Niagara

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A FEW REMARKS ABOUT THE NIAGARA GORGE.

By L. L. BUCK, M. Am. Soc. C. E.

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Various scientific societies have discussed this gorge and in some cases attempts have been made to estimate the length of time required by the river to excavate the chasm as it now exists. But there are some of its features which appear to have been overlooked in such papers as have come under the writer's observation, and which he has thought might be of interest to our members while they are here, where they will be able to examine and study the question for themselves. It presents abundant opportunities for the development of theories. The writer has had various theories about it, but should any of them become evident in this paper he warns anybody who attacks them that he may suddenly find him on his side regarding them.

To simplify the following description, the gorge has been divided into six parts, as follows:

A B, 11 500 ft. long; *B C*, about 4 000 ft.; *C R*, about 1 200 ft.; *R D*, 2 000 ft.; *E F*, 3 200 ft.; *F H*, 3 700 ft. These distances are but roughly approximate, and obtained by scaling. The portion *A B*, beginning at the falls, is generally about 800 to 1 200 ft. wide at the water surface, has but slight descent and a rather slow current, and along its axis, as shown by the soundings, depths of 120 to 190 ft., the latter depth being toward the upper portion. This is the only portion in which soundings have been taken.

B C, at the water surface, has a width of about 400 ft., a descent of about 26 ft., and, as would be expected, a tremendous current, very much broken up and about 10 or 12 ft. higher in the middle than at the edges.

C R, at the water surface, has a width of about 600 ft., a descent of about 2 ft., current decreasing and becoming smoother at *R*.

R D, the portion known as the Whirlpool, has at the surface a length of 2 000 ft.; width, 1 100 ft. The outlet *E*, on the right-hand side, is about midway between *R* and *D*. The axis of the current from *R* approaches the right side, and while some of the water flows directly through the outlet, the greater part flows past the outlet, impinging against the shore at the right of *D*, turns to the left and circles around till nearly opposite the outlet, where, meeting the portion coming down the left side, both currents are driven toward the outlet, and, passing under the former current, come boiling up at the outlet and flows through it in a new direction at an angle of over 90° from its former direction. Beyond *D* is a ravine, down which a small brook flows and empties into the Whirlpool at *D*. *E F* has a surface width of 600 ft., a descent of 4 or 5 ft., and a considerable current.

At *F* the surface suddenly narrows to about 300 ft. in width, with an increasing current and a descent of 7 or 8 ft., to *H*, where the width becomes about 900 ft.

Throughout the whole distance the sides of the gorge are vertical at the top, and next to the Horseshoes the vertical portion extends nearly to the lower surface. Below this point the banks are vertical or overhanging, with heights of 30 to 60 ft. Below this, a slope formed of the débris from the sides with inclinations of 35 to 45°, extends to the water's edge. The upper stratum of rock is generally 10

to 15 ft. thick of limestone, possessing considerable strength, but flakes off slowly by exposure to the atmosphere. This is succeeded by limestone shale, blue shale, more finely stratified limestone and red sandstone, red shale and limestone strata with clay seams. The existence of the great falls is due to this arrangement of the formation. The water falling over the edge of the top stratum excavates the softer materials below, until the top stratum projects so far out that its own weight and the superincumbent water causes it to break off.

From the soundings below the falls, as well as from a study of the Genesee Falls at Rochester, where the formation is very similar, it appears that generally the fall excavates to a depth below the lower surface about equal to the height of the fall above that surface.

Judging from the generally uniform conditions existing from *A* to *B*, it is reasonable to suppose that the excavation throughout the 11 500 ft. has gone on at about the present rate. If so, it would have occupied a period of about 4 000 years.

At *B* the conditions are abruptly changed. The chasm becomes but about half as wide as at *A B*. Although no soundings can be taken, there is good reason to suppose that the depth does not exceed 80 ft. Then there is the rapid descent of the surface. One feature exists in the formation in this portion which does not occur in the former portion, in the fact that here we have a second strong stratum of rock about 12 to 14 ft. thick, located about 115 ft. below the top one, and suggesting that it may have caused the fall to be divided into two parts, the lower following the upper. This argument is also supported by the fact that immediately overlying this second strong stratum is a stratum of blue shale 50 ft. thick, and which would be rapidly disintegrated by a heavy volume of water falling upon it, or if, with a fall of 115 ft., it suddenly brought up against the second smooth stratum, which would deflect a considerable portion of it laterally and violently against the shale. The excavation here would be much more rapid, and consequently make the gorge narrower.

The Whirlpool appears to indicate that there must have been a great cavity in the rock, although some writers have advanced the theory that at one time the river continued in the direction of *R D* produced, and after excavating the gorge up to about the present outlet became dammed by glacial action or some natural convulsion, which diverted

the water into its present course. This may be the most reasonable theory.

The third striking feature is that at *F H*, where the great protuberance *G* juts out from the left bank, with a considerable ravine between it and the bank, and extending from the lower end about half way to the upper end.

There may have been a long, narrow island about over the highest part of this protuberance before the falls reached this part. This would divide the stream, the larger channel to the right. Such larger channel would cut more rapidly and deeper than the other one, so that by the time the smaller had cut about half way up, the larger would have reached the upper end of the island, and would then divert the water from the smaller channel to itself. The island afterwards would crumble down to its present form.

It must be constantly borne in mind that at whatever point the falls have been, the river above them has spread over a much greater width than that of the present gorge, and that the falls themselves always left the gorge narrower than we now find it, to be afterward widened by atmospheric influences.

In the remaining two miles the gorge presents some features of minor interest, but none so striking as those described.

The elevations
at the intersection
are 20 feet apart,
Niagara at
the level of

et.
Assistant Engr.
& and drawn

Chart depend
on rawanda NY.
observed in 1875.
1875.

Magnetic declination 2° 24' West.
At Suspension Bridge N.Y.
July 1875.

SCALE OF FEET
SCALE OF METRES
SCALE OF MILES