

Petrified Forest

NATIONAL MONUMENT

Arizona



UNITED STATES
DEPARTMENT OF THE
INTERIOR

Harold L. Ickes
Secretary



19

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NATIONAL PARK SERVICE

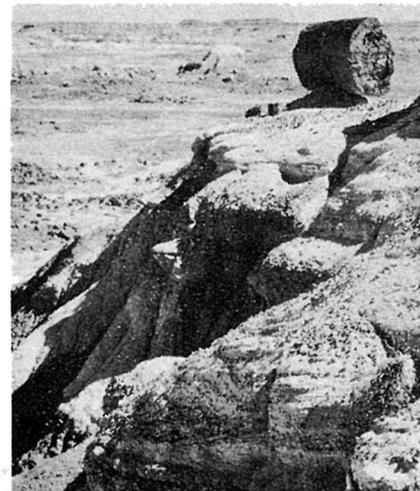
NEWTON B. DRURY, *Director*

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Historic Events

- 1539 First exploration of the Southwest by Coronado.
- 1851 Petrified wood first reported in northern Arizona by Lieutenant Sitgreaves.
- 1853 Petrified Forest Monument area visited by Army expedition headed by Lieutenant Whipple.
- 1857 Camel caravan of Lieutenant Beale crossed area.
- 1898 First Government investigation of the area made by Lester F. Ward of the U. S. Geological Survey.
- 1900
- 1906 Petrified Forest set aside as a national monument by President Theodore Roosevelt.
- 1906 John Muir discovered, explored, and named the Blue Forest.
- 1911 Agate Bridge supported by stone pillars, replaced by present reinforced concrete beam in 1917.
- 1921 to 1929 Phytosaurs excavated in Blue Forest.
- 1930 Blue Forest and Newspaper Rock included in the monument by President Hoover.
- 1932 Painted Desert area added to the monument by President Hoover.
- 1932 Completion and dedication of Puerco River Bridge, making area accessible to motorists.
- 1933 Agate House restored and three rooms of Puerco River Ruin excavated.
- 1933 to 1940 Fossil leaf beds of Blue Forest discovered, explored, and described.
- 1940 Painted Desert Inn and Museum completed.



Petrified Forest

NATIONAL
MONUMENT

ARIZONA



SECTION OF PETRIFIED LOG BALANCED ON
EDGE OF CLIFF

THE most spectacular display of petrified wood known in the world, as well as some of the most colorful portions of the Painted Desert, are included in Petrified Forest National Monument in northeastern Arizona. Unique in its vivid and varied colors, the petrified wood of this area has long attracted visitors from all parts of the world. Within the monument are six separate "forests" where giant logs of agate lie prostrate on the ground and where numerous broken sections and smaller chips and fragments form a colorful ground cover.

The area is a part of the Painted Desert of northern Arizona, a region formed of banded rocks of many hues carved by wind and rain into a landscape fantastic in color and form. Here and there are beds of shale containing perfectly preserved fossil leaves of plants of a remote age. Occasionally the bones of giant reptiles and amphibians are washed from their burial place in the rocks.

Many Indian ruins and petroglyphs are found, evidence of Indians who lived in this area long before

America was discovered. The Petrified Forest is a convenient base for visits into the land of the modern Indians—the Navajos, Apaches, Zunis, and Hopis.

West from Petrified Forest, by short detour on the way to Grand Canyon National Park, travelers may visit Walnut Canyon National Monument, a colorful area with many well-preserved cliff dwellings; the lava fields, cinder cones, and ice caves of Sunset Crater National Monument; and the interesting Citadel and Wupatki Ruins of Wupatki National Monument. A hundred miles northeast is Canyon de Chelly National Monument, an area of deep, branching canyons whose protecting walls and caves were once the stronghold of prehistoric Indians. In these canyons today Navajos pasture their flocks, build their hogans, and weave their rugs.

HISTORY

We have no knowledge of the petrified forests from the early Spanish explorers. Apparently the first man to report the "stone trees"



ONE OF THE GIANT PETRIFIED LOGS

was Lieutenant Sitgreaves, an Army officer who explored parts of northern Arizona in 1851, soon after Arizona was acquired by the United States. Two years later an Army expedition, under Lieutenant Whipple, visited the present monument area, camped near the Black Forest, and gave the name "Lithodendron" (stone tree) Wash to the creek which drains the Painted Desert. In 1857 Lieutenant Beale led an exotic caravan of camels across the area en route to California.

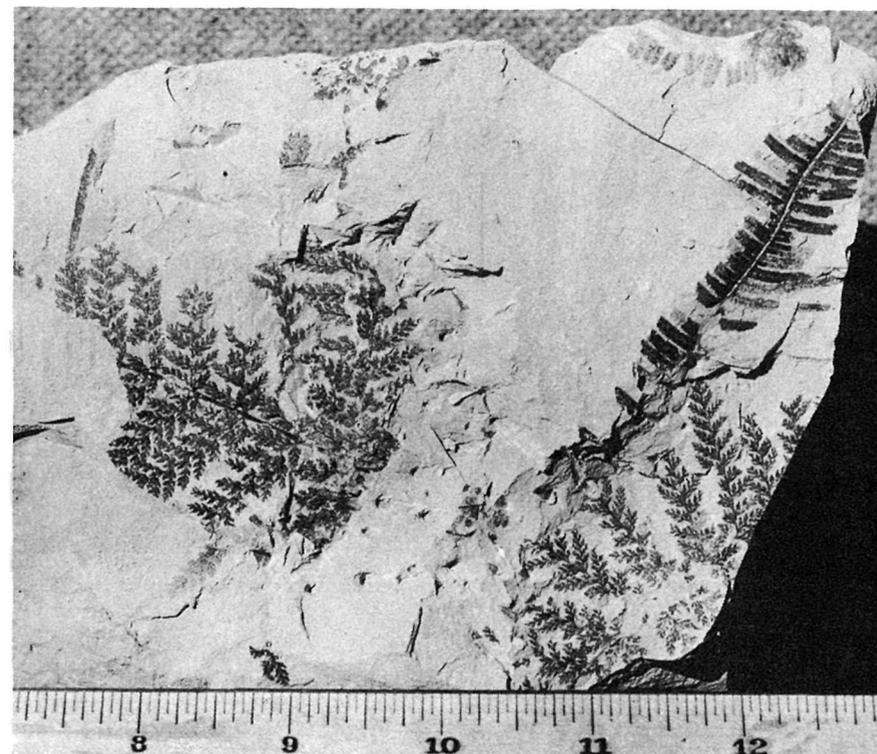
The petrified forests remained largely unknown, however, until the starting of the settlement of northern Arizona in 1878, and until the Atlantic and Pacific, now the Santa Fe Railroad, was completed across northern Arizona in 1883. During the following years the existence of the petrified forests was threatened by souvenir hunters, gem collectors, commercial jewelers, and abrasive manufacturers. Entire logs were blasted to obtain the quartz and amethyst crystals often found within the logs, and much agate was carried away for making jewelry. The most serious threat, however, came with the erection of a stamp mill near the forests for the purpose

of crushing the petrified logs into abrasives. Alarmed, the citizens of Arizona through their territorial legislature petitioned Congress to make the area a national park "so that future generations might enjoy its beauties, and study one of the most curious effects of nature's forces."

Accordingly, Lester F. Ward, of the United States Geological Survey, was instructed to investigate the area, and his report was instrumental in causing Congress to pass "An Act for the Preservation of American Antiquities." Under authority of this law President Theodore Roosevelt established Petrified Forest National Monument by proclamation on December 8, 1906.

GEOLOGICAL FEATURES

Petrified Wood.—Petrified wood is not wood. These logs once were living trees; now they are mineral reproductions of those trees. The wood is gone but in its place are jasper, chalcedony, carnelian, and agate—semiprecious gem stones. How this substitution of mineral for wood took place is still something of a mystery. It is believed, however,

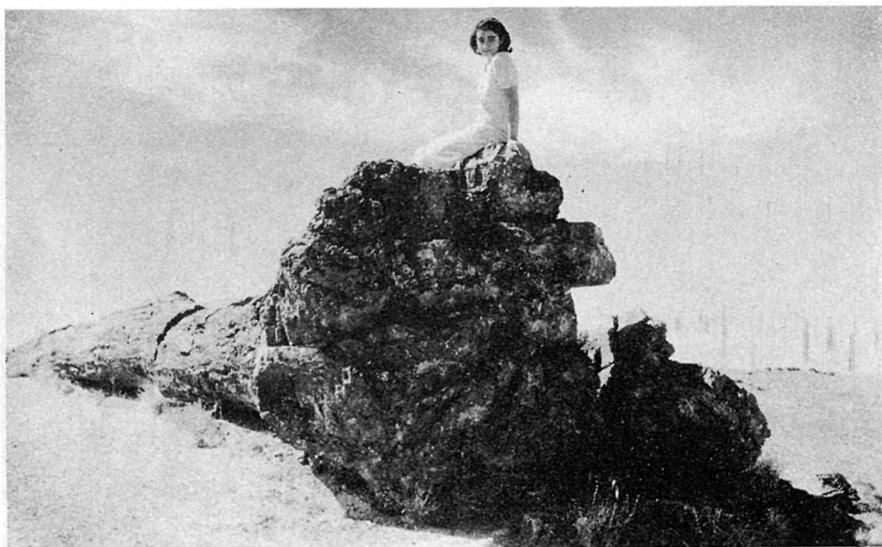


FOSSIL FERNS FOUND IN SHALE NEAR THE SECOND FOREST

that the mineral substance known as silica was first carried into the wood by underground waters and there deposited to fill all open cracks, pores, and even the wood cells. Later, the wood tissue of the cell walls was removed and additional silica was deposited in place of it. This substitution of mineral for wood was so perfectly done that not only was the form and size of each log exactly duplicated, but even the minute cell structure of the wood was often perfectly reproduced. The trees grew, were buried, and were petrified during the Triassic geological period.

The Triassic Landscape.—During the Triassic period, which, according

to calculations based on the rate of disintegration of radium, ended some 150 million years ago, northern Arizona was a flat lowland close to the level of the sea. Great rivers, flowing from a surrounding fringe of low hills and plains, shifted constantly back and forth spreading layer upon layer of sand, gravel, and muds over this lowland. On the stream banks and flood plains were growing many ferns, giant horsetail rushes (neocalamites), and primitive, coniferous trees (cycads). In the rivers and on the mud flats lived giant crocodilelike reptiles (phyosaurs), large salamanders (stegocephalians), advanced types of reptiles (anomodonts), and primitive lungfish



THE LARGEST ROOT SYSTEM YET DISCOVERED AT PETRIFIED FOREST

(dipnoi). But, where were the trees that later formed the colorful petrified logs?

The Forests.—Most geologists believe that the growing forests were located upstream, possibly as much as a hundred miles to the west and southwest of the present petrified forests. It is improbable that many of the trees grew within the boundaries of the present monument. The trees were similar to modern pines, but were more closely related to the araucarian pines of South America and Australia. One species (*Araucarioxylon arizonicum*) predominated, but two other species (*Schilderia adamanica* and *Woodworthia arizonica*) are sometimes found in the petrified log jams. No broadleaf trees existed during Triassic times.

There was nothing mysterious in the manner of growth and death of these trees. They grew from seedlings, matured, produced seeds, and died of old age or were killed by disease, insects, fire, wind, or flood in

the same manner as modern trees. Doubtless most of the trees decayed away, but some fell into rivers and were carried downstream to their final place of burial on the flat lowlands. In the course of their journey downstream, the trees lost their bark, most of their branches and roots, and even the wood apparently was partly worn away from the outside of the logs. This theory accounts for the occurrence of the petrified logs only in sandstone and conglomerate beds of stream origin, for their concentration in certain restricted areas, and for the predominantly horizontal position of the logs today. It explains why the trees as a rule have no bark, branches, or roots and why it is that among the many perfectly preserved leaves of ferns and cycads there are only rare, fragmental leaves of the petrified trees.

From time to time distant volcanoes gave forth great clouds of volcanic ash which, carried by winds



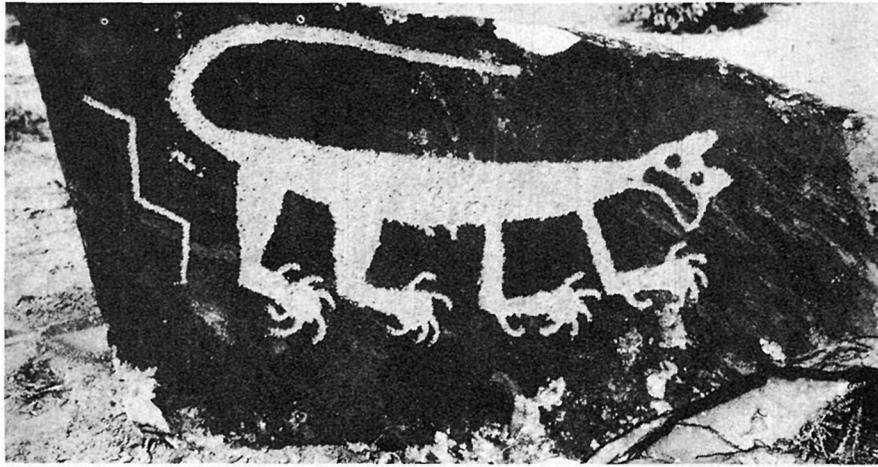
BADLAND FORMATIONS IN THE THIRD FOREST

or water, choked the streams, buried the sand and gravel deposits and their included logs, and thus built up a new land surface on which the rivers developed new courses, brought in and buried more logs, and were in turn covered with more volcanic ash.

The Logs Petrified.—Burial, the first step in petrification, was important because it prevented the total decay of the logs. But, more than burial was required, otherwise the logs merely would have turned into carbon or coal. The factor that determined that these logs should petrify was the presence in the ground of mineral waters charged with silica. It is believed that the silica came from the volcanic ash which is found abundantly in adjacent rock strata. The ash decomposed to form the colored, banded Painted Desert rocks, but in the process much silica was freed, leached out, and carried by underground waters into the logs. There, slowly, the silica was de-

posited, impregnating the wood and replacing the wood fiber until the pine logs became logs of stone.

The Forests Uncovered.—Today, the petrified wood which was formed deep in the earth is on top of the ground. No violent earthquake forced these logs to the surface—they are on top of the ground simply because they have been uncovered by erosion. Blankets of limestone, sandstone, and shale, a thousand feet thick or more, have been stripped away from above the logs by wind and rain. This erosion was accelerated by the gradual uplifting of the Colorado River plateau from sea level to over a mile above the sea. Thus exposed to weathering and erosion, the rocks crumbled, and the rivers carried the fragments away and cut deeper and deeper into the rocks until at last the petrified logs were again exposed. This process is by no means complete, and throughout northern Arizona today there are doubtless thousands of petrified logs



PETROGLYPH OF A MOUNTAIN LION FOUND IN PETRIFIED FOREST. THIS PETROGLYPH IS NOW ON DISPLAY AT MONUMENT HEADQUARTERS

scattered in the ground, near the surface in some places and as much as three or four thousand feet deep in others.

The Rainbow Colors.—The colors of the petrified wood are not the colors of silica alone. In pure state, silica or chalcedony is white or gray. The great variety of red, brown, and yellow colors are usually produced by minute quantities of iron oxide stain in the silica, and similarly the black is produced by iron and manganese oxide pigment. Sometimes the red and black stain followed cracks in the petrified wood and diffused unevenly into the silica to form the "picture wood" or moss agate.

Crystals of Quartz.—Where wood was present the silica took the form and structure of the wood, but in open cracks and cavities where there was no wood to interfere, the silica assumed its natural crystalline form—a six-sided prism capped with a six-sided pyramid. Many quartz crystals—red, yellow, green, black, white, clear, and amethyst—thus occur in cavities in the petrified logs.

Semiprecious Stones.—The petrified forests constitute a storehouse of semiprecious gem materials known to the lapidary by a variety of names. The wax-like, colorless quartz is known as chalcedony. The colors of the clear varieties of quartz determine their names, such as carnelian for the red and chrysoprase for the apple-green. The opaque varieties colored red, brown, dark green, or bluish-gray are called jasper. The vari-colored varieties are called onyx if the color bands are straight and agate if the bands are curved or concentric. Moss agate is chalcedony that contains mottled or tree-like designs.

From sources outside the monument private dealers obtain crystals and other forms of quartz to shape and polish into a great variety of ornaments and jewelry settings.

Broken Log Sections.—A most conspicuous feature is the manner in which some of the logs are broken into more or less even sections as if sawed into stovewood lengths. This is an entirely natural phenomenon which, it is believed, was started by



NEWSPAPER ROCK

earth shocks and pressure while the logs were still buried and tightly enclosed in the rocks. The forces that produced the strain may have been the earth forces that lifted the area from sea level, or the unevenly distributed weight of the rocks above the logs. The original cracks were small, tight, and inconspicuous. However, as the logs are exposed to weathering, these cracks are soon opened and extended until the logs are separated into sections from one to several feet long.

The Painted Desert.—Both the color and the intricate land forms of the Petrified Forest areas and Painted Desert intrigue the spectator. In color, these badlands relate back to the ancient volcanic experience of the region, and in form to the present desert type of erosion.

The material from which the badlands have been sculptured originally was deposited layer upon layer as volcanic ash, probably of drab color. The decomposition of the ash which released silica for petrification converted the ash into the claylike rock *bentonite*. When pure, the bentonite

is nearly white, but in the Painted Desert it is stained all shades of red, orange, maroon, blue, purple, and yellow by iron minerals that also had their source in the volcanic ash.

Bentonitic beds, in arid or semi-arid regions, erode into badlands. The bentonite absorbs water like a sponge, swells, and disintegrates into a fine mud. As a result, the torrential summer rains that fall in northern Arizona rapidly cut the banded, bentonitic beds into sharp, conical hills, turreted ridges, and sharp, interbranching canyons and ravines. When dry, the bentonite is hard and strong and is thus able to preserve these intricate badland forms during the long periods between rains. Locally, a hard sandstone caprock may prevent rapid erosion of the shales beneath to form an abrupt-sided, table-topped butte or mesa.

ARCHEOLOGY

Throughout the area ancient ruins, petroglyphs, and potsherds are found which indicate that this fascinating but rather desolate Petrified Forest country was occupied by prehistoric



AGATE HOUSE IN THE THIRD FOREST

Indians over a period of almost a thousand years. These peoples lived in Petrified Forest from before 500 A. D. until about 1400 A. D. These dates have been established by the finding of various types of pottery the time span of which is known from tree ring dates established in other parts of northern Arizona.

The earliest inhabitants lived in small scattered villages of circular pit house or slab house dwellings consisting of shallow excavations lined with stone slabs and covered with dome-shaped walls and roof of poles, brush, and earth. Later, numerous small settlements of rectangular masonry rooms were built, and in the last phase of occupation these small scattered villages were abandoned in favor of a few comparatively large towns such as the one to be seen just back of the Puerco River Ranger Station. The Puerco River Ruin consisted of some 125 small rectangular rooms arranged in a hollow square around a plaza. The pueblo was probably two-storied, and could have housed over 100 families. It is the only site in the monument occupied continuously from Basket-maker III (6th-7th century) to Pueblo IV times (14th century).

The prehistory of the Petrified Forest closely follows that of northern Arizona as a whole. Three features of Petrified Forest archeology, however, are of unusual interest. First, the relatively dense population by a farming people of an area now so desolate. The explanation is probably in the ability of these primitive people to utilize the small springs and seeps that emerged from the base of the mesas framing the area. Minor climatic changes may have caused some of these springs to dry up. The great drought of 1276-99 doubtless caused a sharp decrease in population, but the final abandonment of the area may have been the result of Apache raids.

The second interesting feature is the occurrence of an unusually extensive, well-preserved series of petroglyphs around the low, brown sandstone cliffs. These include many realistic and geometric designs cut into rock. The most striking of these, perhaps, is a very realistic picture of a heron eating a frog, popularly called the "stork." Others include phallic symbols, birds, antelope, snakes, footprints, and intricate patterns of dots and lines. The best examples and greatest variety



A FORKED PETRIFIED LOG IN THE RAINBOW FOREST

are at Newspaper Rock, and others may be seen near Rainbow Forest. Petroglyphs can seldom be interpreted and usually have no story to tell. In many cases they may be the clan symbols of passers-by.

The third feature of interest is the evidence of the utilization of petrified wood for building material, tools, and weapons. Arrowheads, hammers, scrapers, and other objects fashioned from agate are often found, and near the Rainbow and Third Forests are several ruins of houses which were built of blocks of petrified wood. One of these, the Agate House, has been partially restored and is easily accessible via the Third Forest Trail.

INDIANS OF NORTHERN ARIZONA

No modern Indians live within the boundaries of Petrified Forest National Monument, but several important tribes and pueblos are located in surrounding areas within a day's journey from the monument. Two groups are represented—the

seminomadic Navajo and Apache who appear to have come to the Southwest about the time of the discovery of America, and the Pueblo Indians, descendants of the prehistoric inhabitants of the region.

The Navajo Indians.—The Navajo Indian Reservation borders the north side of the Painted Desert section of the monument and includes most of the area north of Highway 66 between Gallup, N. Mex., and the Colorado River. The Navajos are a progressive people who, since they were conquered in 1863, have led a peaceful, seminomadic mode of life following their flocks of sheep and goats. Their spirit has never been conquered, and they remain today a proud race, practically independent and self-supporting. Their houses are hogans built of stone, logs, brush, and earth. Sheep raising is the chief industry, and some farming is practiced. Rug weaving by the women and silversmithing by the men are the chief crafts. The Navajos have many ceremonies, most of which are for the purpose of



AGATE BRIDGE

healing the sick. These ceremonies also serve as social gatherings.

The Apache Indians.—The Apaches and their Navajo relatives came to the Southwest not long before the first Spanish explorers. After obtaining horses, the Apaches became the terror of the Southwest, raiding other Indians and molesting Spanish and American settlements and travelers. Since the surrender of their last great chief, Geronimo, in 1886, they have lived quietly on their reservations in western New Mexico and east-central Arizona. The largest of these reservations is the White River Reservation in the mountain country about a hundred miles south of Petrified Forest. The principal occupations of the Apaches are stock raising, farming, and lumbering. They once wove excellent baskets, but have, in recent years, largely discontinued this craft. They worship numerous individual and personal gods, and formerly held many ceremonies. Today the Devil Dance is the most spectacular and best known.

The Zuni Indians.—Zuni Pueblo in New Mexico, about 75 miles east of the Petrified Forest, is, perhaps, the most historic Indian village in the Southwest. When first visited by the Spaniards under Coronado in 1539, the Zunis were living in seven towns, the famous Seven Cities of Cibola. The modern pueblo, established in 1695, is on the site of one of the original seven. Today the Zunis practice farming, stock raising, and make much pottery, silver jewelry, and other objects for sale. In tribal organization, customs, and religion, the Zunis are similar to the Hopis. They have many ceremonies which, like those of the other Pueblo Indians, are chiefly supplications for rain and good crops.

The Hopi Indians.—The Hopis, occupying several mesa villages in the center of the Navajo Reservation, are among the descendants of the prehistoric Pueblo Indians of north-eastern Arizona. Of all the modern Indians, the Hopis are least changed by contact with the white man's civilization. The old people, espe-

cially, closely follow the traditional Hopi ways of life. Oraibi, one of their mesa villages, has been continuously occupied since about 350 years before the discovery of America. The Hopis are a peaceful and hospitable people engaging in farming, pottery making, basketry, and some silversmithing and textile weaving. Their ceremonies are frequent and are probably the most elaborate now practiced by American Indians. The Kachina Dances during the spring and summer, and the Snake Dance in August are the best known, the latter being the public performance which closes a 9-day ceremony held in the secrecy of the Kivas. It is a prayer for rain and a thanksgiving.

ADMINISTRATION

Petrified Forest National Monument is administered by the National Park Service of the United States Department of the Interior. A superintendent is in immediate charge of the area and his headquarters are in the Rainbow Forest. The post-office address for the monument is Holbrook, Ariz.

INTERPRETIVE SERVICE

All visitors are invited to see the Rainbow Forest Museum. Here are displayed many outstanding examples of polished petrified wood, quartz, and amethyst, as well as a diorama, fossils, minerals, charts, etc., explaining the formation of the petrified forests and badlands. During the summer months a short talk is given each hour in this museum, and, as circumstances permit, guided tours through the Rainbow Forest are conducted by ranger-naturalists. Other exhibits may be seen at the Puerco River Ranger Station and at the Painted Desert Museum. All of these services are free of charge.

ACCOMMODATIONS AND SUPPLIES

Lodging, meals, gasoline, tourist supplies, and curios may be obtained at the Rainbow Forest Lodge near the south entrance to the monument as well as at the Painted Desert Inn on the Painted Desert Rim Drive. The rate for lodging at the Rainbow Forest Lodge is \$1.50 for a house-keeping cabin with accommodations for two. At the Painted Desert Inn a few double rooms are available at \$2.50 per day. These rates may change slightly, but the latest rates approved by the Secretary of the Interior are on file at the Superintendent's office.

A small campground at the Rainbow Forest, equipped with tables, ramadas, and water supply is available for the free use of campers.

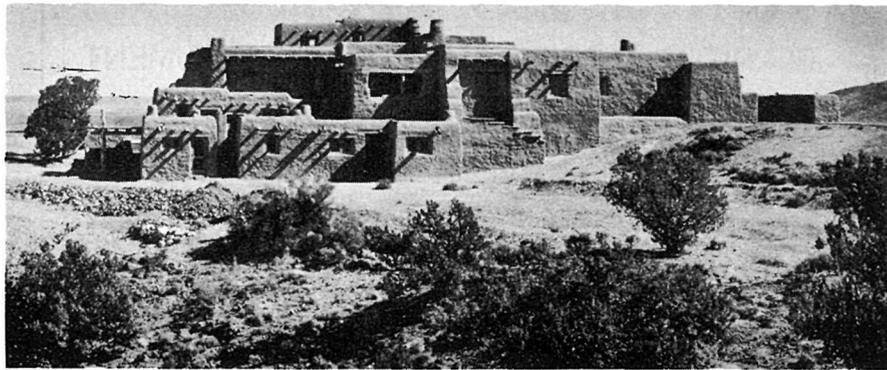
The nearest towns where cabin, hotel, store, and garage facilities are available are Holbrook, Ariz., 20 miles west; Gallup, N. Mex., 70 miles east; and St. Johns, Ariz., 45 miles southeast.

TRAVEL INFORMATION

Excellent paved approach roads make Petrified Forest National Monument easily accessible by car. U. S. Highway 66, crossing the area near the Painted Desert, is the approach from the east. Travelers from the southeast, south, and west enter the monument from U. S. Highway 260. The monument highway connects these two main arteries of travel and leads through the more interesting parts of the monument.

West-bound travelers on Highway 66 may turn south from the Painted Desert, travel through the monument to Highway 260 and rejoin Highway 66 at Holbrook, adding only 16 miles to their journey.

East-bound travelers on highway 66 may take Highway 260 at Holbrook,



PAINTED DESERT INN

pass through the Petrified Forest and rejoin Highway 66 at the Painted Desert, adding only 16 miles to their trip.

East-bound travelers on highway 260 should take Highway 66 at Holbrook to the Painted Desert, thence travel south through the Petrified Forest to Highway 260. The added distance is 26 miles.

West-bound travelers on highway 260 may go through the monument and continue west from the Painted Desert with an increase of only 26 miles in the total trip.

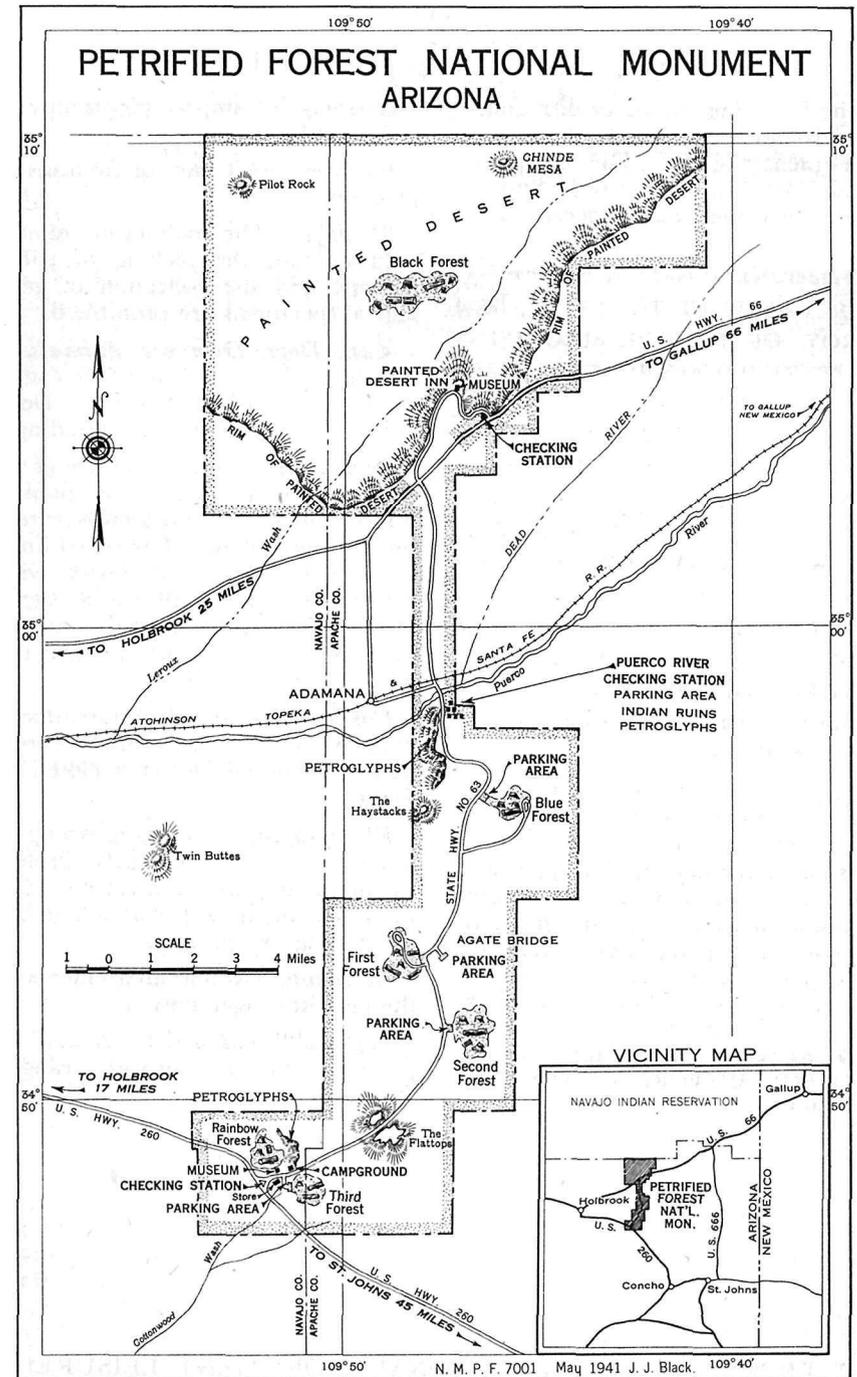
Painted Desert Rim Drive branches north from Highway 66, circles the rim of the Painted Desert, and rejoins Highway 66, adding but 2½ miles to the distance traveled.

Closed at Night.—The monument highway is open from 7 a. m. to 7:30 p. m. in summer, and from 7:30 a. m. to 5:30 p. m. in winter, the schedule more or less following daylight hours.

Entrance Fees.—Permits, good for the calendar year, are issued at the entrance stations. Fees are 50¢ per car or motorcycle, and 50¢ for a house trailer.

Trails—The monument highway passes close to most of the important scenic areas, but all visitors are encouraged to follow some of the short foot trails that lead into the forests in order to inspect the petrified wood. It is necessary to see the petrified wood at close range in order to appreciate fully the beauty of the colors. These short trails start at conveniently located parking areas and lead through the Rainbow Forest, the Second, Third, and Blue Forests, and to the Agate Bridge, Newspaper Rock, and the Puerco River Indian Ruins.

Railroad Tunnel.—The Santa Fe Railroad passes through the monument. Travelers by rail may obtain privately operated cars in Gallup, N. Mex., and Holbrook and Winslow, Ariz., for tours through the monument.



RULES AND REGULATIONS

The following summary of regulations is intended as a guide for all monument visitors. The complete regulations may be seen at the Superintendent's office or at ranger stations.

Preservation of Natural Features.—

IT IS UNLAWFUL TO INJURE, DESTROY, OR REMOVE SPECIMENS OF PETRIFIED WOOD OF ANY SIZE WHATSOEVER FOUND WITHIN THE MONUMENT BOUNDARY OR TO DEFACE, INJURE, DESTROY, DISTURB, OR MARK ANY RUINS, PICTURES, PETROGLYPHS OR OTHER WORKS OF PRIMITIVE OR PREHISTORIC MAN, GOVERNMENT PROPERTY, OR NATURAL FORMATIONS, IN ANY MANNER. VIOLATORS ARE LIABLE TO FINE UP TO \$500, AND IMPRISONMENT UP TO 6 MONTHS.

At first glance it might seem that the regulations pertaining to petrified wood are quite drastic, but it must be remembered that petrified wood is not being formed by nature in this area today. When a piece is removed, it is gone forever and can never be replaced. All of the wood would be gone within a few years if each of the 200,000 yearly visitors took away a few pounds. **HELP PROTECT THIS FOREST FROM VANDALISM.**

Camping.—Camp or picnic only at designated areas.

Firearms.—All use of firearms is prohibited.

Wildlife.—The molestation of any wild animal, the picking of wildflowers, and the collection of geological specimens are prohibited.

Cats, Dogs, Domestic Animals.—All domestic animals must be caged or kept on a leash at all times. Dogs are not permitted in public buildings.

Automobiles.—An annual fee of 50 cents is charged each automobile, house trailer, and motorcycle entering the monument. The speed limit is 35 miles per hour. Drive with caution and heed all traffic signs. It should be remembered that the driver's courtesy toward others is the greatest factor in safety.

Hours of Travel.—The monument highway between the Rainbow Forest and the Painted Desert is closed at night.

Photographs.—Photographs may be taken freely by amateurs. Professional photographers must secure a permit from the superintendent before taking any pictures.

Accidents.—Report all accidents to the nearest ranger station.

Lost and Found articles should be reported to the nearest ranger station.

SEE PETRIFIED FOREST NATIONAL MONUMENT LEISURELY