

## FURTHER OBSERVATIONS OF THE EROSION OF CLIFTY AND BUTLER RAVINES, JEFFER- SON COUNTY, INDIANA.

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In the Proceedings of the Indiana Academy for 1897 there is given an account of preliminary work, looking forward to the approximate determination of the time required for the erosion of Clifty and Butler valleys. This preliminary work was done by Dr. Glenn Culbertson of Hanover College. It consisted in making accurate measurements of the length of the valleys mentioned, in drilling holes and driving steel rods into the rocks both above and in the amphitheater-like space beneath the falls, and in making accurate measurements from these rods so that the rate of recession of the falls could be determined.



Fig. 1—Clifty Falls. Iron rod at (a). At present most of the mist from the falls strikes the cliff at point marked (b).

“Proc. Ind. Acad. Sci., vol. 37, 1927 (1928).”

In 1911 (Proc. Ind. Acad. Sci.) it was noted that measurements from the rods driven in the bed of the stream above the falls produced no results of immediate value. But that the results from measurements of the rod driven in the softer strata below the falls were quite satisfactory, especially in the case of Clifty Falls.

Observations showed that during the 14 years between 1897 and 1911 the undermining at Clifty Falls amounted to four and one-fourth inches. The sapping, as it is sometimes called, is due principally to the weathering caused by the mists carried by the waterfall winds against the rocks, followed by frost action.

At the present time the weathering has amounted to seven and one-eighth inches, two and seven-eighths inches of which has taken place since 1911, 16 years ago. The rate of retreat for the first 14 years was approximately two-sevenths of an inch per year and for the last 16 years the figure is very nearly three-sixteenths of an inch, the average falling near one-fourth inch per year for the 30 years. The period required for the retreat of the falls from the edge of the deep valley of the Ohio, a distance of 11,000 feet, if the 30-year average has held throughout its history, should be 528,000 years. If the rate for the first 14 years were more accurate the period would be 462,000 years. It is probable that the latter figure is more nearly correct because in recent years erosion at the base of the falls has caused the waterfall winds to carry more mist against the rock some 30 feet north of the iron rod, which is directly behind the falling water. When the iron rod was placed the greatest amount of mist was directed against the cliff at that position. (Fig. 1.)

Because of the many variable factors in the erosion of this valley it is difficult to say just how accurate this figure may be. The rock over which the water flows is essentially of the same character as that over which the water flowed during the whole past history of the valley. Hence so far as that element is concerned, the erosion should have been uniform throughout the period of growth of the valley.

Whether or not the amount of water flowing over the falls at present is as great as in the past is a problem rather difficult of solution. The falls are in the main valley, yet as they have retreated through the two and one-twelfth miles, several tributaries have been left to work back their heads and their water no longer helped to erode the main falls. As far as this element is concerned, it may be that there is a smaller volume of water flowing over the falls than in the past, and hence a somewhat slower retreat.

To offset this factor, the valley above the falls has certainly been growing longer and developing tributaries in the flat Illinoian Glacial plain, and hence has been adding to its drainage area and volume of water during this period. The Wabash-Ohio divide would gradually shift westward. Because of this factor the falls may be retreating more rapidly than during the earlier period of its growth. The area drained by the tributaries above the falls is practically the same as the area drained by the tributaries which empty into the main stream below the falls, so possibly the present amount of water is not greatly different from the average of the whole period of retreat. (Fig. 2.)

Assuming that the amount of rainfall has been almost uniform it is probable that the rate of sapping beneath the falls and hence the retreat of the falls up the valley, is approximately that which has held throughout the history of its growth. According to the average estimate of the time lapsing since the Illinoian glacial advance it would seem that Clifty Valley came into existence near that time but probably practically all of the erosion has taken place since.

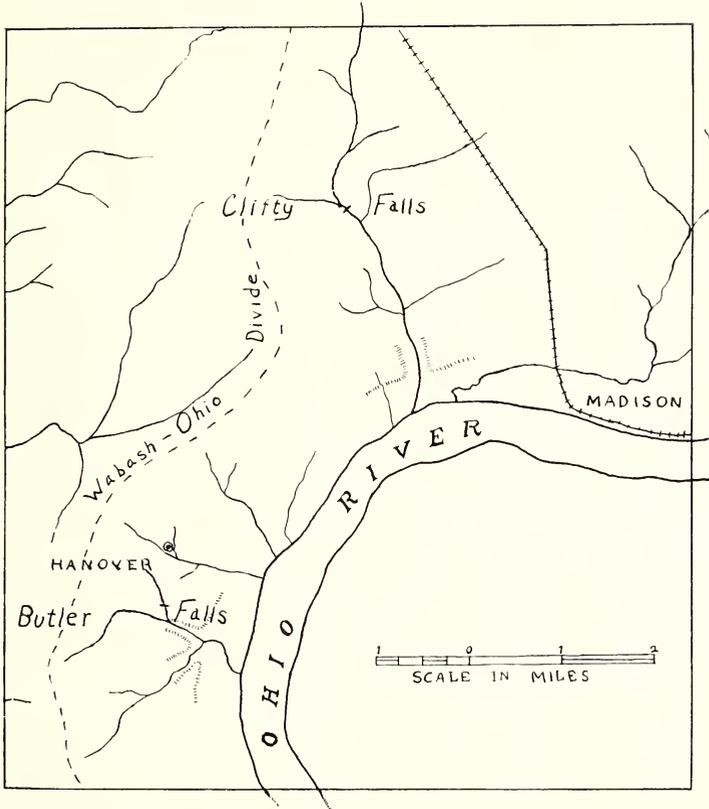


Fig. 2—Part of Jefferson County, Indiana, showing location of Clifty and Butler valleys.

An observation of the amount of sapping under Butler Falls seems at first to lead to a very different figure. During the 30 years it has retreated only thirteen-sixteenths of one inch through the same rock and in the same direction that Clifty Falls has retreated. At that rate it would have required approximately 1,600,000 years to retreat the 3,300 feet from the Ohio River bluffs. (Fig. 2.) However Butler Falls is in a short tributary of the main valley and the stream drains only about one-fourth as great an area as the main stream. So the retreat for nine-tenths of the distance was probably four times as rapid as the

present rate of retreat. The time in years would be about 400,000, which would seem to indicate that the age of Butler Valley is about that of Clifty Valley or possibly somewhat younger, and had its origin about the time of the Illinoian ice advance.

### NOTES ON SOME OHIO RIVER TERRACES.

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Some of the best developed alluvial terraces to be found in the central states are located along the Ohio River where it forms the southern boundary of Indiana. A typical development is found in Jefferson County, Indiana, and Carroll and Trimble counties, Kentucky, where they are known as "first bottoms" and "second bottoms." The terms "third bottoms" and "fourth bottoms" would be applicable though they are not used.

These deposits, varying from a few feet to more than a mile in width, alternate on both sides of the river with steep bluffs which rise abruptly from the water's edge to a height of about four hundred feet. A bluff on one side is faced by a wide "bottom land" on the opposite side and vice versa, because of the swinging of the current from one side to the other. The length of each separate alluvial area varies from less than two miles to more than six, and the area ranges from approximately one-half square mile to more than four square miles. (Fig. 1.)

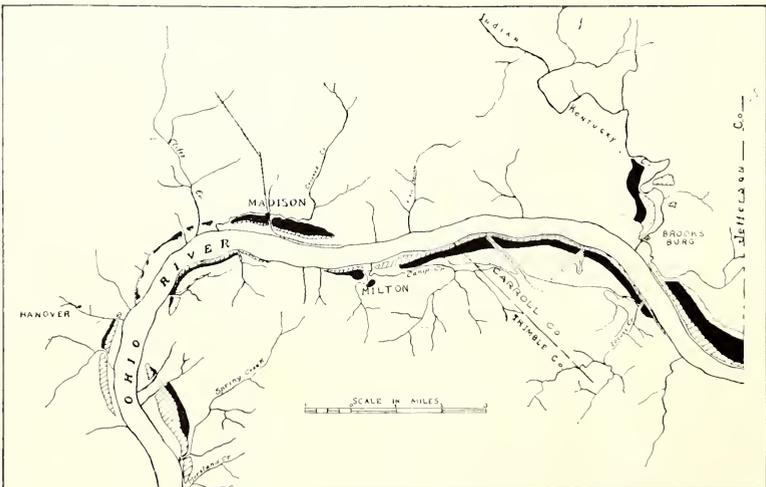


Fig. 1—Parts of Jefferson County, Indiana, and Carroll and Trimble Counties, Kentucky, showing area and location of terraces.  
 Diagonal lines // // // terrace number one.  
 Solid black ——— terrace number two.  
 Stippled ..... terrace number three.  
 Area between diagonal lines and the Ohio River represents flood plain.