2

Caprock Coulee Nature Trail. Across the road from the trail parking, two lignite coal seams can be seen in the bowl-shaped face (scarp). The overlying sand and clay layers often flow over and cover lignite seams at the surface. This is the reason lignite is generally not easily seen except on fresh cuts.

Two hiking trails are accessible from here. The 4.1-mile loop Caprock Coulee Trail reaches the River Bend Overlook before it returns to this parking area. A nature trail guide, available at the trailhead, corresponds to numbered posts along the first 0.8 mile of this trail.

A spur also connects with the 11-mile loop Buckhorn Trail. About one mile from here along this trail is a small black-tailed prairie dog town. In 1986, the population of this town was wiped out by sylvatic plague. The disease was introduced by fleas from a domestic dog. After a year, prairie dogs

began moving down from another town to repopulate this site.

As you leave this area, the road climbs and curves through Cedar Canyon, taking you up 400 feet to the top of the buttes. Watch for differences in the topography. You will be changing habitat zones once again, driving through north-and south-facing slopes (zone 3 - fig. 10).

If it snows during the winter months or is icy, the park road is closed at this point.

Look at the bluish-colored bed draping the surface like a blanket. This bed is a volcanic ash deposit that has been chemically altered to become clay. Geologists have determined that this 10- to 30-foot-thick bed was deposited by clouds of volcanic ash blown to this area from west-central Montana about 55 million years ago. The ash (glass particles) covered the area and was transported into a shallow lake system by rivers and streams. Most of the volcanic glass was later altered to clay by the action of groundwater. The resulting purplish-blue clay, which is called bentonite, may swell up to 16 times its dry volume when wet. The characteristic "popcorn texture" is due to the repeated wetting and drying of the clay. Bentonite is used commercially in over 200 products and is actively mined not far from here, in Wyoming.

River Bend Overlook. A short walk from the parking area will take you to a stone shelter providing a prominent view of the Little Missouri River, 550 feet below. The overlook shelter is constructed of sandstone slabs and was built in 1937 by the Civilian Conservation Corps (see page 13, mileage 12.9). The North Unit was added to Theodore Roosevelt National Memorial Park in 1948.

The flat, wooded area on either side of the Little Missouri is the river floodplain (fig. 11). The floodplain contains river-deposited sand and gravel that forms an aquifer—a body of saturated sediment from which a well can produce water. This particular aquifer ranges from 25 to 200 feet thick. Many of the ranches along the river have wells that produce from this shallow aquifer.

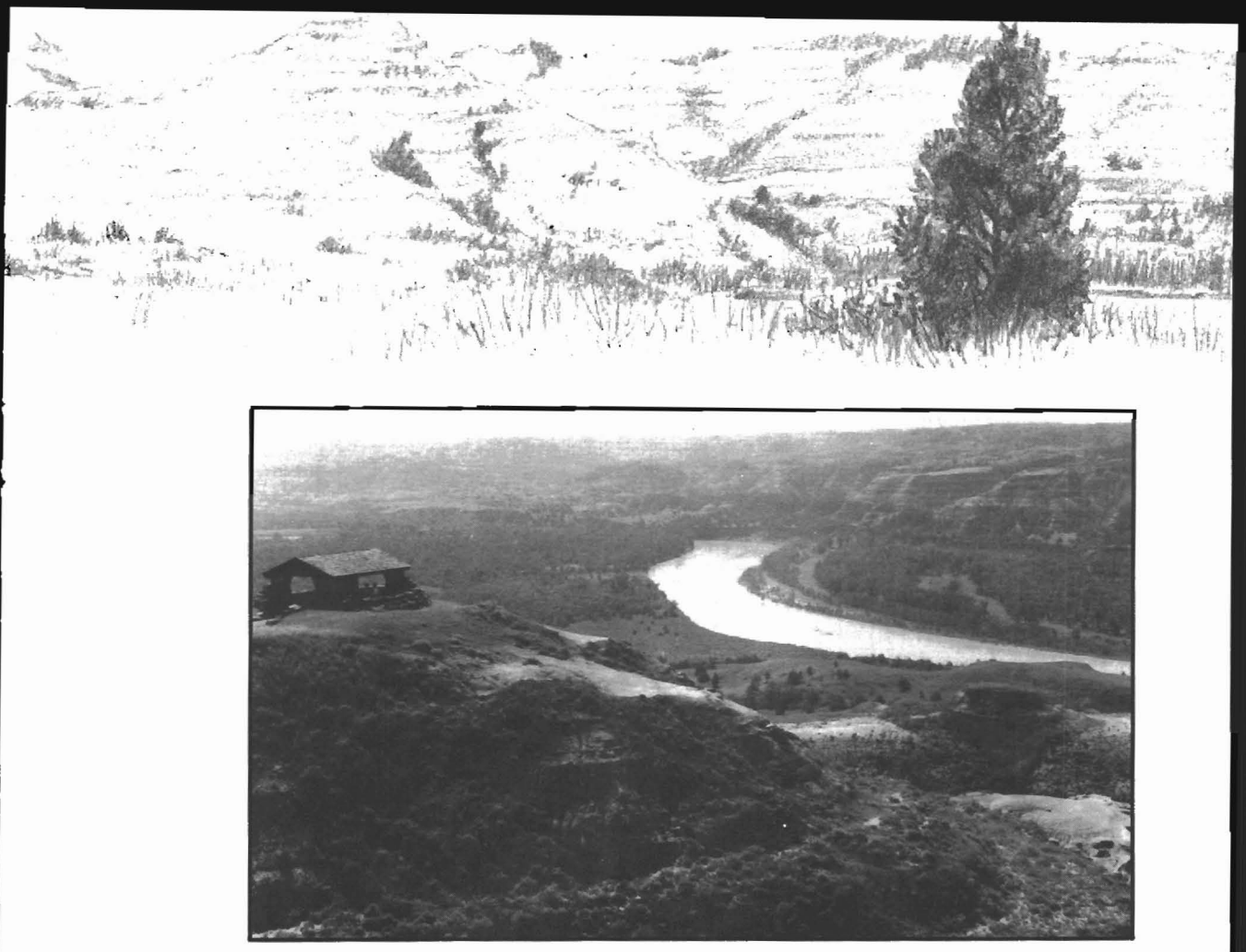


Figure 11. View of the Little Missouri River Valley looking to the east (left) from the stone shelter.

The Little Missouri River is variable in size and depth over the course of a year. In the spring and early summer, it may be bank full (7 to 8 feet deep) and strong enough to transport entire cottonwood trees. The river usually shrinks as summer progresses until, in very dry years, it is only a few feet wide and a few inches deep. At times, it may stop flowing altogether on the surface.

The Little Missouri was diverted into this area by a glacier which blocked its north-flowing course about 600,000 years ago. The new route was shorter and steeper than the old one and for this reason the river began to erode easily downward through these soft layers of sedimentary rock. The river has sliced its way down 550 feet below the surrounding uplands. Therefore, to cut this valley, the river has averaged slightly over one inch of erosion for

every hundred years. Runoff from rain and snowmelt also contribute to the carving of the badlands. The poor vegetative cover over most of the badlands area leaves the soft sediment unprotected. The numerous landslides and slumps also contribute to the development of the badlands area.

8.0

Mile marker 8. Elevation 2450 feet. You have climbed to the highest habitat zone (#4) in the park - the upland prairie or grassland environs which comprises nearly 6,000 acres of the park. This zone provides critical ecosystems for a wide variety of life and the park's biological diversity depends on a healthy prairie. Hidden amid the grasses are many other plants. Wildflowers bloom spring/summer/fall to add a touch of color.

8.6

Wooded draws on both sides of the road provide shelter and food for migrant birds. Watch and listen for mountain bluebirds, Lazuli buntings or clatter of the black-billed magpie.

8.9

Bentonitic Clay sign. From this commanding view, one can easily pick out different features that have been discussed previously. The blue/gray bentonitic clay layer and the reddish/orange scoria outcrops are well exposed. North- and south-facing slopes can also be compared and contrasted.

On a clear day, the Killdeer Mountains can be seen to the southeast, approximately 30 miles away.

9.6

Man and Grass Pullout. The amount of annual precipitation received (about 15 inches), plus temperature extremes and wind, dictate the type and size of grasses that grow here. Most of the grasses grow between 2 and 4 feet. Therefore this part of the Great Plains is referred to as the mixed grass prairie. The more common grasses in this area are needle-and-thread, western wheatgrass, little bluestem, blue grama, prairie sandreed, sideoats grama and prairie Junegrass.

The root system is the secret to the grasses success on the prairie. Each plant has a very deep root system that may extend as much as 8 feet down. The roots are very effective in providing an anchor for the plant against the prairie winds and protect the soils from wind and water erosion. The root

systems of different plants grow to different depths so they are not all drawing from the same soil level for their water and nutrients. The roots also play an important role in grass reproduction.

12.0 **Mile marker 12**. Ahead of you across the river on the horizon are the Achenbach Hills, where the highest point in the North Unit is located: 2687 feet. The hills were named after one of the pioneers who once lived and ranched there. Many ranchers in the badlands sold their land to the government under the Resettlement Act during the depression of the 1930s.

12.4 **Edge of Glacier Pullout**. The occasional boulders hidden in the grass are glacial erratics, rocks "out of place," carried some distance from their origin by glacial ice and deposited here. Erratics can range in size from pebbles to car-sized blocks and some may be worn smooth from bison using them as rubbing stones. These rocks are all that remain of early glacier deposits, which may have been much more extensive here in the past. You will not see erratics in the South Unit since the glacier ice did not extend to that area.

13.7 **Oxbow Overlook**. End of road. The Little Missouri River makes a huge bend as it turns to the east (left). Eventually, the river will abandon the large U-shaped portion of the channel and will flow in a more direct course, leaving an oxbow (fig. 12).

In the history of landform development, the Little Missouri River has undergone crucial and dramatic changes. Prior to the Ice Age, the Little Missouri joined the Yellowstone River near Williston and flowed on to Hudson Bay (fig. 2, page 7). A southward advancing glacier blocked the northerly flow of the ancient Little Missouri River just west of here. The glacier dammed the river and formed a temporary lake which increased in depth until it overflowed to the east over the containing walls of the ancient valley. After the glacier melted, the Little Missouri did not return to its old river bed but, instead, continued to flow eastward, rapidly eroding downward over its new, steeper course. The old, abandoned river valley north of here - that is, the Little Missouri River bed before the glacier blocked it - can be seen from this

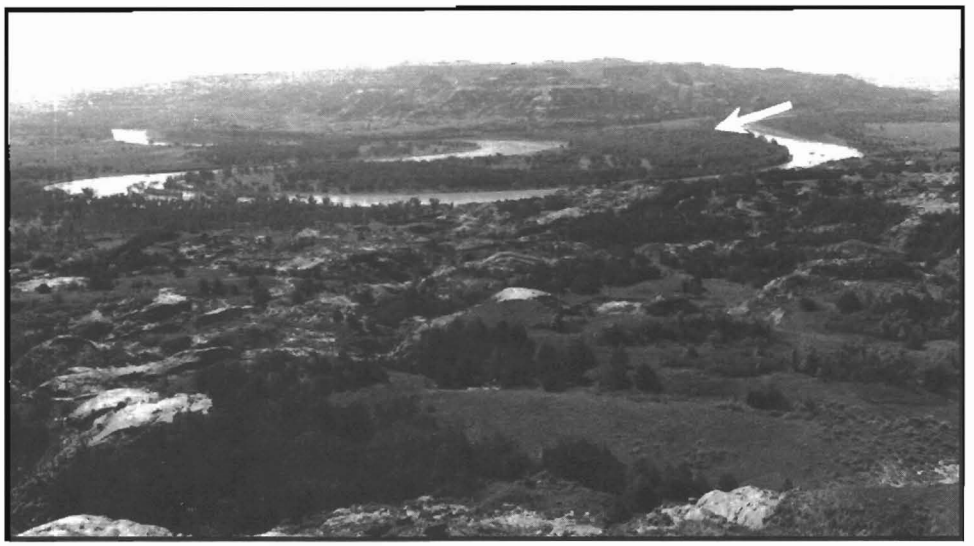
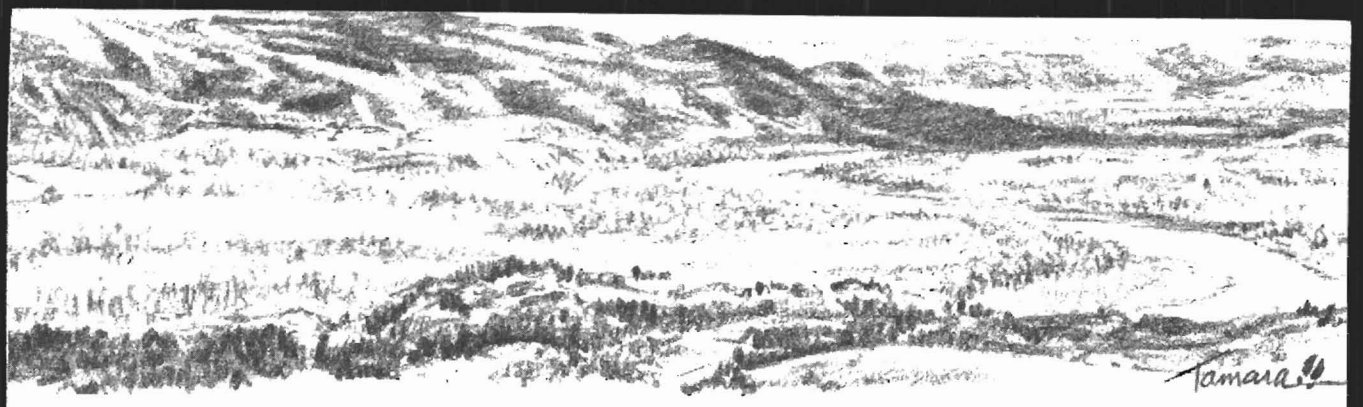


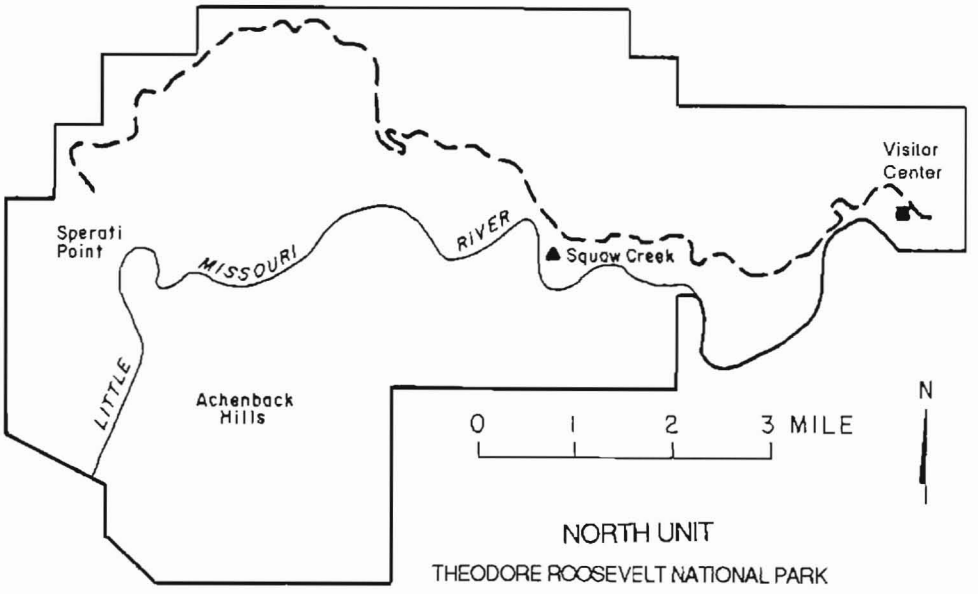
Figure 12. The Little Missouri River at the Oxbow Overlook. The arrow points to where the meander loops are eroding toward each other and will eventually intercept, leaving the loop abandoned as an oxbow.

overlook. It is the flat, gently depressed area four miles north of here now occupied by Cherry Creek.

If you look down below the cliff, you can see a section of the 16-mile loop Achenbach Trail. Hikers may start on the trail from this parking area or from Squaw Creek Campground.

As you retrace your steps back toward the park entrance, the drive will provide different views of the badlands. Geologic features hidden before may now be visible. Also, keep a lookout for evasive wildlife. They may have moved into sight after you passed by them the first time. You never know what surprises will appear as you round the next curve or top the next hill! Drive carefully.





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