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IN
STORAGE

WHERE DID THE TREES GROW?

Report submitted

to

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WHERE DID THE TREES GROW?

One of the most difficult problems before the naturalists in the petrified forest is just how to answer the question, "where did the trees grow?" Most of the tourists come to the forest with a very vague idea of just how a forest is buried and turned to stone. Many who have no idea at all soon get one from the many road-side stands who deal in curios and sell the petrified wood. The idea most of them have is that the trees were drifted into this region. The road-side stands are not the only ones responsible for such a theory, for many of the old reports and some of the early custodians gave out just such information.

The main reasons for believing that the trees did not grow here and that they were drifted in are as follows: In the first place there are no (tall) standing petrified trees, although we now believe there are a number of short stumps actually in place; the trees are an extinct type of pine which does not grow in the northern hemisphere today; the only places where we may find living relatives of these trees are in South America, Australia, and on Norfolk Island. In the early days, the formations observed in the petrified forest were considered to have been deposited in an ocean. Of course trees would not grow in the middle of an ocean, and they could get there only by drifting.

It has been proven that no ocean existed here at the time the trees grew and were buried because the formations of the petrified forest are now determined as fresh water and continental deposits. We now believe there are a number of short stumps actually in place.

Brief extracts from a number of reports follow, and perhaps explain why the "drifted Forest" theory got its start. Knowlton (6) has the following to say; "As may be presumed from what has already been said, none of the fossil trees now stand upright in the position in which they grew, nor have any been found which retained the branches, though petrified limbs and small twigs are not infrequently associated with them. The evidence seems indisputable that they have all been transported for a greater or less distance by the agency of water. Although the geological formation in which the forests occur is known to cover many hundreds of square miles, and to be characterized throughout by the presence of fossil wood, the exact places where the trees grew are not known. The accumulation of these logs in the masses which now mark the fossil forests suggest floating and stranding of the logs such as may be seen in great eddies or the deltas of rivers. The rocks in which they are now embedded lend support to this view, since they consist of coarse sand and gravel and are laid down in fresh water and are conspicuously cross-bedded, an indication of rapid and changing currents".

Ward's (11) report is as follows: "The best popular account of this region is given by Mr. George F. Kunz, and is as follows: 'There is every evidence to show that the trees grew beside some inland sea. After falling they became water-logged, and during decomposition the cell structure of the wood was entirely replaced by silica from sandstone in the walls surrounding this great inland sea'.

Ward (11) goes on to say: "Although there is no longer any question as to the true stratigraphical position of these profuse vegetable remains, there are many facts which stand in the way of the supposition that the trees actually grew where we now find them. Several accounts profess that stumps occur erect with their roots in the ground, showing that they grew

and were buried and petrified on the spot, but I was unable to confirm any such observations, and on careful inquiry of the residents of the country, who had minutely examined every part of the area, I was unable to learn of a single indisputable instance of such an occurrence. The only trunk that I saw standing on end was one that was inverted and had its roots high in air. In fact, from the nature of the case, as I have just shown, there would be no use looking for any such phenomenon in any of the principal fossil forests, since they all lie from 100 to 400 feet below where they were originally deposited. It is only in the beds of coarse sandstone that hold them, therefore, that the evidence need be sought. This I did with the utmost care, but even here I found no example of an upright trunk.

In this, as I was glad to learn after my return on looking the matter up, I was only confirming the observations of Dr. J. S. Newberry, made in 1858 and published in 1861".

Dr. Newberry's (9) statement is as follows: "I examined these specimens with some care to determine, if possible, whether they had grown on the spot, as those of Lithodendron Creek are supposed to have done by the members of Captain Whipple's party or whether they had been transported to their positions. In all that came under my observation, I failed to find any evidence that they had grown in the vicinity. All the trunks are stripped of their branches and exhibit precisely the appearance of those transported to some distance by the agency of water. In confirmation of this view I should also say I found in the marls, with the entire trunks, rounded and water worn fragments of wood, in some instances silicified and in others converted into lignite. I gathered

the same impression from all the collections of silicified wood which I observed in this formation in western New Mexico, viz; that all had been transported, but not far removed from their place of growth".

Dr. George P. Merrill (8) makes the following statement: "There is nothing to indicate that the trees even grew near the locality where the logs are now found. It is apparent rather that they grew at some distant point and were drifted by stream action into eddies after having been reduced to mere trunks or logs through the loss of the leaves and smaller limbs".

Darton (2) in "Guide Book of the Western United States" says: "Doubtless they (the trees) grew in a near-by region and after falling, drifted down a watercourse and lodged in some eddy or a sand bank. Later they were buried by sand and clay, finally to a depth of several thousand feet".

Ward (12) later found additional information which is as follows: "In my report on the Petrified Forests of Arizona (p.15) I mentioned that statements made by Mollhausen and Marcou that they had seen trunks standing erect and evidently in place, and I quoted (p.16) Dr. Newberry's conclusion, agreeing with mine, that this phenomenon probably did not occur. So far as the conglomerates are concerned, I have seen no reason for altering this conclusion, although I would not be as positive now as I was then that cases of the kind will not be found. But with regard to the trunks entombed in the variegated marls, or next horizon above the conglomerates, we practically demonstrated that erect stumps do occur in them. Within a quarter of a mile of the butte from which Mr. Brown found the best preserved vertebrates bones there is a small area, probably 30 or 40 acres, which contains a group of twenty or more such stumps. They

are low, rarely rising more than 4 feet above the ground, but some of them are large, having a diameter of from 3 to 4 feet. Nearly the entire trunk above these stumps, as well as all the branches, has wholly disappeared, but the ground is strewn with small chips and blocks. It is a somewhat level area and the stumps all stand erect upon it, and many of them are not deeply buried in the earth, but show the natural enlargement toward the roots. A careful examination of these stumps convinced me that they were not only in place but stood precisely where they grew".

Frank H. Gunnell (5) makes the following statements: "In the area about 2 miles north, (magnetic) of the Painted Desert Inn, the writer identified 5 stumps as being in place". ----"On the east side of the present road within the connecting strip north of the Rio Puerco occurs petrified wood in the same strata as the Painted Desert. ---It is here that large stumps occur in place. One of these stumps in place here is about $4\frac{1}{2}$ feet in diameter."

Mr. Edwin D. McKee (7) makes the following statements: "It was by these streams that a great quantity of logs of evergreen trees were carried down probably from what is now the region of Colorado. Many of the tree trunks were worn and battered on the way, and in this region (from southern Utah to the vicinity of Adamana and Holbrook, Arizona), they were buried in great numbers among the depositing sediments. All four of the Petrified Forests south of Adamana originated in this manner--and probably represent old log-jams. Nine miles north of Adamana, however, is the North Sigillaria Forest where the pine trees are found standing where they grew".

The report of Gregory (4) in the Geology of the Navajo Country is as follows: "The conditions under which the large amount of fossil wood was

accumulated in the Triassic sediments are not clearly understood. That the spots where they are now found is highly improbable. Of the standing trees reported one has its roots in the air, the others so far as I have observed are wedged among other logs in a manner common to driftwood. The few stumps noted are in proper position, and Ward is of the opinion that a group of stumps near Tanner Crossing is in place. Mr. Heald who studied these stumps, considers this conclusion to be open to doubt. No roots extending downward have been found attached to stumps". -- It is believed that the tree trunks now turned to stone were carried by streams during the flood. Many of them have worn ends and battered sides, and most of them are without bark".

From the reports cited we may draw the conclusion that the trees in the Petrified Forest south of the Rio Puerco are considered by nearly all as having drifted in, and that no evidence has been found that would prove that they grew where they are found today. Several of the reports (Ward, McKee, Whipple, Gunnell), mention that trees are in position on Lithodendron Creek and at Tanners Crossing. Daugherty, Walker and Felton have visited the locality on Lithodendron Creek and are of the opinion that there are a number of stumps, ten or more, that are upright with the roots in the ground, and that they grew exactly where they are found today. Gunnell has reported and Walker has observed the stumps in the "strip" north of the Rio Puerco. Walker and Felton have examined the area south of the Rio Puerco and are now ready to challenge the theory that these trees were all drifted in, and that no evidence can be found where one is in place.

About 2 miles west of the Museum in the Rainbow Forest there is a very short stump in position, with the roots imbedded in the original matrix rock. There are drifted trees all around it, but it appears never to have been moved. The top shows beveling by sand and water on the north east surface. A photograph of this stump was taken by Grant and is negative No. 152 and 153--1934.

About 1 or 2 miles northeast of the third forest Walker found a small trunk resting at about an angle of 45 degrees. This trunk was traced out and perfect root structure was discovered. Evidently the tree was nearly pushed over by the currents but the roots remained anchored and the tree was finally buried in this slanting position.

Perhaps the most interesting stump of all is a tree about 3 feet in diameter, which is located about one mile southwest of the second forest. When discovered, only about two feet of the top was exposed. This top was beveled off, the direction of the current coming from the northeast, and the top section leaning at an angle of about 20 degrees off of vertical. It was thought advisable to excavate this stump and determine whether or not roots were present.

At the present time only about 7 feet of the trunk has been exposed. It is beginning to show the natural enlargement at the base. We believe fine root structures will be found. A very fine shale (carbonaceous) and sandstone are the enclosing matrix. In the fine black shale numerous leaf, stem and seed impressions were found, thus indicating an undisturbed land mass. It is hoped that some of the leaf and seed impressions may be determined as belonging to Araucarian pines. From the evidence at hand this specimen appears to be the finest example of a tree buried, upright in the position in which it grew.

Numerous discoveries since the early publications have given us an

altogether different picture of the conditions when the trees grew and were buried. A few of those discoveries are as follows:-- the discovery of numerous fossil leaf impressions, Cycads, Ferns, Horsetails, Lycopods; the discovery of fossil fresh water invertebrates, clams and snails; the discovery of fossil land and shore-line vertebrates such as Stegocephalians, Phytosaurs and Anomodonts and the tracks of these same vertebrate forms.

Perhaps it would be well to quote from Camp (1), "A Study Of The Phytosaurs", and give the picture as he has painted it.--"The fossil occurrences in the Lower Chinle together with what is known of the lithology and sedimentary history of this formation would most certainly indicate fluvatile conditions, presumably a great, low-lying flood plain near the seacoast, traversed by slow-moving streams subject to occasional overflow and freshets, and interspersed with large swampy areas and shallow lakes with scattered stands of conifers on highground."

It might be well here to mention that Camp discovered and Daugherty, Walker and Felton (3) also observed, standing, upright casts of the stems of large Horsetails (Equisetums) in the Chinle near Saint Johns.

CONCLUSION

From various observations, and with due regard for the many recent discoveries, Walker (10) and Felton (3) believe that many of the trees grew near where they are found today, and that there are several localities where stumps may be observed, upright, with the root structure intact, and in exactly the place and position in which they grew.

It is evident that most of the trees were drifted by water into some lake or river eddy, but Walker and Felton find little evidence to support the old theory that they drifted any distance. It appears that the Agate

Bridge and the First, Second, Third and Rainbow Forests are largely accumulations in channel or lake deposits, but in each instance trees evidently were growing along the margin of the stream or lake, and in such cases, they were buried upright, and in exactly the place and position in which they grew.

Respectfully submitted

to

Supt. Chas. J. Smith

Petrified Forest National Monument

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