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THIRD GEOLOGICAL REPORT

ON

PETRIFIED FOREST NATIONAL MONUMENT

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REGIONAL GEOLOGIST

REGION III

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Two previous reports have been made by me on Petrified Forest National Monument, namely No. 64, from an inspection made July 19, 1936, and No. 139, from an inspection made June 14, 1937.

The first of these reports, No. 64, is concerned chiefly with the general geology of the forest and to it reference is made. In this report I also spoke of the water situation on the monument and the work accomplished by Park Naturalist Walker in the matter of the collection and identification of fossil plants and animals.

In my second report, No. 139, I discussed these matters more fully, and, particularly, the water problem.

A much more complete report than either of mine listed above, was prepared by Vincent W. Vandiver, then Regional Geologist. Under date of January 12, 1936, he submitted a comprehensive study of the geology of the monument, prepared as the result of approximately two weeks' field study. This report contains a very full bibliography. Copies of the report are on file at Washington and in the Regional Office.

A series of brief papers, entitled "Notes on the Geology and Paleontology in the Region of the Petrified Forest National Monument," were issued during the period from June to December, 1936, by Park Naturalist M. V. Walker. These papers, in mimeographed form, are available at the monument, at Washington, and at the Regional Office.

On the inspection which forms the basis of the present report I was accompanied by Wildlife Technician W. B. McDougall; Park Naturalist Walker accompanied us to several points, especially to Black Forest on the Painted Desert, and pointed out a number of geological features including numerous tree stumps in place, and also the occurrence of neocalamites trunks.

Since the time of my last visit in July, 1937, the water system at the Painted Desert View Lodge has been put into operation. Several wells have been drilled along Lithodendron Wash which is located west of the lodge. This wash was named by Lieutenant Whipple in 1853 from the fact that he here found a number of petrified trees.

Fourteen test holes were drilled along the wash, practically all of which found water at depths of about 30 to 40 feet. Four of these wells were cased and a pump installed in one of them. This water is now pumped a distance of approximately one mile, and raised 500 feet, to a 50,000 gallon concrete tank located at an elevation of about 100 feet above the lodge, from which tank water is carried

by gravity. This pump has a capacity of 50 gallons per minute, and the 50,000 gallon tank can be filled without appreciably lowering the water in the well. This would appear to be an ample supply of water for the buildings on the Desert View Rim.

Water for headquarters and the CCC camp is still hauled 16 miles from a well located in the sands of Rio Puerco at the bridge near the North Checking Station. This well is 45 feet deep and yields 800 gallons per hour. A 10,000 gallon underground tank has been built on the hill south of the checking station.

Preparations are being made to move the CCC camp from the present monument headquarters to a site at the foot of the bluff near the Rio Puerco Checking Station. This camp will be supplied from the well and tank just described, thus obviating the 16-mile haul for water to supply the camp.

The following data regarding the deep well at headquarters was supplied me by Park Naturalist Walker:

Total depth of well 1023 feet

The following log gives the approximate thickness of the various formations encountered:

Chinlee	shales and sandstone	300 feet
Shinalump	conglomerate	50 feet
Moenkopi	red sandstone (salt water)	400 feet
Kaibab (?)	limestone and shale	40 feet
Coconino	white sandstone	<u>230 feet</u>
	Total	1023 feet

This well supplies an abundance of water, but it is too salty for drinking or domestic use. Mr. Walker believes that this salt water comes from the Moenkohi formation which usually carries salt water. The Coconino, on the other hand, almost always contains fresh water. Holbrook, and other towns in this region, are supplied with water from the Coconino sandstone.

Mr. Walker believes that by taking proper precaution there is a good chance of finding an ample supply of potable water in the Coconino at about 950 feet. He recommends the following precautions:

1. New well to be located not less than a quarter of a mile from the existing well.
2. Start with a 12-inch hole.
3. Test water in all sands as drilling progresses.
4. Shut off salt water in Kaibab at about 800 feet.

From all I have been able to learn of local conditions, I am of the opinion that his recommendations are logical.

Since my last visit to the park the Desert Rim Scenic Drive has been completed. This drive, 4.8 miles in length, skirts the Rim of the Painted Desert and affords a magnificent view of the multi-colored formations which make up the Desert. The stone building on the Rim is rapidly nearing completion.

On this inspection with Dr. McDougall, we visited all six of the areas known as "Forests," namely, First Forest, Second Forest, Third Forest, Blue Forest, Rainbow Forest, and Black Forest. The

first five of these, located south of Highway 66, are easily accessible to the public by roads and trails, and are visited by thousands of tourists each year. The map shown herewith, as Plate I, gives the location of these areas.

Black Forest lies north of Highway 66 and the Painted Desert Rim, and at an elevation of several hundred feet below this rim. Part of Black Forest can be reached by a very indifferent road, which is not passable after rains.

According to Mr. Walker, Black Forest is approximately eight miles long, averaging half a mile in width. Within this area thousands of fallen logs lie scattered on the surface. In this forest there are several of the best examples of petrified stumps to be seen on the monument, as shown in figures 1, 2, 3, and 4.

One of the moot questions regarding the Petrified Forest has always been that of the origin of the logs. Did they grow near where they are now found, or did they float in as driftwood? Dr. Lester F. Ward of the U. S. Geological Survey, the first scientist to study these logs and who made an examination of the area in 1899, was of the opinion that the greater part of these logs grew elsewhere and were floated to their present position. His reason for this belief seems to have been that all the logs which he noted are lying prone and that no stumps were observed. Most later observers seem to have followed Ward in this belief.

The work of Mr. Walker and his associates seem to prove the accuracy of the opposite theory; namely, that the trees, at least part of them, grew on the ground where they now lie. He has found traces of one hundred or more stumps which apparently grew at their present location. Figure 5 shows a stump, or base of a tree, 12 feet high and 3 feet in diameter with five long roots and several smaller ones. The lower part of this trunk and the roots contain much carbonized material, differing in this particular from the majority of the trunks which are silicified.

Near the trunk just described, as well as in many other places, the clay banks yield great quantities of fossil plant remains. There are layers or strata, apparently one above another and separated by layers of clay, sometimes several inches thick, composed largely of broken fragments of twigs, leaves, stalks and branches of plants, such as today accumulates on a forest floor. The common name for such an accumulation is duff.

The most abundant and conspicuous of the fossil plants remains in Petrified Forest are five genera of trees which go to make up the petrified logs. These were not the broad-leaved trees like the oaks or willows such as occur in the modern forest: They were not even like the conifers such as pine and cedar. Rather - they were a lower form of plant life, known as Pteridophytes, to which belong our modern ferns. Perhaps we can best describe them by calling them

by calling them fern allies. They grew as tall as many modern trees, with trunks often four to six feet in diameter.

Other fossil plants include fifteen or more species of true ferns, two cycads, and two neocalamites. Other fern allies include equicetae, or horsetails, cordites, and lycopods. It is rumored that the ^gginkgo, one of the oldest forms of conifers, has also been found. Many of these forms are as yet undescribed. When this has been done we will know much more about the ancient plant life at Petrified Forest.

The weathering of the soft shale has given rise to several Natural Bridges. Two views of one of these bridges is shown in figures 6 and 7. The famous Agate Bridge reinforced by concrete is shown in figure 8.

As with plants, so with fossil animals. The dominant type of life was the Phytosaur, a long-nosed reptile, looking something like a modern crocodile. Many bones and teeth of these primitive reptiles have been found, including at least three species. There appear to be four species of Ammodons, with Stegocephalia, lung fishes, and possibly a primitive lizard. Molluscan life is represented by clams and snails, and there appear to be evidences of insect life.

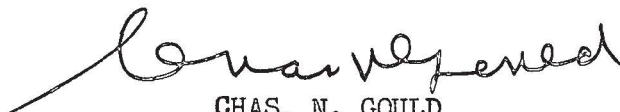
The entire ensemble of plant and animal life appears to be indicative of swamp, lagune, or deltate conditions of deposition.

It was not deep sea; neither are there indications of deserts. But, rather, shallow water with fern-like trees growing along the margins or in the swamps. The primitive reptiles and amphibians swam in the shallow water or crawled over to the mud flats. There were probably some periods of oscillation of the land. Clays were deposited largely in still water off shore, and beds of sand piled up along the margins of the land, now forming sandstone ledges.

For bringing these things to our attention, Mr. Walker deserves much credit.

One of the outstanding objects of interest on Petrified Forest is the Agate House, shown in figures 9 and 10. This is a restoration of a prehistoric structure built of the same blocks of petrified wood. The restoration was accomplished in 1933 and 1934 under the direction of Dr. H. P. Mera of the Laboratory of Anthropology at Santa Fe.

Respectfully submitted

A handwritten signature in dark ink, appearing to read "Chas. N. Gould", written in a cursive style.

CHAS. N. GOULD
REGIONAL GEOLOGIST



Figure 1. McDougall and Walker at stump of petrified tree. Black Forest.



Figure 2. Petrified stump in foreground. Black Forest, scattered trunks in background.



Figure 3. Petrified stump and log.
Black Forest.



Figure 4. Petrified stump, 8 feet in diameter.
Black Forest.

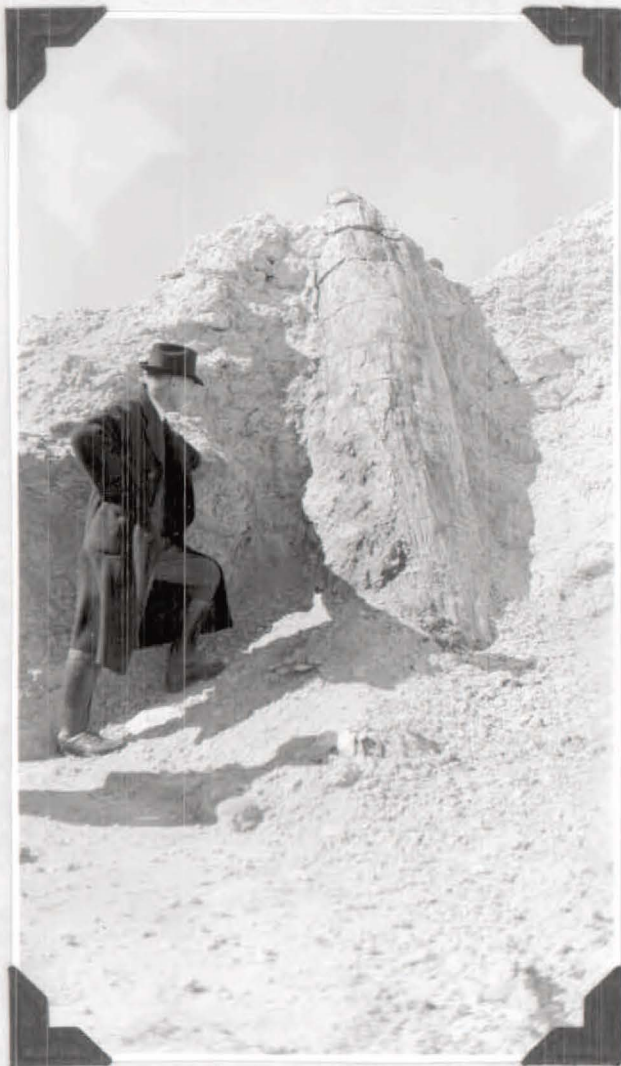


Figure 5. Stump excavated under
direction of Park Nat-
uralist Walker.
Petrified National Monument.

Figure 6. End view of natural bridge
formed of petrified log.
Black Forest.
Petrified Forest National Monument.





Figure 7. Side view of Petrified log natural bridge. Black Forest.



Figure 8. Park Naturalist Walker standing on Agate Bridge, formed of petrified log and reinforced with concrete.



Figure 9. Agate House, Petrified Forest National Monument.



Figure 10. Agate House, built of petrified wood. Petrified Forest National Monument.

PETRIFIED FOREST NATIONAL MONUMENT **ARIZONA**

RULES AND REGULATIONS (Briefed)

"IT IS UNLAWFUL TO INJURE, DESTROY, OR APPROPRIATE SPECIMENS OF PETRIFIED WOOD OF ANY SIZE WHATSOEVER, FOUND WITHIN THE MONUMENT BOUNDARY, OR TO DEFACE, INJURE, DISTURB OR MARK ANY RUINS, RELICS, PICTURES, OR OTHER WORKS OF PRIMITIVE, OR PREHISTORIC MAN, GOVERNMENT PROPERTY OR NATURAL FORMATIONS, IN ANY MANNER, AND VIOLATORS WILL BE PROSECUTED TO THE FULL EXTENT OF THE LAW, PENALTY UP TO FIVE HUNDRED DOLLARS (\$500) FINE OR SIX (6) MONTHS IMPRISONMENT, OR BOTH."

At first glance it may seem that this law pertaining to the petrified wood is quite drastic, because the fragments and chips are so abundant within the monument. But it should be remembered that there are more than one hundred thousand visitors annually, and that it is most important that the reserved area be kept intact so as to be enjoyed by future generations.

"HUNTING OR SHOOTING
PROHIBITED"

"LEAVE A CLEAN CAMP"

"KEEP DOGS ON LEASH"

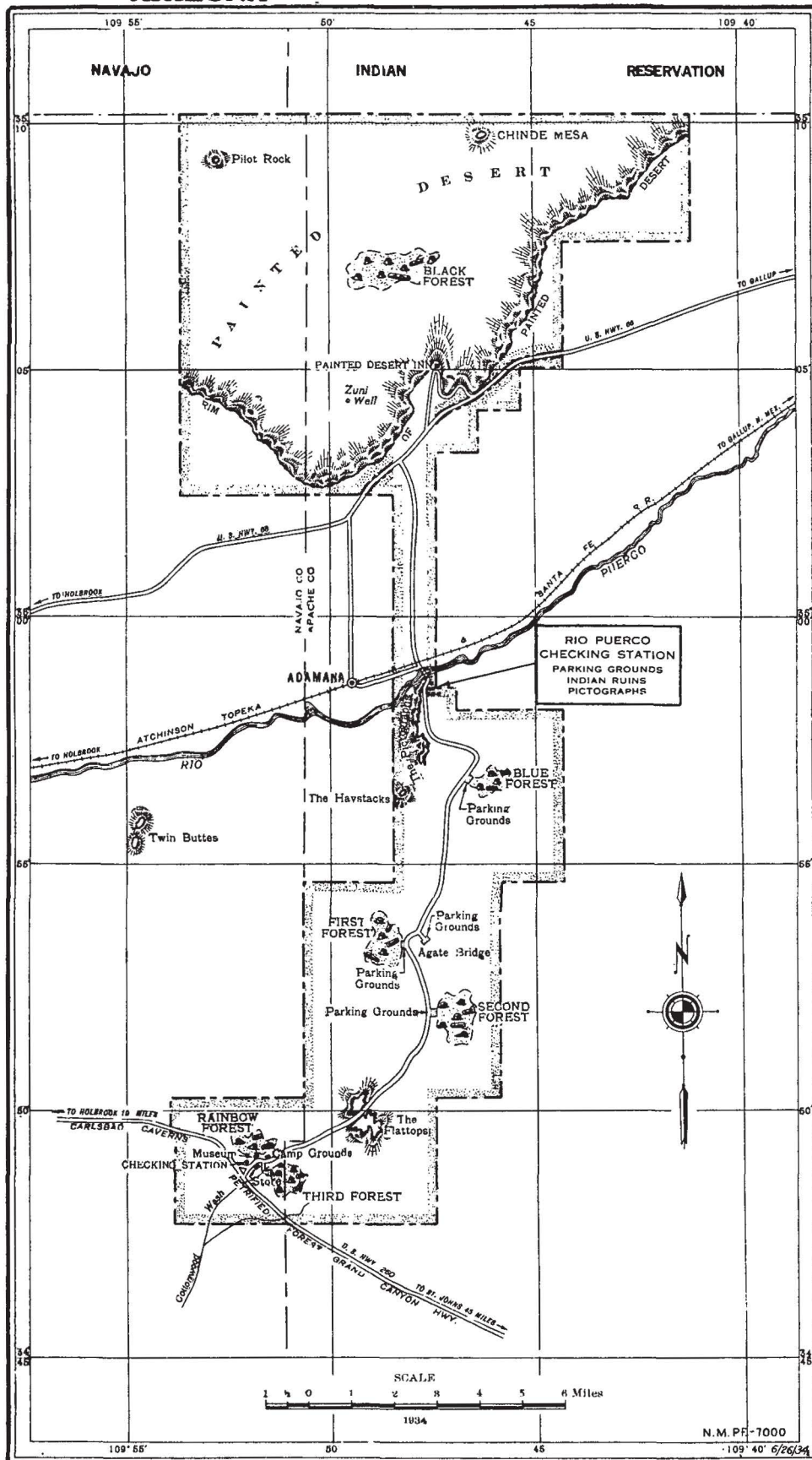
"TRANSPORTATION OF PASSENGERS FOR HIRE WITHIN THE MONUMENT IS PROHIBITED WITHOUT A PERMIT FROM THE NATIONAL PARK SERVICE"

READ AND OBEY THE REGULATIONS

**KEEP ON THE MAIN TRAVELED
ROADS**

**CAMPING AND PARKING ALLOWED
AT DESIGNATED AREAS ONLY**

THE MONUMENT HIGHWAYS BETWEEN RAINBOW FOREST AND U. S. HIGHWAY NO. 66 ARE CLOSED DURING THE NIGHT.



UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

PETRIFIED FOREST NATIONAL MONUMENT

The Petrified Forest National Monument located in Northern Arizona contains 92,000 acres. It is open to visitors every day in the year. A fine highway has been constructed across the Monument, and the Rio Puerco has been spanned by a fine steel and concrete bridge, forming an all year connection between U.S. Highway 260 on the south and U.S. Highway No. 66 on the north. These two highways join at Holbrook, Arizona, 19 miles west of the National Park Service Headquarters in the Rainbow Forest near U.S. 260.

Adjacent to, and north of U.S. 66 is the scenic Painted Desert section of the Monument, which includes the famous Black Petrified Forest.

Between U.S. 260 and U.S. 66 there are 6 areas called "Forests" namely: Blue Forest; First Forest; Second Forest; Third Forest; and Rainbow Forest. They all have individual characteristics and are all worth visiting. There is a scenic drive through the First Forest. Near the First Forest is the Agate Bridge, a petrified log 4 feet through, spanning a 40 foot arroyo 20 feet deep. The Agate Bridge is the most noted single petrified log in the world. Throughout the Monument are the ruins of the habitations of a former people, and thousands of their "picture writings" or petroglyphs are engraved on the sandstone cliffs.

Taken all in all, the Petrified Forest National Monument, including the combined Painted Desert and the Petrified Forests, forms one of the most popular and interesting units under the National Park Service.

Holbrook; to the west, has good hotels, cafes, and camps. Westward from Holbrook 33 miles is Winslow, the largest city in Northern Arizona.

Gallup, New Mexico, is 75 miles east from the Painted Desert Section of the Monument, on U.S. 66.

St. Johns and Springerville are the nearest towns to the east on U.S. 260, being respectively 45 and 75 miles from the Rainbow Forest. Both towns furnish good accommodations.

Visitors traveling west on U.S. 66 wishing to visit the Forest, should turn south at the Painted Desert Junction, traverse the Forest and continue to Holbrook on U.S. 260. Persons traveling east on U.S. 66 may leave that highway at Holbrook, follow U.S. 260 nineteen miles east to the Rainbow Forest, pass through the Monument and reach U.S. 66 again at the Painted Desert.

Those traveling west on highway 260 will visit the Rainbow Forest and may continue across the Forest, see the Painted Desert and continue to Holbrook on U.S. 66. Visitors going east on U.S. 260 will pass through the Rainbow Forest or they may follow U.S. 66 to the Painted Desert and then turn south through the Forest, reaching U.S. 260 again at Rainbow Forest.

Charles J. Smith, Superintendent,
Petrified Forest National Monument,
Holbrook, Arizona.

