VI. OLD BEACH MARKINGS IN THE WESTERN WICHITA MOUNTAINS

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The horizontally grooved granites in the west end of the Wichita Mountains have been observed by a number of geologists, but so far as the writer knows, they have been described only by C. H. Taylor and by Dr. Samuel Weidman. Taylor thinks they were caused by water action along old beach lines, while Weirman ascribes their origin to the work of glacial ice.

If a line is drawn north and south through Cooperton, Oklahoma, these markings are found at various places in the granite areas to the west. They have not been observed to the east of the line, nor to the west of it in the gabbro mass in which the towns of Cold Springs and Roosevelt are situated.

The grooves are nearly always approximately horizontal, and are of various widths from about an inch to four or five feet and have a depth from about 1-5 to 1-2 of the width. They sometimes occur singly, but often cover a surface of considerable size. The largest surface so far observed is in the SW. 1-4 of sec. 33, T. 5 N., R. 20 W. and is about 375 feet long and 90 feet high. It is hard to say just what the vertical distribution of the markings may have been originally as the lower part of the belt is now in the process of being uncovered by erosion of the red beds surrounding the granite masses and the upper part of the belt in places is apparently being destroyed by weathering.

Five possible ways have been suggested by which the markings may have been formed.

1. By ordinary weathering.
2. By wind action
3. By underground water action.
4. By work of glacial ice.
5. By work of water along a shore.

Of these methods the first three would probably be almost at once rejected by any geologist observing the markings in the field but were suggested seriously to the writer by men who had not been in the area and for that reason are discussed here. A choice between Nos. 4 and 5 requires more careful study.

1. *Ordinary Weathering.* It is true that the granites of the Wichitas give rounded forms in many places as the result of weathering. However, the horizontal regularity and the vertical variation in size of these markings is unfavorable to the weathering theory. Also the variation in exposure seems to make no difference in the regularity and depth of the grooving as would be the case in weathering.

Wind Action. If caused by wind action the regular horizontal groovings could be formed, in the absence of stratification only, at the surface of the ground. In many cases, the grooves are too small and regular to have been formed in this way. Also we would expect

wind work to be more effective on the side of mountains toward the prevailing winds and to be more effective on exposed surfaces than in recesses of the rock, but the grooves are found equally well developed on all sides of the mountains and as well developed in deep recesses as on exposed surfaces.

. *Underground water action.* It has been suggested that layers of porous water bearing sandstone separated by impervious shale layers lying up against the granite mountain might cause the grooving by a sort of underground weathering. However, in those places where the groovings are being uncovered by erosion the surrounding red beds do not have this structure.

4. *Work of glacial ice.* This has been suggested by Weidman in an article in the Journal of Geology for September-October, 1923, although on page 478 he states that he has not seen all of the exposure of grooved granites. Some of the surfaces do have a strong resemb'ance to ice work, but closer examination shows many features different fom ice action and some that are impossible for ice work. Glacial ice will groove and striate a rock face and will enter curved recesses if the radius of curvature is not too short, but ice will not turn at a right angle and enter a triangular recess and carry the grooving to the apex of the recess and come out again. This is what has occurred in dozens of places on these grooved faces. For example, in the NE. 1-4 of sec. 7, T. 5 N., R. 18 W., there is a place where a groove about 10 inches wide and four inches deep passes along the face and turns at a sharp angle into a triangu'ar recess about 16 inches wide and three feet deep and without change in shape or size, reaches to the apex of the triangle and comes out again on the other side and continues along the face . In another place a somewhat larger groove enters a recess about 2 feet wide in front and eight feet deep and comes out again. On the south side of Soldier Mountain at about 150 feet from the bottom is what appears to be an old seacave.It is wedge shaped about six feet wide in front and 30 feet deep. Here, large horizontal grooves continue clear back to the apex.

On section 7, T. 5 N., R. 18 W., are recently uncovered inliers of rock three or four feet high and perhaps twenty feet in diameter. These have large grooves running around them horizontally and equally deep on all sides, but no grooves running over the top. These are evidently not *Roche Mountonnees* because on a *Roche Mountonee* of these dimensions the glacial ice instead of grooving horizontally around the mass goes over the top and grooves and striates in a direction parallel to that of the ice movement.

5. If we eliminate ice work, this leaves as the only possible agent the action of water along a shore line. Water could penetrate the triangular recesses in the rocks as described above and affect them equally with the more exposed surfaces. It would seem also that water is the only agent that could groove a boulder or stack horizontally around and equally on all sides.

The grooves were formed before the present red beds were laid down because they are being uncovered by erosion. They could not

have been formed very long before red beds time else the markings would have been weathered out before being uncovered as they are now being weathered away. It therefor seems probable that if they were formed at the edge of a lake or sea that it was the same body of water in which the red beds were deposited. The groovings are not very large in many cases and it would seem that the body of water in which they were formed was not very large and probably had no tides. The work of groove making was probably mostly chemical. That is, the wetting and drying along the edge of the water hastened the weathering of the granite. The granite of this region is at the present time more readily acted on by water in this way than is usual with igneous rocks. On sec. 26, T. 6., N., R. 21 W., there is a very large exposure of granite and where the water runs down the face after a rain regular channels have been weathered out. One of these is about 18 inches wide and 5 inches deep. Similar channels have also been observed on Soldier Mountain. This being the case, it would seem that an agency that would alternately wet and dry the rock along a horizontal line would cause a horizontal groove to form in a relatively short time. It is also probable that the effect of salt water would be more rapid than that of fresh water.

It would seem then that these grooves might have been formed in a salt lake or small arm of the sea at a time when the water was gradually advancing and the present red beds of the area were bing deposited.