

on probably from the southern ridge, as it is working on along the ditches still, as that ridge itself may have been washed up before the first recession took place, from the depths of Lake Michigan. The peat on that marsh now is a quite new or fresh formation, having come from the roots of the vegetation that sprang up when the water had largely receded.

But these operations of nature, of large interest always, and especially when we can observe them for a few years, are mostly speculative, rather than certain. The writer of this has had an opportunity to observe through the space of forty years, and therefore to know with certainty with what great rapidity, in some places, during heavy rainfalls, sand will be washed over a large area of bottom land. He has seen prodigious quantities of sand and gravel removed quite a distance by successive rainfalls.

PRELIMINARY WORK FOR THE APPROXIMATE DETERMINATION OF THE TIME
SINCE THE RETREAT OF THE FIRST GREAT ICE SHEET.

BY GLENN CULBERTSON.

It was with the desire of obtaining a close approximation to the time which has elapsed since the retreat of the Kansan or first great ice sheet that, during the past summer, the two most important waterfalls—Clifty and Butler—in the vicinity of Madison and Hanover, Jefferson County, Indiana, were visited by me and the work to be described was performed.

The well-known Clifty Falls, over which the water leaps a vertical distance of seventy feet, was the first visited. Into drilled holes steel rods were driven vertically to the depth of twelve or more inches in the solid limestone of the stream bed at a distance from the precipice over which the water falls, and accurate measurements from the rods to the edge of the precipice were made and recorded.

Butler Falls, which is located about one-half mile south of Hanover, and over which the water falls eighty feet, was also visited and similar measurements made and recorded.

The falls in both cases are caused by the presence in the stream beds of very durable strata of limestone, chiefly of the Madison and Clinton formations, and which is of very uniform texture and hardness over the region referred to. The rate of valley growth toward the head is governed by the erosion or undermining of these rocks.

A steel rod was also driven horizontally into a drilled hole in the even-textured but softer rock of the vertical or overhanging walls of the amphitheater-like excavations beneath the falls, and in each case a mark was made upon the rod from which from time to time measurements can be made as the gradual weathering of the rock continues.

The excavations beneath the falls are caused chiefly by the saturation of the rock by means of spray and mist carried by waterfall breezes or winds during winter floods, when frosts follow and complete the process. Better results will in all probability be obtained from the measurements of the weathering beneath the falls than from those upon the edge of the precipice, since the rate of weathering beneath is quite uniform and since the wearing away of the softer rock beneath determines largely the amount of breaking away and falling of the harder rocks above.

By means of data obtained from such measurements during a period of years, a close approximation to the rate of valley erosion can be obtained. These data taken in connection with the length of the valleys from the Ohio River to the falls, which in the case of Butler ravine or valley is approximately 3,100 feet, and in the case of Clifty is 11,000 feet, will give us an approximation of the time since the streams began work on the valleys.

The topography of these valleys and of the surrounding region, which gives every indication of the youthful stage of erosion, together with evidence of another character, indicates that these valleys have been eroded since the retreat of the Kansan or first great ice sheet. This ice sheet not only covered all the region referred to, but crossed the Ohio Valley, if the valley were there at that time, and advanced at least twelve or fifteen miles beyond in Trimble County, Kentucky. All the region was planed off to essentially the same level, and there are now within one and a half miles of the Ohio River undrained flats produced by glacial action.

A close approximation to the time required to erode these valleys should, then, give a fairly accurate approximation of the number of millenniums that have passed since the disappearance of the first great ice sheet from the borders of the glaciated region. This period, even approximately obtained, will be of great importance in ascertaining the causes of glacial periods, as well as being of interest in the discussion of other problems of import.