

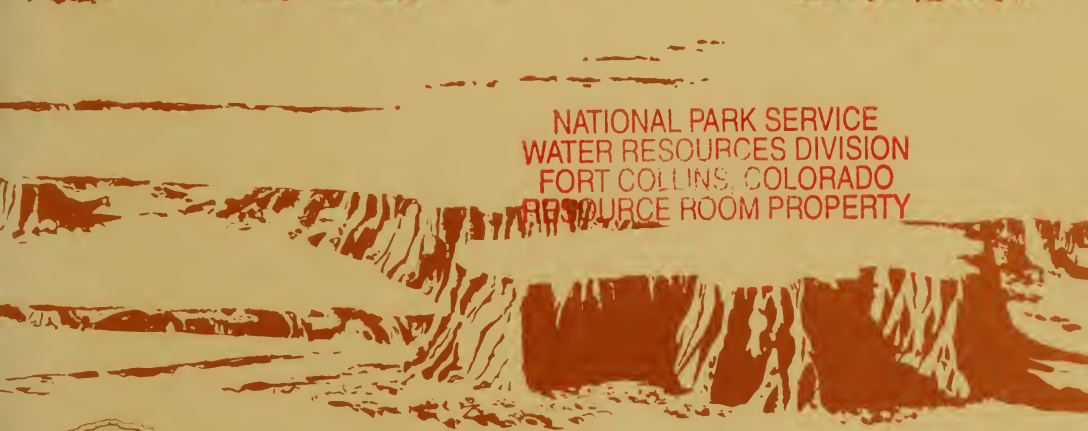
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BADLANDS

NATIONAL MONUMENT



NATIONAL PARK SERVICE
WATER RESOURCES DIVISION
FORT COLLINS, COLORADO
RESOURCE ROOM PROPERTY



NATURAL HISTORY HANDBOOK



UNITED STATES DEPARTMENT OF THE INTERIOR

Stewart L. Udall, *Secretary*

NATIONAL PARK SERVICE

Conrad L. Wirth, *Director*

NATURAL HISTORY HANDBOOK NUMBER TWO

This publication is one of a series of handbooks explaining the natural history of scenic and scientific areas in the National Park System administered by the National Park Service of the United States Department of the Interior. It is printed by the Government Printing Office and may be purchased from the Superintendent of Documents, Washington 25, D. C. Price 25 cents.

BADLANDS

NATIONAL MONUMENT

South Dakota

*By Carl R. Swartzlow
and Robert F. Upton*



NATURAL HISTORY HANDBOOK SERIES No. 2

WASHINGTON, D. C., 1954

(Revised 1962)

NATIONAL PARK SERVICE
WATER RESOURCES DIVISION
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The National Park System, of which Badlands National Monument is a unit, is dedicated to conserving the scenic, scientific, and historic heritage of the United States for the benefit and enjoyment of its people.

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SOUTH DAKOTA STATE HIGHWAY COMMISSION PHOTOGRAPH

The badlands contain a myriad of erosional forms



BADLANDS NATIONAL MONUMENT *is a wonderland of bizarre, colorful spires and pinnacles, massive buttes, and deep gorges. The forces which carved these features have not only created a unique topography; they have given a strange beauty to an almost desolate land. Here, from many points of vantage you can see with clarity the process of wearing away the land and cutting new and complex features in an older surface of more subdued form. The rapidity of the wearing away, or erosion, of a land poorly protected by vegetation is also well illustrated.*

The highway through the badlands is a show window through which you can look into the heart of one of the world's most dramatic demonstrations of the great sedimentary land-building process, shown in storybook form in the color-banded formations. These sedimentary deposits, derived from the breakdown and transportation of older rocks, have been and are being cross-sectioned so rapidly by erosion that the story of earlier deposition is being revealed almost with the speed and continuity of a motion picture. A short walk into the badlands, perhaps on the marked route from "The Door" (near the east entrance to the monument) will make the raw action of badlands erosion a vivid personal experience.

You will not have to hike into the badlands, however, to appreciate its complex of sharp ridges, steep-walled gullies and canyons, pyramids, knobs, and spires. You can drive along the highway through the monument and stop at parking overlooks to view this landscape of varied forms and pleasing, soft colors. It seems to be another world. The scene that unfolds may raise the question, "What is going on here?"

The story of what is happening began millions of years ago. This semiarid region was then a broad plain of marshes and of sluggish rivers flowing eastward and depositing on their flood plains layers of silt, sand, and gravel. Lush vegetation covered the land. Animals

that no longer exist were abundant. As they died, the remains of some of them were buried in the river sediment or sank into the ooze and decaying vegetation in the marshes. A long chapter in the majestic story of animal evolution is vividly told by the abundant fossil remains.

Gradually, because the land was rising, with the change in elevation affecting the climate, the well-watered land of luxuriant vegetation gave way to the semiarid high-plains region of today. Aimlessly wandering rivers no longer deposited their loads of sediments across a broad region, but rather began to cut into and carry away the layers formerly deposited. This rapid cutting-away action is going on today. As streams cut back into the high plain, the "bad land" is forming. As erosion exposes the layers of rock and the remains of plants and animals, it makes it possible for geologists to help us visualize life and landscapes that were here millions of years ago.

Location of the Badlands

Several areas in the United States have a type of landscape called badlands. Some of those in the National Park System are described on page 46. The classic example, however, is here in the "Big

Modern roads lead into the heart of the badlands





SOUTH DAKOTA STATE HIGHWAY COMMISSION PHOTOGRAPH

A great thickness of rocks is now exposed in the wall of the badlands

Badlands of South Dakota.” Since the White River flows through much of the area, references are found to the “White River Badlands.” Geologists have placed this formation in the Oligocene Epoch. (See geological time chart, p. 6, and the description beginning on p. 5.) To remove any doubts as to identity, they have applied the title “White River Oligocene Badlands.” All of these names refer to the same locality, mostly in southeastern Pennington County and northeastern Shannon County, in South Dakota.. Southwestern Jackson County and northwestern Washabaugh County also have colorful examples of this weird landscape. (See map, pp. 22-23.) Both exceptional and typical portions of these extensive badlands are within the National Monument.

History and Prehistory

Early French-Canadian trappers, probably in search of beavers, are credited with being the first white men to view the badlands. They aptly described the region as “Les mauvaises terres à traverser” be-



The "White River Badlands." Note the new cycle of badlands forming at the base of the badlands wall

cause it was, indeed, "bad lands to travel across." The Indians, too, had a name for it—"Mako Sica" (mako, meaning land; sica, bad).

Although it was never heavily utilized as a habitation area by prehistoric Indians, Badlands National Monument contains ancient remains which indicate that Indians roamed over this country, from time to time, for several thousand years. A lance-shaped point, of a type used during the Archaic Period (about 2000 B.C. to A.D. 500), was found northeast of Dillon Pass a number of years ago.

On the west rim of Sage Creek Basin there is an abundant supply of good water. Since this was presumably the only source of water within many miles, it attracted groups of hunting or traveling Indians. Stone chips and camp refuse at this site indicate that Indians camped here periodically while they refreshed themselves and made arrow-points, knives, scrapers, and articles necessary to the hunt.

Later Indians, probably late prehistoric Mandan and Arickara, brought pottery into the area on their seasonal bison hunts. Probably a few small groups lived in sheltered valleys and along the White River in the badlands.

A little over a century ago (in 1846 and again in 1847), there appeared the first published accounts of a fossil animal from the badlands. Dr. Hiram A. Prout, of St. Louis, was the writer. In 1849, Dr. John Evans, under the direction of Dr. David Dale Owen, geologist of the General Land Office, explored and made fossil collections in the badlands. Owen's report, containing fossil descriptions by Dr. Joseph Leidy, may be considered the beginning of the science of vertebrate paleontology in the United States. Other expeditions soon followed, and many universities, museums, and scientific bodies came to the area to gather a share of its scientific treasures. The South Dakota School of Mines and Technology in Rapid City is perhaps the institution most actively engaged today

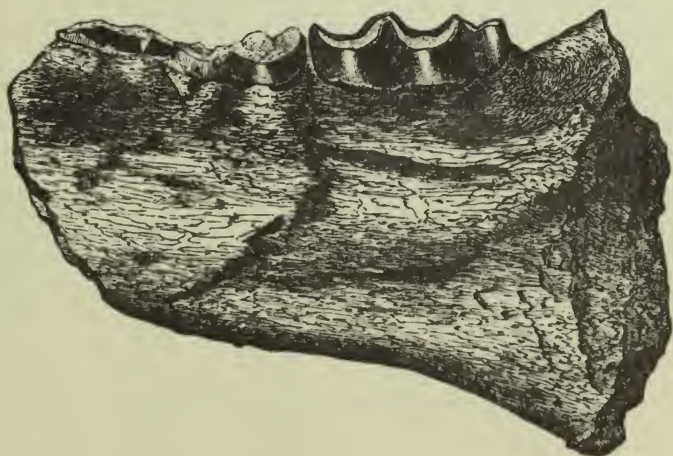
in research in the area. Recent field explorations and studies have resulted in numerous important discoveries, and the reports on them have enriched the scientific literature of the region.

The badlands were off the principal early travel routes and played only a minor role in western history. Only a few events of general interest are known. Two of these are worthy of mention.

Jedediah Smith, famous western explorer, is believed to have followed the White River Valley through this region en route to the Black Hills from the Missouri River in 1823. In 1890 the Sioux Indian Chief, Big Foot, was moving his followers to what is now the Pine Ridge Indian Reservation and was pursued by soldiers of the United States Army. The latter expected to corral the Indians on the northerly edge of the badlands, since the military were convinced that there was no way in which the Indians could traverse the rugged country. Chief Big Foot, however, had other ideas. He moved his entire band through a pass and thus escaped the soldiers for a short time, to meet them later in the famous Battle of Wounded Knee. Big Foot Pass is named for this enterprising warrior. There are two known campsites of Big Foot and his band within the monument.

Age of the Badlands Rocks

Although the formations of the badlands are young as compared to some rocks such as the granite in the Black Hills or the limestone in which Wind Cave is formed, they are ancient indeed when



The first fossil described from the badlands—a fragment of the jawbone of a titanotheré, a rhinoceros-like animal that lived here some 30 million years ago

GEOLOGIC TIME CHART

Era	Duration, millions of years	Period	Duration, millions of years	Cumulative total, millions of years	Remarks
CENOZOIC (Recent Life) Age of Mammals.	58	QUATERNARY: RECENT EPOCH.....	The atomic age.
		PLEISTOCENE EPOCH.....	1	1	Continental glaciers of North America. Man appeared.
		TERTIARY: PLIOCENE EPOCH.....	12	13	Modern animals and plants became abundant.
		MIOCENE EPOCH.....	12	25	Badlands rocks laid down. Ancestral horse appeared.
		OLIGOCENE EPOCH.....	11	36	
		EOCENE EPOCH.....	22	58	
MESOZOIC (Middle Life) Age of Reptiles.	172	PALEOCENE.....	5	63	Devils Tower formed. Rocky Mountains and Black Hills uplifted. Culmination of the dinosaurs.
		CRETACEOUS.....	72	135	
		JURASSIC.....	46	181	
		TRIASSIC.....	49	230	
		PERMIAN.....	50	280	
		PENNSYLVANIAN.....	65	345	
PALEOZOIC (Early Life) Age of Invertebrate Life.	370	MISSISSIPPIAN.....	}	405	{Great coal beds formed—Jewel Cave and Wind Cave rocks laid down. Fishes and invertebrate animals dominant.
		DEVONIAN.....		425	
		SILURIAN.....		75	
		ORDOVICIAN.....		500	
		CAMBRIAN.....		600?	
PRECAMBRIAN (First Life Appeared) Beginning of the Earth.	2,400 +	NOT SUBDIVIDED HERE	3,000 +	Mostly granite. Mount Rushmore figures carved in rocks of this age.

compared to human history. The geologic period (Tertiary) in which they originated began about 63 million years ago, and the Oligocene epoch of this period began about 36 million years ago and lasted for about 11 million years.

Most laymen are bewildered when confronted with a statement that a certain exposure of rock is 36 million years old. How do we know the age of anything so remote from human experience? The geologist has several ways of determining comparative ages; some are fairly accurate and some admittedly less so. The most accurate determinations are made when the rocks contain radioactive elements. Certain elements, after formation in the earth, break down into other elements at known rates of speed. By carefully controlled chemical and physical techniques, the amount of disintegration can be determined and the age of the mineral computed.

The most reliable estimates place the age of the badlands formations at about 36 million years—an almost incomprehensible figure. Try to visualize it this way: The width of this mark / is $\frac{1}{64}$ of an inch. Let it represent 5,000 years, or about the sum total of recorded human history. Now place 7,200 of these lines side by side to make a solid black bar about 112 inches long and you will have a graphic comparison of the age of recorded history and the approximate age of the layers of rock in the badlands.

Ancient Climates

So far in our brief account of formation of the layers of rock, we have merely mentioned the climate that existed during Oligocene time, the kinds of plants that grew, and the types of animals that roamed the land or lived in the waters.

There is good evidence that at least during the first part of the Oligocene epoch, the climate was comparatively warm and moist. A type of crocodile lived here at that time; palms were present, as were other plants and animals that require a warm, moist environment. Later, these typical warm-weather species vanished from the scene because of changing climatic conditions, and those now commonly found in cooler regions appeared in great numbers.

Local Life of the Oligocene Epoch

Ancestors of many modern animals lived during Oligocene time. Fossil remains from many have been found in Badlands National Monument; fossils of those not found here have been discovered in



VERNE ORDAHL PHOTOGRAPH

Fossils of animals are frequently found in the rocks of the badlands

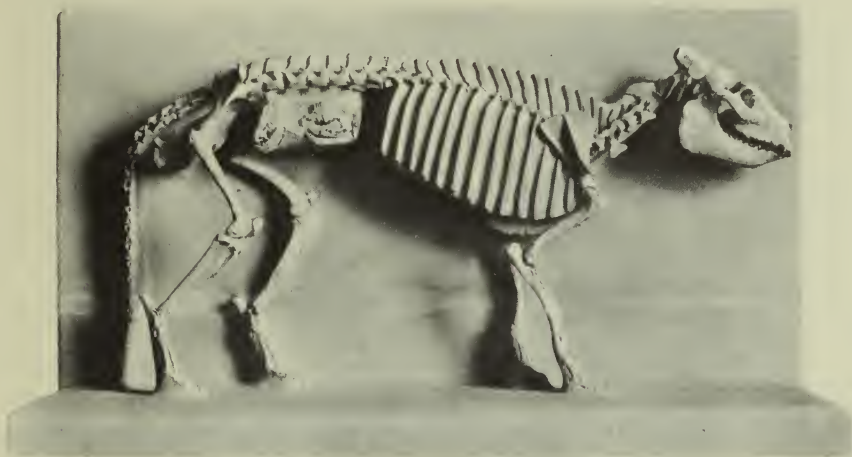
Oligocene rocks of neighboring localities. Paleontologists (scientists who study the life of past geologic periods) have identified remains of early forms of the horse, camel, rhinoceros, tiger, opossum, pig, and dog. We know that primitive rats, mice, squirrels, marmots, beavers, rabbits, and turtles also existed at this stage in the earth's development; but very few are similar to species living today. We also know there were lizards, owls, eagles, gulls, and pelicans; but there are only a few fossil records of them. The bones of these small reptiles and birds were too fragile to survive in quantity. The first horse, about the size of a domestic cat, appeared at the dawn of the Tertiary period (some 20 million years before the Oligocene epoch). By the beginning of the Oligocene, it had evolved into an animal about the size of a sheep. Other strange creatures such as the oversized titanotheres and brontotheres no longer exist.

The swampy areas were death traps that claimed the lives of scores of animals. We assume that the larger ones were mired in the muds and sands and could not extricate themselves, and others died of disease, were killed by predators, or succumbed from other natural causes. In any event, the skeletons of many species are entombed in the badlands rocks.

After the bodies were covered by mud and the fleshy parts decomposed, petrification began. In brief, this process consists of the infiltration of buried bones by mineral-carrying waters and deposition of material, usually silica (which has great hardness), in the pores and other open spaces of the bones. Thus, instead of a normal skeleton,

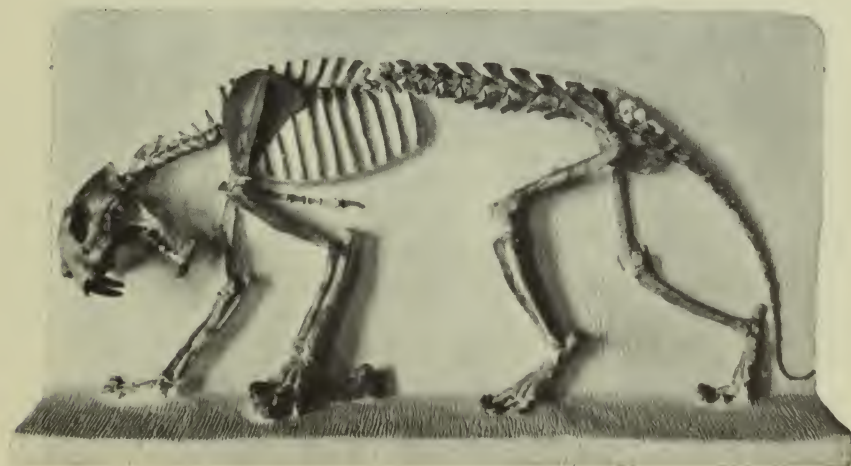
a hard and resistant structure is formed. These stoney skeletons (fossils) are normally much more durable than the enclosing rocks and, as the softer covering is worn away, the fossils tumble to the base of cliffs or are left exposed in the rocks.

We have already noted that the first published record of a Badlands fossil appeared in 1846. After the first few accounts called attention to this region, a great deal of collecting was done and fossils



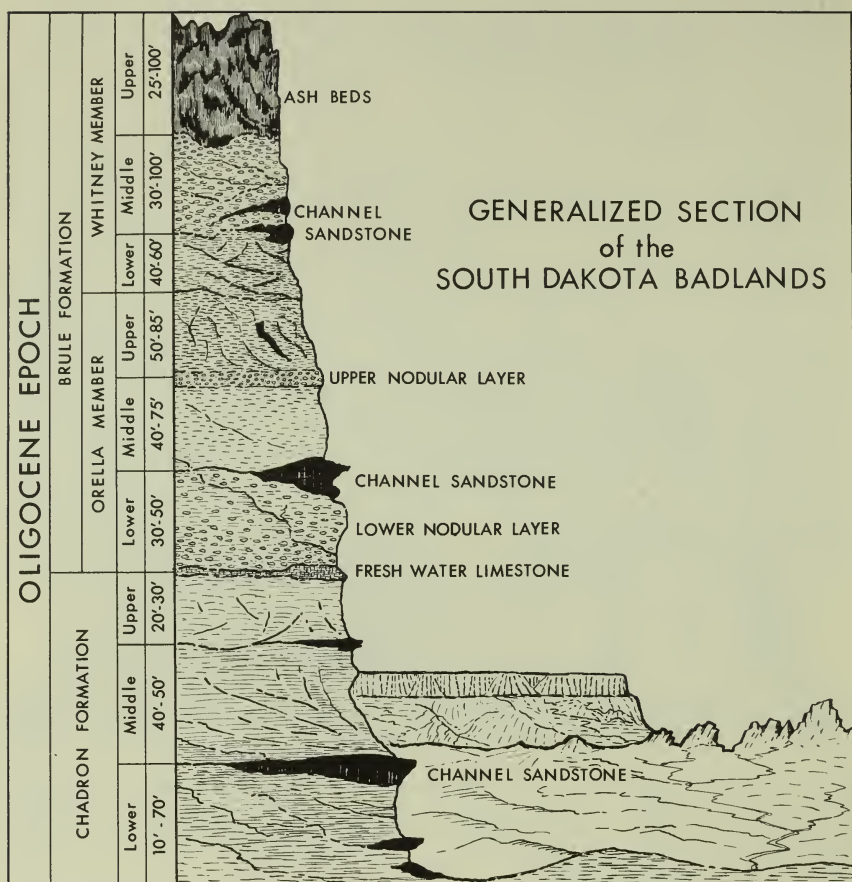
SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY PHOTOGRAPH

An articulated skeleton of an oreodon, a primitive cud-chewing, sheep-sized animal, here with unborn twins. This is displayed in the museum of the South Dakota School of Mines and Technology in Rapid City



SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY PHOTOGRAPH

A saber-toothed cat skeleton from an exhibit in the museum of the South Dakota School of Mines and Technology. This animal was about the size of a large lynx



were sent to most major museums in the country. Collection of fossils on public land is now limited to approved scientific institutions operating under special permits. Excellent collections of Oligocene fossils are on display at the museum of the South Dakota School of Mines and Technology in Rapid City and the University of Nebraska Museum in Lincoln. You are welcome to visit these museums, where you may profitably spend several hours studying the fascinating story of the life of this bygone epoch.

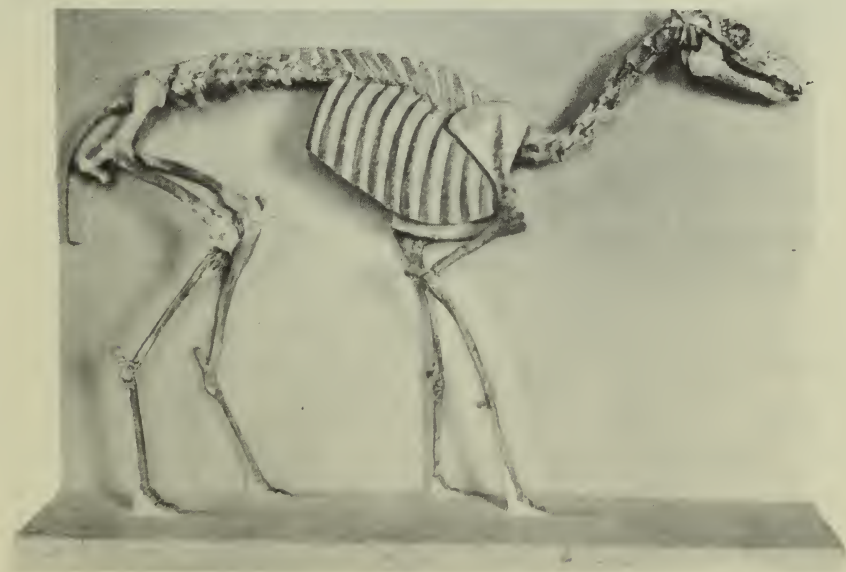
Deposition of the Rocks

A vast period of time (probably around 3 billion years) preceded the creation of the badlands as we now know them. If you will look

at the geologic time chart (p. 6), you will notice that a period called the Cretaceous began about 125 million years ago and ended some 60 million years ago. At the close of this period, the North American continent experienced widespread changes. These took place especially along the present Rocky Mountain range and to a lesser extent in the vicinity of the Black Hills. Up to this time, the land where these mountains now stand was comparatively flat. In it were shallow lakes, swamps, and wide plains crossed by sluggish streams. It was pretty much as central and eastern South Dakota is today. Then gradually but slowly, forces within the earth caused a buckling of the continent in a general north-south direction across most of the United States—along the present Rockies and also in the Black Hills region.

In the uplifted areas, streams that once were sluggish now flowed more rapidly. Before this they were clear; but now they started to scour their channels. Their tributaries also dumped large quantities of mud, sand, and gravel into the main streams.

These rapidly moving waters carried their burden of sediment out of the mountains to where the country flattened out. Here the carrying capacity of the streams was reduced as the currents slowed down. This resulted in the deposition of sand bars, mudflats, and gravel banks along the course of the streams. These choked the



SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY PHOTOGRAPH

Camels once lived in the badlands region. This camel skeleton, smaller than the skeleton of a sheep, is displayed in the museum of the South Dakota School of Mines and Technology



RISE STUDIO PHOTOGRAPH

The layering in the exposed rocks gives evidence of the method of their deposition

channels and caused the water to fan out over wide areas. Depressions were filled with the sands and clays that the streams could no longer carry. This process continued throughout the long period when the Rocky Mountains and Black Hills were being pushed upward. It stopped only when the streams had graded their courses to a gently sloping bed. About 2,000 feet of sediments were laid down in this part of the Great Plains before the process ended.

Toward the close of this period of deposition, a series of prolonged volcanic eruptions took place, principally in the Big Horn and Yellowstone regions. Huge quantities of volcanic ash were carried by westerly winds and dropped over western South Dakota. These accumulated in the badlands region to as much as 25 feet deep. In the vicinity of Sheep Mountain some of these ash deposits can be recognized by their chalky-white color. Much of the ash was washed away by the streams and redeposited on the flood plains in the same manner as were the clays. The older ash deposits are a rather dirty gray, compared to the younger white ash beds. The darker color indicates a larger amount of impurities present. These impurities are mostly bits of clay and silt, added, in the redeposition process, by the streams.

The whitish color of the ash beds, even those of reworked material, stands out in rather sharp contrast to the pink, red, tan, brown,



Sheep Mountain

bluish gray, and gray of the other badlands rock layers. Generally speaking, the intensity of the red color is proportional to the amount of red iron oxide present. The various shades of tan and brown are produced by brown iron oxide, the same substance found on rusty iron. Gray colors are most frequently caused by the absence of organic matter. Occasionally, some purplish colors are noticed. These are believed due to the presence of manganese. Whatever the causes, the varied hues of the badlands spires and pinnacles have contributed to the fame of this eroded landscape. You'll see the colors at their best when they are intensified by rains and the light of evening or early morning.

Formation of the Landscape

The deposition of the badlands rock scarcely had been completed before the process of erosion of the same area began. At this stage,

the broad valleys had been filled with sediments to depths of several thousand feet. We can surmise that the rise of the earth's crust caused the streams to increase their speed slightly and thus to start cutting downward. By this process definite channels became established. Of course, the rivers meandered and, by cutting their valley sides, widened their flood plains to some extent. However, the flowing waters were not following identifiable courses and were not wandering all over the landscape as they had during the time the badlands rockbeds were being deposited

We should remember that the Oligocene sediments were mostly clays and shales, with a few thin beds and lenses of sandstone and some layers of volcanic ash. These rocks are comparatively soft and easily washed away by rain or stream action. Such rapid erosion prevents most plants from getting established; so there are few roots in the soil to bind it and resist erosion. In this locality the White River cut downward quite rapidly, and its banks were steep. The smaller tributary streams also deepened their channels to keep pace with the downward cutting of the White River. Thus, along the stream courses steep-faced gullies were developed, and the stage was set for the formation of the spires and pinnacles. The canyons to-day have steeply dipping streambeds and very steep walls. An aerial

Tributary streams have cut deeply into the rocks



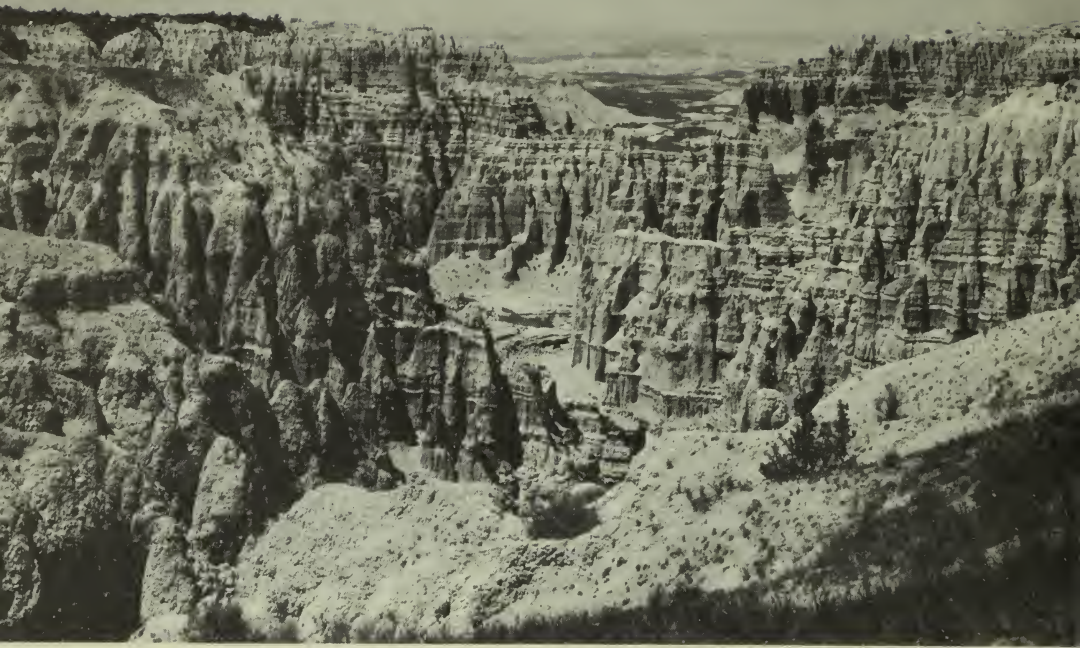


Cedar Pass, looking south to Vampire Peak and the White River

view would give the impression of a giant tree, with the White River forming the trunk and the tributaries forming the branches and twigs.

Rainfall in this section of South Dakota often occurs as a sudden, heavy downpour (cloudburst) accompanied by thunder. Such heavy rains of short duration, with long dry periods between, are essential factors in the formation of badlands topography. The soft rocks and loose soil are rapidly sculptured during the brief heavy rains, but they dry quickly and harden between storms to preserve the intricate turreted ridges and sharp gullies. The rapid erosion and fast drying prevent the development of a plant cover which would otherwise retard erosion.

During cold weather a further modifying force is in effect. Water, from either rain or melting snow, seeps into cracks and crevices and fills them. As you know, when water freezes it expands about $\frac{1}{10}$ of its volume and thus exerts considerable pressure. The repeated freezing and thawing process eventually loosens the rock, and it tumbles to the bottom of the gully, later to be washed away. During the dry summer, winds sweep over the badlands and fine dust particles are carried to distant places. The amount of material moved at any one time is slight, but the cumulative effect of centuries of wind erosion is astonishing.



Erosion carves the badlands and then destroys them

In a few localities there are spires with wide, flat caps, looking like huge nails or long-stemmed mushrooms. They developed because the cap rock was harder than the underlying rock, which wore away much faster. Eventually, any such cap tumbles to the base of the weakening spire which has been supporting it.

Secondary Features

At some stage after the badlands rocks had been laid down, the upper exposed part was subjected to drying and, as a result, a series of nearly vertical cracks or fissures developed. Later, percolating ground water dissolved silica from the surrounding rocks and deposited it in these fissures. The most common mineral thus produced was chalcedony—a hard, brittle, waxy, bluish-tinged substance that strongly resists erosion. The soft surface rocks have been worn away and the hard, thin, knifelike ridges (dikes) stand out in sharp relief. In some places they can be traced for considerable distances. Some of the fissures were filled with softer material of contrasting color, such as brown silt or white volcanic ash. Where the filling

is softer than the enclosing rock, erosion often produces a slight trough along the line of the dike.

In places, very thin cracks have been filled with chalcedony, which has later weathered out in thin, flat fragments. Indians often worked one edge of these flintlike natural blades into cutting tools, which have become known as "badlands knives" because they are found only in this region.

At certain levels in the badlands rocks, small, roughly spherical cavities developed, probably as a result of dissolving away of materials. Later, percolating ground waters lined these cavities with chalcedony. In many instances, silica crystals (quartz) grew inward from the cavity walls, sometimes completely filling them. These spherical nodules are called geodes. In some parts of the United States they occur in sizes as large as a basketball or even larger. Badlands geodes are quite small—about the size of a lemon. Since the silica is relatively resistant, the geodes wash out of the soft clays and tumble to the base of the cliffs in considerable numbers.

Sometimes the quartz crystals do not completely fill the geodes and, occasionally, a crystal becomes detached and is loose within the cavity. When such a geode is shaken, a harsh, rattling sound is heard—hence the name rattlerock.

Future of the Badlands

Every wind that blows and each drop of rain that falls removes some fragment of rock and deposits it in a new location. Each spring freshet, each cloudburst, each stream and its tributaries cause a change in the landscape. In time, the rugged pinnacles will become grass-covered mounds, the fossils will become scattered, unintelligible fragments, and the badlands will have vanished. In time to come, a new earth convulsion may rejuvenate the streams and a new badlands sediment may be deposited in which man could well be the chief fossil. Paleontologists of millenniums hence may ponder over the characteristics of the primates of, say, the 30th century.

*There rolls the deep where grew the tree.
O earth, what changes hast thou seen!
There where the long street roars, hath been
The stillness of the central sea.*

*The hills are shadows, and they flow
From form to form, and nothing stands;
They melt like mist, the solid lands,
Like clouds they shape themselves and go.*

—Tennyson.

Plants

It is estimated that 60 percent of the monument is nearly barren badlands. The remainder, however, contains the various types of grasses that are found just above the broken wall of the badlands, on isolated buttes extending out from the wall, and on the plain below the wall. In addition, colorful wildflowers dot the land in the early summer. Broad-leaved trees occur sparsely along the stream courses. Small groves of juniper grow in the vicinity of Sheep Mountain and in many of the protected pockets and passes. With their verdant foliage, they relieve the barrenness of the deeply eroded canyons and pinnacles.

TREES

The juniper, unlike many other conifers, appears to thrive in all parts of the country and under the most contrasting weather conditions. It withstands the cold of the north and flourishes in the extreme heat of the south. Most of the members of this large genus prefer open, sunny locations and light, clay soils. It is commonly, but incorrectly, called "cedar." It is one of the best-known conifers, for with its wide range of shapes it serves well as an ornament in landscape work.

ROCKY MOUNTAIN JUNIPER. Having an exceedingly wide range, this juniper occurs from Montana to Arizona. In Badlands National Monument and vicinity its height does not exceed 20 to 25 feet. Often it is no higher than a man's head. The foliage has both sharp-pointed, prickly needles and smooth, scalelike ones; sometimes both appear on the same tree. The small, blue, berrylike cone remains on the tree and is a source of food for birds, coyotes, and some other animals during both summer and winter. The foliage and wood have a pungent odor.

PLAINS COTTONWOOD. This is a rapidly growing tree, which matures quickly. It much resembles the eastern cottonwood, with which it was long confused. Often reaching a diameter of 2 or 3 feet, it has a large, spreading top, which gives shade to both man and animal. In early times it was planted by the settler as a shade tree. The leaves are large and oval, with the typical waxy, green gloss of the cottonwood. It grows singly or in small groves in the valleys and along the streambeds. For the beavers that live in the permanent streams of the monument region, cottonwood is the first choice for food and building material.



Junipers have become established on the better stabilized slopes

AMERICAN ELM. The beautiful, vasselike form of the elm is a common sight on the streets of American cities. Along the streams of the badlands, wherever sufficient moisture is available, it grows singly or in small clumps. The leaves are oval, with pointed tips, evenly spaced parallel vein ribs, and finely and evenly serrated edges. This is an important browse tree for deer.

BOXELDER. The fast-growing boxelder was planted extensively as a shade tree by the early pioneers. Though not particularly attractive, it has dense foliage and provides shelter within a few years. It is sometimes called ash-leaved maple, for it is actually a maple with leaves compound (divided) like those of the ash. Boxelder grows along stream courses and in the canyon bottoms.

COMMON CHOKECHERRY. Actually a large shrub, this wild cherry grows in dense thickets in draws and in canyon bottoms. It bears a bright red berry that turns shiny black when ripe. The fruit, which was used by the pioneer housewife, is still the source of delicious jelly and jam. It is a favored food of birds, coyotes, foxes, and some rodents.

SILVER BUFFALOBERRY. This dense, bushy shrub is found growing along the sides of streambeds and nestling in the depressions on the slopes of protected ridges. The long narrow leaves are silver-gray on both surfaces and grow on branches and twigs that bear long, sharp thorns. The red, currant-sized fruit is borne in clusters and is extremely sour. From it a wonderful, tart jelly is made—a favorite of both the pioneer and the modern housewife. It provides an important food for birds.

WILDFLOWERS

When spring arrives and the sun climbs higher in the sky, this land of deeply cut canyons and strangely formed spires and capped knobs becomes a garden of warmth and freshness.

Early in April the AMERICAN PASQUEFLOWER, which is locally known as the crocus, and is the State flower of South Dakota, transforms overnight the bare hillsides, covering them with a pale-blue blanket. Clumps of TUFTED EVENING-PRIMROSE begin to show on the bald clay hills, opening in the evening in their white radiance and wilting the next day with the rising sun.

May brings SEGOLILY MARIPOSA, with its cup-shaped flower on a stem, and COMMON STARLILY, with its stemless, narrow-petaled white blossom. The FENDLER WOODS ROSE is evident by the fragrance of its pink blossoms. The yellow of the PRAIRIE THERMOPSIS, better known as "wild pea," and the rose-purple clumps of LOCO and LAMBERT CRAZYWEED begin to show in the draws and ravines. The white or pink daisy-eyed FERNLEAF FLEABANE dots the roadside and the sides of the hills, and scattered patches of white or bluish HOODS PHLOX form mosslike mats.

In June, yellow PLAINS ERYSIMUM, frequently called wallflower, appears by the roadside. Then come PENSTEMONS, or "wild snapdragons," in shades of blue and white. Bushy SNOW-ON-THE-MOUNTAIN EUPHORBIA begins to flower. If there have been adequate spring rains in the badlands, July will be brightened by blue CANADA VIOLET, orange splashes of SCARLET GLOBEMALLOW, and the yellow-and-brown nodding heads of UPRIGHT PRAIRIE-CONEFLOWER.

The introduced WHITE SWEETCLOVER lines the road through the passes. The white heads of WESTERN YARROW dot the prairie. COMMON PRICKLYPEAR, the most abundant form of cactus in the badlands, has budded and begins its yellow and pink floral display that covers the land as far as the eye can see.

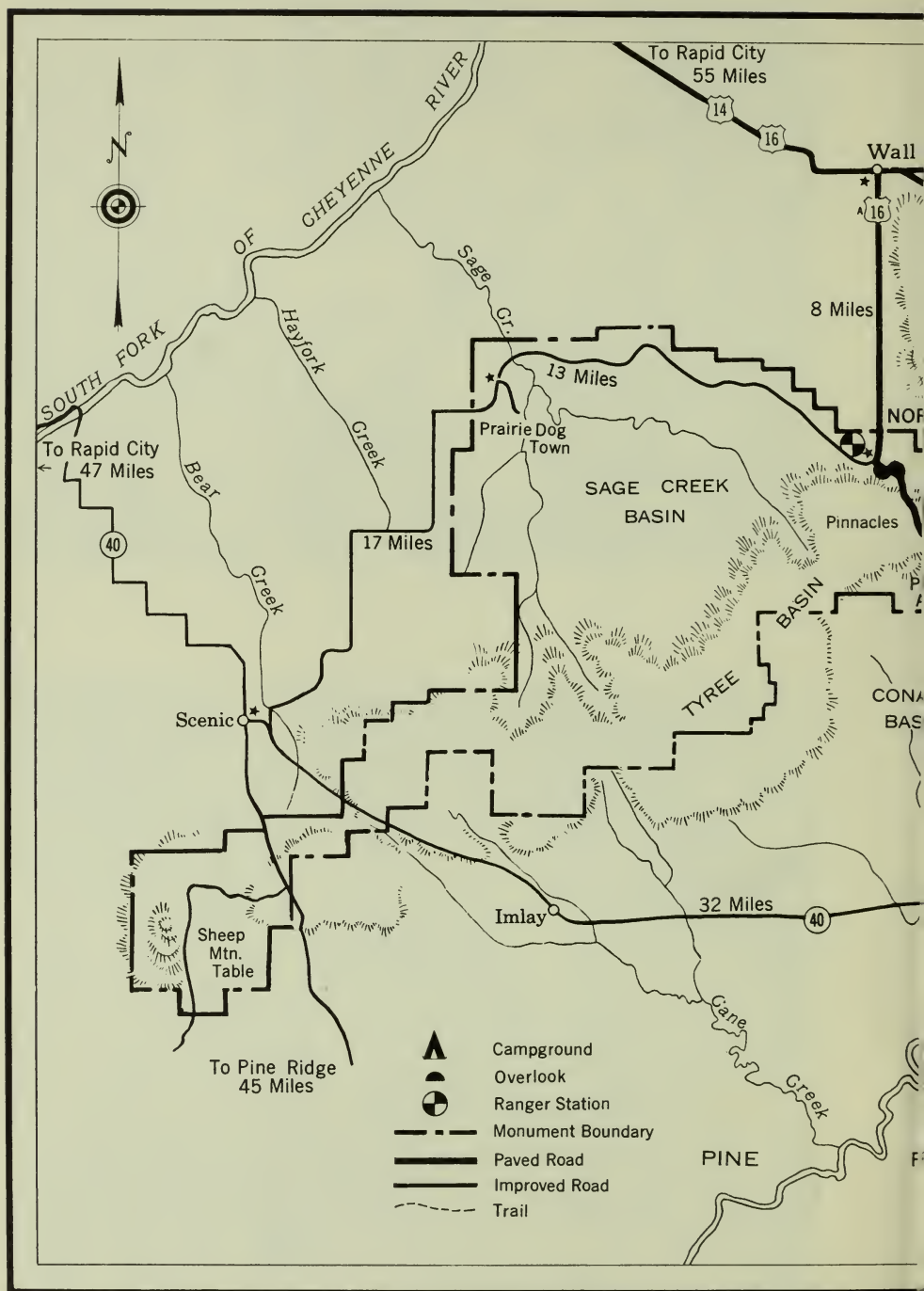
By August and September, most of the flowers have bloomed and faded. Large masses of YELLOW SWEETCLOVER bloom along the roadsides. The coneflower and yarrow still persist, with an occasional scarlet globemallow remaining. The length of the season



Tufted evening-primrose

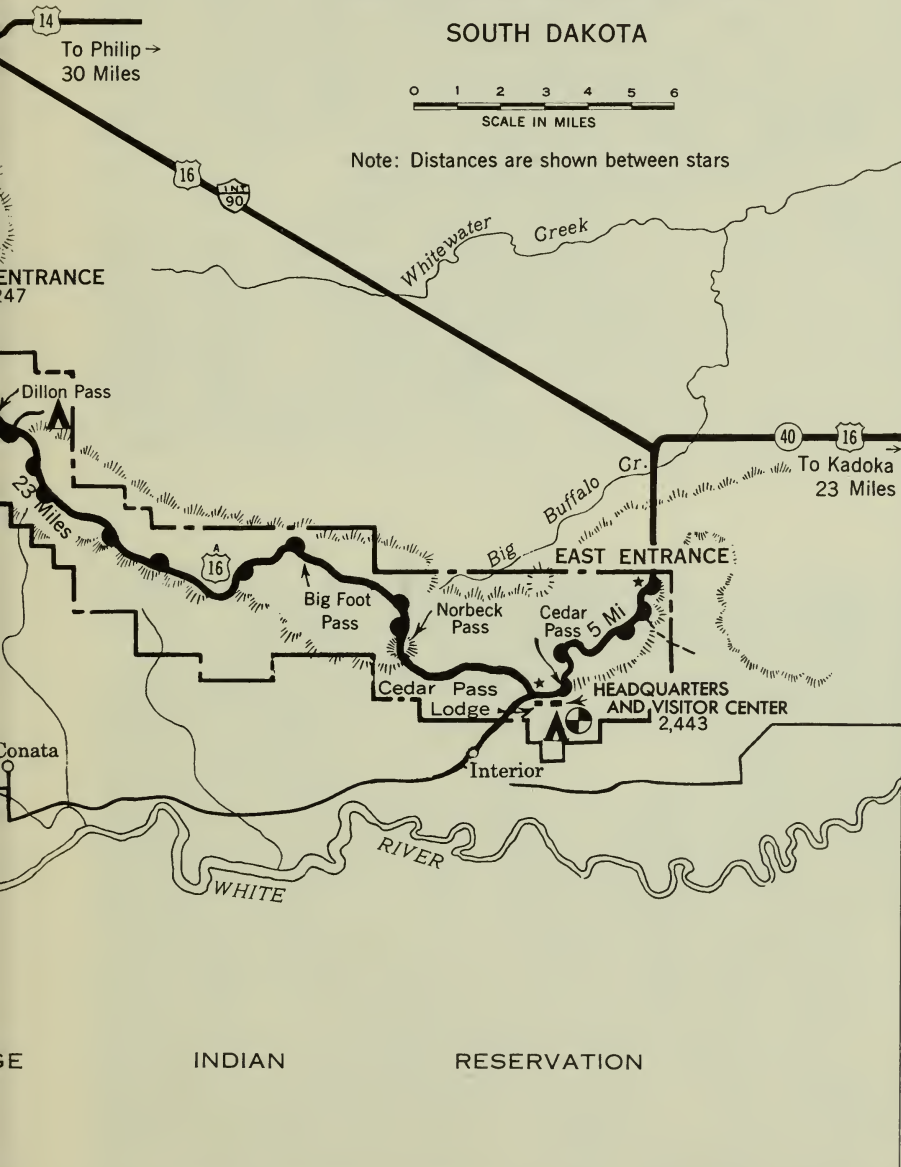
Wild Pea



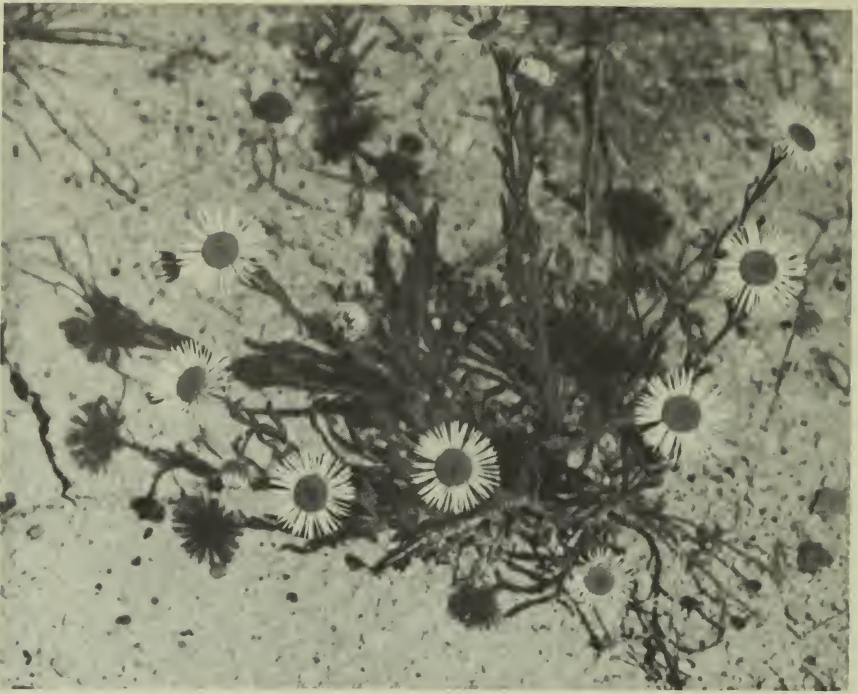


BADLANDS NATIONAL MONUMENT

SOUTH DAKOTA



MARCH 1961 N.M. B.L. 7019



Fleabane

Wallflower



depends upon the rainfall; with occasional summer showers, the flowers continue their display; but if it is dry they soon wither and disappear.

GRASSES

The grasses, although not as colorful as the wildflowers, are a more important part of the ground cover. From them comes the food of the larger animals; within their protection many of the birds build their nests; because of them the topsoil is formed and grows in fertility; their covering mat retards erosion; and from their green mantle man derives great pleasure. The grasses of these plains have supported untold generations of grazing animals in astronomical numbers, from the camels and horses of the geologic past to the bison and pronghorns of the last century.

The various grassland types have developed because of differences in the environment, chiefly soil conditions, in which they grow. There are many such types referred to by the character and depth of soil. Here in the badlands are found representatives of nine types of range, of which four have special significance.

On the higher land, especially along the approach to the Badlands, is a good cover of upland vegetation. It contains principally BLUE GRAMA and NEEDLE-AND-THREAD. At lower elevations, however, the same type of site appears with these grasses subordinated by BLUESTEM ("western") WHEATGRASS and BUFFALOGRASS. The clay and thin-clay sites have a similar covering, with western wheatgrass, blue grama, and buffalograss predominating. The shallow site, as the name implies, consists of a patchy basal cover. Fairly dense stands of blue grama and buffalograss alternate with western wheatgrass. SIDEOATS GRAMA is also a major constituent.

Occasional patches of LITTLE BLUESTEM can be spotted by its reddish color after curing in midsummer. Commonly mixed in with the grasses is the grasslike THREADLEAF SEDGE. At sandy and heavy-soiled sites, the PRAIRIE SANDREED is conspicuous by its unusual height above the other grasses.

The grasslands, or prairies, were once the most extensive plant-type areas of the North American continent. Cultivation, grazing, fire, urbanization, and other factors have so removed or modified these vast areas of grassland that little now remains in essentially its natural condition. The importance of preserving grassland types in Badlands National Monument lies in the opportunity provided present and future visitors to see samples of this cover which is so rapidly disappearing from the American scene. Protection of grasslands in the monument permits study and comparison with other areas that have been greatly modified. The results can be of



Grassy plain at the foot of the badlands wall

Rabbitbrush



value in working out methods of better management, for many rangelands are badly damaged through overuse and their yield reduced as much as half their normal potential.

Animals

The animal life of the badlands and vicinity, as of any region, is molded by the vegetation, the type of soil, and availability of water; the climate, which intimately controls the type of vegetation, thus indirectly has great effect upon the animal life. Most of the animals of the badlands are adapted for living in open grassland and for survival with comparatively little water. Many of them are rather pale in coloration. Thus, they blend with the light color of the soil and dry grass and are less easily detected by their enemies.

BIRDS

Birds live under conditions most favorable to their particular needs. The grassland, the occasional groups of small shrubs and juniper, and even the bare canyon walls provide the food and the environments that certain birds require. Some are transients and are here for only a few days in the spring and autumn. Others nest here and return to warmer climes in the winter. A few remain—dwellers of the badlands—the year round. It is not the purpose to list here all the birds, but mention will be made of some of the more common and interesting ones.

Members of the finch family are seedeaters and have strong bills for crushing their food. In this region members of that family prefer the prairie and the margins of the groves that are close to their food supply.

The AMERICAN GOLDFINCH, frequently called the "wild canary," is a charming little yellow songster with black cap, wings, and tail. Often it flits along the roadside, feeding on the seeds of sunflowers and weeds.

The sparrows, which belong to the finch family, are modest-colored birds, and are often difficult to distinguish. One of the common summer residents is the VESPER SPARROW. You will find a good identifying mark in the white outer tail feathers which flash conspicuously in flight. Its song will come to you in the evening from a lone bush or tree.



Dillon Pass

The LARK SPARROW likes the open country and the grassy hill-sides. The striped crown, chestnut ear-patches, and white breast with a single dark central spot are the best identifying markings. It is a summer resident with a beautiful song.

The song of the CHIPPING SPARROW is a single, prolonged, vibrating trill. A resident of the meadows, the little "chippy" with the bright rufous-red cap is equally at home in the sparsely wooded sections.

The juncos are sparrow-sized, with uniform gray coloration on the back, lighter or contrasting underparts, and white outer tail feathers that flash conspicuously when they fly. Their winter occurrence and gray color help distinguish them from the summer resident, the vesper sparrow. They, like the sparrows, are seedeaters and occur both in the open prairie and in the shrub thickets and sparsely wooded areas.

The SLATE-COLORED JUNCO and the WHITE-WINGED JUNCO are found in the badlands. Common in winter, they are often seen in mixed flocks or with sparrows. The slate-colored junco is distinguished by the slaty-gray back, white bill, and white underparts. The white-winged junco resembles the other in color but is slightly larger and has two prominent, white wing bars.

The LARK BUNTING is distinctly a bird of the prairie and nests on the ground near clumps of weeds or sagebrush. The male, a beautiful singer, is black with large white wing patches. It is often mistaken for a small blackbird or confused with the bobolink. The song, warbling and gurgling, with several distinct phrases, begins as the bird rises in flight and continues until it alights. Females are sparrow-like in color.

Swallows are sparrow-sized with long, slim wings. They capture and eat insects in flight. Both the CLIFF SWALLOW and the VIOLET-GREEN SWALLOW can be seen in the badlands. The rusty-buff rump distinguishes the cliff swallow; perceived overhead it appears square-tailed, with a dark throat patch. It builds mud nests in ledges of the badlands formations, or under bridges or roof eaves. The violet-green swallow is glossed with green and purple, with clear white below and white patches that almost meet over the base of the tail. Social birds, the two species are often seen together in flocks.

Wrens are small, energetic, brown-backed birds with slender bills, and tails that are often cocked over the back. An inhabitant of canyons and rocky slopes, the CANYON WREN is readily identified by the reddish-brown back and conspicuous white throat and breast. The song is a gushing cadence of clear, curved notes that come tripping down the scale. It nests in rocky crevices.

The ROCK WREN also inhabits rocky places and is one of the few small birds to be seen frequenting the most barren badlands formations. It is easily distinguished from the canyon wren by its lack of a white throat and dark belly. Watch for the white eye streak and buffy tail tips.

Curiously, the BLACK-CAPPED CHICKADEE is a permanent resident in the badlands, most often seen among the junipers. It is the only small bird with the combination black cap, black bib, and white cheeks. Its most common note is the clearly enunciated "chick-a-dee-dee-dee." It becomes more friendly in winter when snow covers much of its normal food supply.

Few people think of the ROBIN as a thrush, but actually it is the most highly developed of that family. To most of us it is just "the robin"—a good neighbor, a dependable friend—the first bird to arrive with its cheering spring song, often before the snow has disappeared. One of the most familiar of all birds, it is easily recognized by its gray back and brick-red breast.

The MOUNTAIN BLUEBIRD, another member of the thrush family, lacks the chestnut breast of its eastern cousin and is azure blue above with a grayish-white belly. The female is a dull brownish, with bluish wings, rump, and tail. As though to accentuate its beauty, it has a delightful habit of hovering on wing like a hummingbird while watching for insects in the grass.

The erratic flight of the COMMON NIGHTHAWK, seen in the late afternoon and evening, is punctuated by frequent regular repetitions of a short, nasal, and utterly unmusical call. The most unusual flight performance is the astonishing aerial dive that the nighthawk executes by almost closing its wings and plunging downward. Suddenly the descent is checked; a weird booming sound is heard as the diver sweeps gracefully upward to renew its flight. It feeds on flying insects that it gathers into its large mouth. Just before and after sunset, nighthawks often are seen swooping and diving over the badlands and adjacent plains. This bird is closely related to the whip-poor-will.

SAY'S PHOEBE is a summer resident about the size of a bluebird. Like others of the flycatcher family, it feeds on flying insects, darting out upon its prey from a perch, usually a limb of a tree, an old stump, or an overhanging cliff. The pale rusty breast contrasted to the brownish back and black tail identify it. The phoebe prefers the open prairie country, although, not uncommonly, it builds its home near the habitation of man. Its plaintive call is usually accompanied by a nervous flit of the tail.

The HORNED LARK is one of the first birds to nest in spring, often when snowbanks are still visible. This brown prairie bird is distinctly marked with a black mustache, black breast patch, and a black horseshoe crown terminating in two erect, black horns. It does not hop, but walks. Preferring the open prairie and fields, it lives principally upon weed seeds. During the winter, flocks of horned larks often feed on the shoulders of the highway.

The BLACK-BILLED MAGPIE, a close relative of crows and jays, is the only large black-and-white land bird with a long, sweeping tail. In flight, the iridescent tail streams out behind, and large white patches flash in the wing. The magpie, a year-round resident of the badlands and vicinity, is a scavenger, often seen feeding on animals that have been run over by automobiles on monument roads.

The WESTERN MEADOWLARK, a prairie dweller, arrives early in March and lingers in autumn until a severe storm drives it south-

ward. It is somewhat smaller than the eastern meadowlark, but the general coloration of the yellow breast and black crescent at the throat is similar. It feeds chiefly on insects and seeds and builds its nest on the ground. The meadowlark's song can be heard a considerable distance and fairly fills the prairie with its melody.

The TURKEY VULTURE is a large, blackish, eagle-sized bird, usually seen soaring on motionless wings in wide circles high over the cliffs of the badlands. Birds of this family seldom attack living

A western meadowlark hiding in the grass

J. S. DIXON PHOTOGRAPH





REX GARRY SCHMIDT PHOTOGRAPH

The sparrow hawk

animals, but feed chiefly upon carrion. The nest is built on shelves under overhanging cliffs. The turkey vulture is able to sail for hours with few wing movements. It may be distinguished at a distance from other soaring birds by the upward angle of the wing planes. The BLACK VULTURE, with a black instead of a red, featherless head, is found in few areas so far north; yet it is not uncommon in the badlands. A white spot under each wing and a fan-like tail may help distinguish this bird from the more familiar turkey vulture.

A familiar hawk and one of man's best friends is the MARSH HAWK. In ordinary flight the bird glides low over the ground,



FISH AND WILDLIFE SERVICE PHOTOGRAPH

A closeup of a western burrowing owl

with the white rump patch, the badge of the species, plainly visible. The nest is built on the ground, hidden in tall grass or brushy thickets. Mice and gophers constitute the bulk of its food, with only a small part coming from small birds and poultry. You should become familiar with it and aid in its protection. Look for it as you drive along the roads through the badlands.

Not much larger than the robin, the SPARROW HAWK is the most common of the falcons. It is the only common small hawk that habitually hovers in one spot and the only one with the rufous-red tail. The chestnut back is clearly marked with several black bars and the tail has one wide black bar. The upper parts are bluish slate and the underportions are creamy white with black spots. Its food is chiefly mice; grasshoppers, beetles, and occasionally small birds. Of all the falcons, this is the most beneficial.



Bison once roamed the grassland in vast numbers

The little BURROWING OWL is found in the badlands. The upper parts are dull grayish brown slightly spotted with white, while the belly is light, barred with brown. The legs appear long for the size of the bird and are feathered only in front. It prefers to build its nest in abandoned holes, or burrows, often taking possession of deserted prairie-dog burrows. Contrary to popular belief, it does not inhabit a burrow occupied at the same time by a prairie dog or rattlesnake.

The food of this little owl consists mostly of small rodents, snakes, lizards, grasshoppers, and beetles.

MAMMALS

Early explorers and settlers tell of bison and pronghorn in great numbers ranging the grasslands above and below the great wall of the badlands. Audubon bighorn, whitetail and mule deer, and occasional bands of American elk and pronghorn fed on the grass-covered tablelands and along the stream courses. Early Indians used this area as a hunting ground.

Westward settlement sounded the death knell for many of the wild animals of the plains. With the coming of the hide hunters in the late 1800's, bison almost disappeared from the scene. Pronghorns were reduced to only a few scattered bands. Bighorn, which



E. P. HADDON PHOTOGRAPH

The pronghorn

were found in the early days on Sheep Mountain, have disappeared—eliminated by the hunter's rifle. Of the larger mammals, only a few deer and pronghorns remain. Conforming to the objectives of the National Park Service, all animals that now live within the monument's boundaries are protected. American elk, bison, and a



FISH AND WILDLIFE SERVICE PHOTOGRAPH

A coyote

few bighorn may still be seen in Wind Cave National Park and Custer State Park, in the nearby Black Hills.

Deer are commonly found in the Black Hills and are occasionally seen in some parts of the badlands. Both the WESTERN WHITETAIL DEER, a relative of the common deer of the East, and the MULE, or BLACKTAIL, DEER live in this section of the State. The former is found here in restricted numbers. Its large, white tail, waved like a warning "flag" when the animal is alarmed, is the famous trademark.

The mule deer is widely distributed throughout the West, and in the Black Hills region is more common than the whitetail deer. The large mulelike ears and the black-tipped tail are distinguishing characteristics.

A few small bands of PRONGHORN still live near the badlands, but they are seldom seen. In some open prairie sections of the West, the pronghorn remains one of the important game animals. The name comes from the conspicuous fork, or prong, on each horn. Although it is often called "antelope," the pronghorn is a member of a different family. True antelopes never shed their horns; the pronghorn sheds its horns annually, the new horns forming on the permanent bony cores.



CARL P. KOFORD PHOTOGRAPH

A young prairie dog at his den entrance

The pronghorn is an animal of the open prairie; its keen eyesight and fleetness of foot help it to detect its natural enemies and make good its escape. The large white rump patch serves much the same purpose as the waving white flag of the whitetail deer; for when alarmed the pronghorn flashes its warning signal to others of the band.

The COYOTE is one animal of the great plains that has persisted and continues to live and raise its young in spite of modern civilization. Whereas its larger cousin, the gray wolf, has been almost completely wiped out in most sections of the West, the coyote has successfully adapted itself to the changing environment created by man. In spite of organized attempts to exterminate it, the coyote has held on, and has even extended its range in some areas.

Small mammals, such as rabbits, ground squirrels, mice, and chipmunks, and all forms of carrion form a substantial part of the coyote's diet. It is a common dweller of the badlands and often may be heard at night singing its weird lament.

The BLACKTAIL PRAIRIE DOG is not a dog, but a fat, colony-dwelling ground squirrel about the size of a full-grown cottontail. Because of its characteristic sharp bark, it has acquired the name "dog." During the early history of this country, "dog towns" were widely scattered over the western plains. Gradually, the prairie dogs were destroyed, until today they are seldom found in their old range.

In areas administered by the National Park Service they are protected with other native wild animals.

During the summer, the prairie dog feeds on the green vegetation surrounding its home. During its semihibernation in winter, when snow covers the ground, it lives on its accumulated fat, emerging from its den only on the warmest days to lie in the sun.

The burrow extends downward as much as 10 to 15 feet at approximate right angles to the surface, with several short branches radiating from it. The entrance is protected from flooding by a mound of earth that is kept in constant repair by the occupants. This dike also serves as an observation post for the sentries that are constantly on guard throughout the town. When danger approaches, those nearest set up a chatter that in turn is picked up by the neighbors. Thus the warning echoes across the colony. As the danger nears, they disappear down their holes with a flip of their stubby tails and a parting "yip" of alarm.

The PORCUPINE, one of this country's largest rodents, is a common resident of the pine forest; it is also found in the more wooded parts of the prairie country, including the badlands.

Prairie dog den that has been dug out by a badger



During summer, it prefers the tender shoots of small shrubs and green herbs, and in winter it lives on the underbark of trees. It is an expert climber. Normally, "Porky's" quills lie flat and are well hidden by the long yellowish-white guard hairs that cover the head and back. The hollow, white, black-tipped quills are 1 to 2½ inches long. Contrary to the mythical story, the porcupine does not throw its quills. Peace-loving by nature, it goes its solitary way; but when danger threatens, it is immediately on guard. It is unfortunate for the animal that comes too near, for with a slap of the broad tail, the quills, which are minutely barbed on the ends, become deeply imbedded in the flesh of the victim. They are very painful and extremely difficult to remove.

The RACCOON, common throughout much of the United States, is found occasionally in the forested fringes of dry creekbeds and in wooded pockets of the great north wall. Its diet is varied; it relishes fish and small mollusks and feeds on small rodents, insects, fruits, and nuts. It does most of its hunting at night, preferring to roll up and sleep in its nest during the day. In the coldest part of the winter it remains in the den, appearing when warmer weather comes in early spring.

The WHITETAILED JACKRABBIT is one of the largest of several species of jackrabbits in the Great Plains country. Its natural food is grasses and other prairie plants.

A full-grown jackrabbit may weigh from 6 to 10 pounds. The fur, buffy-gray in summer, is white in winter except for the black tips of the long ears. It is unusually fleet of foot, traveling with long leaps of from 10 to 20 feet; when alarmed it may reach a speed of 30 miles per hour or more.

The COTTONTAIL is found all over the United States, in highly populated areas as well as in wildlife preserves. This rabbit is an important small-game item for the hunter's bag. Weighing 2 to 3 pounds, it is smaller than its distant relatives, the jackrabbits, which are hares, not rabbits. The fur, dark brown mixed with gray, does not change color with the coming of winter. The cottontail does not have the speed of the jackrabbit; it depends on the protective cover of fence rows, wooded thickets, and brush patches. It feeds on a variety of vegetation, especially clover and alfalfa.

The BADGER is a large, powerful member of the weasel family, ranging through the central and western part of the United States. In general impression it is yellowish gray, the head with bold white and black markings. It is shaggy-coated, heavy-bodied and short-

legged. The forelegs are armed with long claws adapted for digging out the ground squirrels, mice, prairie dogs, and other small burrowing animals upon which it feeds. It frequents the prairie-dog towns of the badlands. The badger is a tough, fierce fighter.

The NORTHERN PLAINS SKUNK is the local form of the STRIPED SKUNK, which is distributed throughout the United States excluding Alaska and Hawaii. This skunk is easily recognized by the black and white markings on back and tail. Its food consists largely of small rodents, snakes, and beetles; it has a particular fondness for grasshoppers.

The striped skunk's chief defense is a musky secretion with a penetrating, disagreeable odor. This secretion is stored in glands located at the base of the tail just inside the anal opening. By muscular contraction, the skunk ejects the scent in a fine spray. The unaggressive skunk attends strictly to its own business; but if it is annoyed or alarmed, woe to the man or beast in range of its artillery!

The THIRTEEN-LINED GROUND SQUIRREL, frequently called (incorrectly) a "gopher," prefers the open country. Like the chipmunk, it feeds chiefly on seeds and grasses; crickets, grasshoppers, and other insects are also eaten. Grass seeds are a favorite food, and are stored in underground chambers to be used in the early spring after the long winter's hibernation.

The BADLANDS CHIPMUNK, often popularly described as a small edition of the tree squirrel, is not to be confused with the ground squirrels. This bright, alert little creature makes its home in burrows under rocks and tree roots. August, September, and October are busy months, for it is then that the chipmunk gathers seeds and stores them in its underground granaries. With the arrival of snow, it takes to its snug quarters for a long winter sleep. The species found in the badlands is the smallest of the chipmunks. Its pale color, blending with the badlands landscape, serves as protection from enemies. Chipmunks are common at some parking areas along the monument road, particularly those west of Norbeck Pass.

REPTILES

The PRAIRIE RATTLESNAKE is the only poisonous snake in the badlands. It is not abundant, but you may encounter it when walking through the grass or wandering from the main roads. The rattling sound made by this reptile is produced by the vibration of "rattles" attached to the end of the tail. This rattlesnake is grayish-

green in general coloration, with the back marked by a row of circular brown splotches. It averages 2 to 3 feet in length, and has the characteristically triangular head of rattlesnakes. When alarmed, it rattles vigorously and, if approached too closely, strikes by throwing its body forward from a coiled position. The bite may be fatal if not promptly treated.

CAUTION: Wear high-topped shoes and remain alert when walking about in the badlands.

There is a persistent myth that rattlesnakes, owls, and prairie dogs live together in harmony. Both rattlesnakes and burrowing owls often occupy deserted prairie-dog burrows; but it is not true that the three live together.

The largest reptile in the badlands is the nonpoisonous BULL SNAKE, which reaches a length of 5 to 6 feet. Sometimes it is called the "yellow gopher snake" because of its orange-yellow body color. It also has a row of large, square, reddish-brown or black splotches along the back. Farmers consider this reptile decidedly beneficial in that its principal diet is small rodents such as mice and gophers.

The BLUE RACER, a color variety of the black snake, is abundant west of the Mississippi River. It is bluish green or olive, with a pale-yellow belly. The average length is from 3 to 4 feet. As the name implies, the racers are extremely swift in their movements.

The RED-BARRED GARTER SNAKE is common on the Great Plains. It is marked with a central stripe down the back, with fused black spots on each side. The bars are brick red—hence the name. The head is a pale-olive color. The snake feeds on earthworms and often eats toads and frogs. It is harmless to man.

The HOG-NOSED SNAKE, commonly known as "puff adder," often lives in dry, sandy places. Its name is derived from the blunt, up-turned nose. It is a harmless reptile, whose bad reputation is due entirely to its defensive behavior and rather pugnacious appearance. When you encounter this snake, it may rear its head, spread its neck in unconscious mimicry of the cobra, open its mouth wide, flatten its stout body, hiss, and strike repeatedly—but *not* bite. If this ferocious performance does not frighten you away, it may then "play dead" by flopping over onto its back. Beyond these bluffing antics, the hog-nosed snake seems to have no means of self-defense.

The food of the hog-nosed snake is chiefly toads and insects. It may attain a length of 2 to 3 feet. You will recognize it most easily by its actions. The hoglike snout, stout body, and pattern of



A typical badlands scene, near Norbeck Pass

dark patches on brown or red background, with a yellow belly blotched on the sides with black, make identification certain.

Present Climate

The climate of the badlands area is characterized as typically continental and arid. Summers are short and hot, and winters long and cold. Annual precipitation averages 17 inches; most of it occurs during the spring and early summer. Precipitation is irregular, and long periods of drought may be expected. Temperatures vary from a low of -30° , or colder, in January or February, to over 100° in July and August. Those extremes seldom last more than 1 or 2 days. Winter precipitation is mostly snow, but, because of gusty winds, large areas are blown free of snow and sizeable drifts accumulate in road cuts and protected gullies. The transition from winter to summer is usually rapid, so the period of spring lasts but a few weeks.

Summers are characterized by hot and frequently windy days which may see duststorms develop in the exposed badlands formations or the neighboring cultivated fields. Nights are comparatively cool. From time to time rather violent, but short, hailstorms occur, and these speed up erosion. The infrequent summer rains run off rapidly and within a few minutes the gullies may contain raging torrents that disappear shortly after the rain stops.

Establishment of the Monument

Beginning with the establishment of Yellowstone National Park in 1872, "dedicated and set apart as a public park or pleasuring ground for the benefit and enjoyment of the people," the United States has evolved a system of National Parks, National Monuments, and other areas which include the most inspiring of the Nation's scenery and many sites of outstanding historic, prehistoric, or scientific interest.

The National Park Service, a bureau of the U.S. Department of the Interior, was established by an act of Congress on August 25, 1916, to correlate the administration of the National Parks and Monuments then under the jurisdiction of the Department. The act directed the Service to "conserve the scenery and the natural and historic objects and wildlife therein and to provide for the enjoy-

The rocks exposed in the badlands are approximately 40 million years old





A winter scene in Badlands National Monument

ment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.”

The Act for the Preservation of American Antiquities, which had become a law on June 8, 1906, authorized the President of the United States to set aside as National Monuments, by proclamation, lands owned or controlled by the United States containing historic landmarks, historic or prehistoric structures, and other objects of historic or scientific interest. The first National Monument established under this authority was Devils Tower, in northeastern Wyoming, in 1906. Another National Monument well known to Black Hills visitors is Jewel Cave, established in 1908.

With but few exceptions, National Monuments are established under the authority of the Antiquities Act without recourse to further legislation. In a sense, Badlands National Monument is one of these exceptions, because the Congress, by Public Law No. 1021, 70th Congress (45 Stat. 1533), approved in 1929, authorized its establishment contingent upon two specific conditions: That certain

lands be acquired and that the State of South Dakota build a road from interior northwesterly through the monument across Big Foot Pass to the Pinnacles and to Sage Creek. These conditions were met, and Badlands National Monument was officially proclaimed on January 25, 1939.

The late United States Senator from South Dakota, Peter Norbeck, was the chief proponent for the establishment of the monument. It was mainly through his efforts that the area was set aside. "Norbeck Pass" in the badlands commemorates his work.

How and When to Enjoy the Monument

The monument is open all year, and any time is a good time to visit it. However, for those who want to enjoy the floral displays, late May and June are suggested. Most of the colorful flowers will be gone by mid-July, and by August the prairie grasses will have become dry and brown. The climate is generally most pleasant in May and June and in September and October.

A view from near Dillon Pass showing the entire sequence of Badlands formations

FRED W. HALL PHOTOGRAPH



If you have a choice as to time of day, early morning and late evening are ideal. At these times the rising or setting sun produces brilliant color effects and casts shadows that give the scene a depth and beauty not evident at midday. For a special thrill, try to view the landscape under the light of a full moon. The spires and pinnacles are accented by jet-black shadows that give a sharp two-dimensional effect, as if the skyline were cut from cardboard.

As you drive over the monument road, you will find numerous parking areas at or near places where unusual features or outstanding panoramas are evident. Park your car, set the brakes, and enjoy the scenery. Signs at many of the parking areas tell the interesting stories of the natural features. Please park off the traffic lanes if you stop between parking areas. A WORD OF CAUTION—*please do not throw cigarettes or burning material of any kind from your car or into the grass. Devastating prairie fires may result.* To prevent unsightly littering of the monument, place your film cartons, candy wrappers, or lunch refuse or other trash in containers found in the parking areas. It is a mark of a good citizen to take pride in your National Parks and Monuments and to respect the rights of others. *Be a good citizen.*

Related Areas

THEODORE ROOSEVELT NATIONAL MEMORIAL PARK, in the southwestern part of North Dakota, has some colorful examples of a more mature stage of badlands development. There are few spires and pinnacles, and the hills are more rounded, but numerous buttes and mesas are in evidence. The Little Missouri River bears the same relationship to this area as the White River does to the South Dakota badlands. The rocks of the park are older and were probably exposed to erosion longer, which may account for the "older" appearance of the topography.

The Painted Desert of northern Arizona, a spectacular portion of which is located within PETRIFIED FOREST NATIONAL MONUMENT, is a colorful and well known badlands area. It is composed of altered volcanic ash, and its rocks are considerably older than those of Badlands National Monument. The landscape, however, has been formed in the same manner—the result of soft rocks, scanty vegetation, and cloudburst rainfall.

Although seldom considered as "badlands" topography, BRYCE CANYON NATIONAL PARK, in southern Utah, has a vast array of brilliantly tinted spires and pinnacles which resemble the principal features in Badlands National Monument. In reality, Bryce Canyon is a huge, horseshoe-shaped amphitheater on the edge of a high, forested plateau, with precipitous walls which are receding in much the same manner as the wall in Badlands National Monument.

Suggested Readings

- BUMP, JAMES D., et. al., *Guide Book, Fifth Field Conference of the Society of Vertebrate Paleontology in Western Dakota*, 85 pp. Museum of Geology, South Dakota School of Mines and Technology, Rapid City, S. Dak., 1951.
- BURT, WILLIAM H. and GROSSENHEIDER, RICHARD P., *Field Guide to the Mammals*. Houghton Mifflin, Boston, 1952.
- CLARK, JOHN, *The Stratigraphy and Paleontology of the Chadron Formation in the Big Badlands of South Dakota*. Annals of the Carnegie Museum, Vol. XXV, pp. 261-350, Pittsburgh, Pa., 1937.
- DARTON, N. H., *Volcanic Action in the Black Hills of South Dakota*. Science N.S., Vol. 36, pp. 602-603, 1912.
- , and PAGE, SIDNEY, *Central Black Hills*. U.S. Geol. Survey, Folio 219, 1925.
- GERMAN, JOHN C. and GERMAN, LOUISE, *Color Records of the Badlands*. Nat. History, Vol. 37, No. 4, pp. 353-361, 10 figs., April 1936.
- OVER, WILLIAM H., *Wild Flowers of South Dakota*. University of South Dakota, Vermillion, 1942.
- and THOMAS, CRAIG S., *Birds of South Dakota*. University of South Dakota Museum, Vermillion, 1946.
- PETERSON, ROGER TORY, *A Field Guide to Western Birds*. Houghton Mifflin, Boston, 1961.
- ROTHROCK, E. P., *A Geology of South Dakota*. Part 1. So. Dak. State Geol. Survey, Bull. No. 13, 1943.
- SHELL, HERBERT S., *History of South Dakota*. University of Nebraska Press, Lincoln, 1961.
- SCHUMM, STANLEY, *Evolution of Drainage Systems and Slopes in Badlands*. Bulletin of Geol. Soc. of Amer., Vol. 67, pp. 597-646, 43 figs., 6 pls., May 1956.
- WANLESS, HAROLD ROBIN, *Lithology of the White River Sediments*. Am. Philos. Soc., Proc., Vol. 61, No. 3, pp. 184-203, 1 fig., 2 pls., 1922.
- , *The Stratigraphy of the White River Beds of South Dakota*. Am. Philos. Soc., Proc., Vol. 62, No. 4, pp. 190-269, 10 figs., 9 pls., 1923.
- WINTER, JOHN M., et al., *A Check List of the Vascular Plants of South Dakota*. State University of South Dakota, Vermillion, 1959.

Appendix—Common and Scientific Names of Plants

This list of common names and their scientific (Latin) equivalents includes only those plants in the monument that are mentioned in the text. With minor exceptions, authority for the scientific names of all plants and for the common names of all plants except trees is the second edition (1942) of *Standardized Plant Names*, edited by Harlan P. Kelsey and William A. Dayton. Authority for common names of trees is *Check List of Native and Naturalized Trees of the United States (Including Alaska)*, by Elbert L. Little, Jr., (U.S. Department of Agriculture Handbook No. 41, published in 1953).

GRASSES AND SEDGES

Bluestem, little—*Andropogon scoparius*
Buffalograss—*Buchloe dactyloides*
Gramma, blue—*Bouteloua gracilis*
Gramma, sideoats—*Bouteloua curtipendula*

Needle-and-thread—*Stipa comata*
Sandreed, prairie—*Calamovilfa longifolia*
Sedge, threadleaf—*Carex filifolia*
Wheatgrass, bluestem—*Agropyron smithi*

TREES AND SHRUBS

Boxelder—*Acer negundo*
Buffaloberry, silver—*Shepherdia argentea*
Chokecherry, common—*Prunus virginiana*
Cottonwood, plains—*Populus sargentii*

Elm, American—*Ulmus americana*
Juniper, Rocky Mountain—*Juniperus scopulorum*

WILDFLOWERS

Crazyweed, Lambert—*Oxytropis lamberti*
Erysimum, plains—*Erysimum asperum*
Euphorbia, snow-on-the-mountain—*Euphorbia marginata*
Evening-primrose, tufted—*Oenothera caespitosa*
Fleabane, fernleaf—*Erigeron compositus*
Globemallow, scarlet—*Sphaeralcea coccinea*
Loco—*Astragalus missouriensis*
Mariposa, segolily—*Calochortus nuttallii*
Pasqueflower, American—*Anemone ludoviciana*
Penstemons—*Penstemon* sp.

Phlox, Hoods—*Phlox hoodi*
Prairie-coneflower, upright—*Ratibida columnaris*
Pricklypear, common—*Opuntia vulgaris*
Rose, Fendler woods—*Rosa woodsii fendleri*
Starlily, common—*Leucocrinum montanum*
Sweetclover, white—*Melilotus alba*
Sweetclover, yellow—*Melilotus officinalis*
Thermopsis, prairie—*Thermopsis rhombifolia*
Violet, Canada—*Viola canadensis*
Yarrow, western—*Achillea lanulosa*

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