

## CHAPTER VII.

Composition of the terrace cut through—Why retrocession is possible—  
Three sections from Lewiston to the Falls—Devil's Hole—The Medina  
group—Recession long checked—The Whirlpool—The narrowest part  
of the river—The mirror—Depth of the water in the chasm—Former  
grand Fall.

THE water having laid bare the face of the mountain barrier from top to bottom, we are enabled to examine the composition of the mass through which it slowly cut its way. After removing the thin plates of the upper stratum, as we descend, according to Professor Hall, we find:

1. Niagara limestone—compact and geodiferous.
2. Soft argillo-calcareous shale.
3. Compact gray limestone.
4. Thin layers of green shale.
5. Gray and mottled sandstone, constituting with those below the Medina group.
6. Red shale and marl, with thin courses of sandstone near the top.
7. Gray quartzose sandstone.
8. Red shaly sandstone and marl.

Before reaching the Whirlpool the mass becomes, practically, resolved into numbers three, four, and five,

the limestone, as a general rule, growing thicker and harder, and the shale also, as we follow up the stream.

The reason why retrocession of the Falls is possible is found in the occurrence of the shale noted above as underlying the rock. It is a species of indurated clay, harder or softer according to the pressure to which it may have been subjected. When protected from the action of the elements it retains its hardness, but when exposed to them it gradually softens and crumbles away. After a time the superstratum of rock, which is full of cracks and seams, is undermined and precipitated into the chasm below. If the stratum of shale lies at or near the bottom of the channel below the Falls, it will be measurably protected from the action of the elements. In this case retrocession will necessarily be very gradual. If above the Falls the shale projects upward from the channel below, then in proportion to the elevation and thickness of its stratum will be the ease and rapidity of disintegration and retrocession. The shale furnishes, therefore, a good standard by which to determine the comparative rapidity with which the retrocession has been accomplished at different points.

From the base of the escarpment at Lewiston up the narrow bend in the channel above Devil's Hole, a distance of four and a quarter miles, the shale varies in thickness above the water, from one hundred and thirty feet at the commencement of the gorge, to one hundred and ten feet at the upper extremity of the bend. Here, although there is very little upward curve in the limestone, there is yet a decided curve upward in the Medina

group, noticed above, composed mainly of a hard, red sandstone. It projects across the chasm, and also extends upward to near the neck of the Whirlpool, where it dips suddenly downward. The two strata of shale, becoming apparently united, follow its dip and also extend upward until they reach their maximum elevation near the middle of the Whirlpool. Thence the shale gradually dips again to the Railway Suspension Bridge, three-quarters of a mile above. For the remaining one and a half miles from this bridge to the present site of the Falls the dip is downward. We may then divide this reach of the Niagara River into three sections:

First. From Lewiston to the upper end of the Bend above Devil's Hole.

Second. Thence to the head of the rapid above the Railway Suspension Bridge.

Third. Thence to the present site of the Falls.

We are now prepared to consider these sections with reference to the retrocession of the fall of water. Through the first section the shale, as before noted, lying much above the water surface, and the superposed limestone being rather soft and thinner than at any point above, the retreat was probably quite uniform and comparatively rapid, about the same progress being made in each of the many centuries required to accomplish its whole length. Professor James Hall, in his able and interesting Report on the Geology of the Fourth District of the State of New York, suggests the probability of there having been three distinct Falls, one below the other, for some distance up-stream, when the retrocession first began. The average width of this section between

the banks is one thousand feet. About one mile below its upper extremity is "Devil's Hole," a side-chasm cut out of the American bank of the river by a small stream called "Bloody Run," which, in heavy rains, forms a torrent. The "Hole" has been made by the detrition and washing out of the shale and the fall of the overlying rock. A short distance above, on the Canadian side, lies Foster's Glen, a singular and extensive lateral excavation left dry by the receding flood. The cliff at its upper end is bare and water-worn, showing that the arc or curve of the Falls must have been greater here than at any point below.

Near the upper end of this section there is a rocky cape, which juts out from the Canadian bank, and reaches nearly two-thirds of the distance across the chasm. At this point the great Fall met with a more obstinate and longer continued resistance than at any other, for the reason that the fine, firm sandstone belonging to the Medina group, as has been stated, here projects across the channel of the river, and, forming a part of its bed, rises upward several feet above the surface of the water. And here this hard, compact rock held the cataract for many centuries. The crooked channel which incessant friction and hammering finally cut through that rock is the narrowest in the river, being only two hundred and ninety-two feet wide, and the fierce rush of the water through the narrow, rock-ribbed gorge is almost appalling to the beholder. The average width between the banks of this section is about nine hundred feet.

In the second section is found the Whirlpool, one of the most interesting and attractive portions of the river.

The large basin in which it lies was cut out much more rapidly than any other part of the chasm. And this for the reason that, in addition to the thick stratum of shale, there was, underlying the channel, a large pocket, and probably, also, a broad seam or cleavage, filled with gravel and pebbles. Indeed, there is a broad and very ancient cleavage in the rock-wall on the Canadian side, extending from near the top of the bank to an unknown depth below. Its course can be traced from the north side of the pool some distance in a north-westerly direction. Of course the resistless power of the falling water was not long restrained by these feeble barriers, and here the broadest and deepest notch of any given century was made. The name, Whirlpool, is not quite accurate, since the body of water to which it is applied is rather a large eddy, in which small whirlpools are constantly forming and breaking. The spectator cannot realize the tremendous power exerted by these pools, unless there is some object floating upon the surface by which it may be demonstrated. Logs from broken rafts are frequently carried over the Falls, and, when they reach this eddy, tree-trunks from two to three feet in diameter and fifty feet long, after a few preliminary and stately gyrations, are drawn down endwise, submerged for awhile and then ejected with great force, to resume again their devious way in the resistless current. And they will often be kept in this monotonous round from four to six weeks before escaping to the rapids below.

The cleft in the bed-rock which forms the outlet of the basin is one of the narrowest parts of the river,

being only four hundred feet in width. Standing on one side of this gorge, and considering that the whole volume of the water in the river is rushing through it, the spectator witnesses a manifestation of physical force which makes a more vivid impression upon his mind than even the great Fall itself. No extravagant attempt at fine writing, no studied and elaborate description, can exaggerate the wonderful beauty and fascination of this pool. It is separated from the habitations of men, at a distance from any highway, and lies secluded in the midst of a small tract of wood which has fortunately been preserved around it, in which the dark and pale greens of stately pines and cedars predominate. Within the basin the waters are rushing onward, plunging downward, leaping upward, combing over at the top in beautiful waves and ruffles of dazzling whiteness, shaded down through all the opalescent tints to the deep emerald at their base. It is ever varying, never presenting the same aspect in any two consecutive moments, and the beholder is lost in admiration as he comprehends more and more the many-sided and varied beauties of the matchless scene. No one visiting the Whirlpool should fail to go down the bank to the water's edge. On a bright summer morning, after a night shower has laid the dust, cleansed and brightened the foliage of shrub and tree, purified and glorified the atmosphere, there are few more inviting and charming views.

The remaining portion of this section is the Whirlpool rapid, a beautiful curve, reaching up just above the Railway Suspension Bridge. It was the most tumultuous and dangerous portion of the voyage once made by the *Maid*

*of the Mist.* The water is in a perpetual tumult, a perfect embodiment of the spirit of unrest. Owing to the rapidity of the descent and the narrowness of the curve, the water is forced into a broken ridge in the center of the channel. There, in its wild tumult, it is tossed up into fanciful cones and mounds, which are crowned with a flashing coronal of liquid gems by the isolated drops and delicate spray thrown off from the whirling mass, and rising sometimes to the height of thirty feet. Standing on the bridge and looking down-stream, the spectator will see near by, on the American shore, a very good illustration of the manner in which the shale, there cropping out above the surface of the water, is worn away, leaving the superposed rock projecting beyond it.

In the third and last section the shale continues its downward dip, and at several places entirely disappears. The rock lying upon it is quite compact, and some of it very hard. The deep water into which the falling water was formerly received partially protected the shale, so that many centuries must have elapsed before the excavation of this section was completed. Its average width is eleven hundred feet.

Sixty rods below the American Fall is the upper Suspension Bridge. From this bridge, looking downward, no one can fail to be impressed with the serene and quiet beauty of the mirror below, reflecting from the surface of its emerald and apparently unfathomable depths life-size and life-like images of surrounding objects. The calm, majestic, unbroken current is in striking contrast with the fall and foam and chopping sea above.

The greatest depth of the water in mid-channel between the two Suspension Bridges, as ascertained by measuring, is two hundred feet. But it must be borne in mind that this is the depth of the water flowing above the immense mass of rock, stones, and gravel which has fallen into the channel. The bottom of the chasm, therefore, must be more than a hundred feet lower, since the fallen rocks, having tumbled down promiscuously, must occupy much more space than they did in their original bed. There are isolated points, as at the Whirlpool and Devil's Hole, where the river is wider than in any part of this section, but the depth is less. Taking into consideration both depth and width, this is the finest part of the chasm. And for this reason chiefly, when the great cataract was at a point about one hundred rods below the upper bridge, it must have presented its sublimest aspect. The secondary bank on each side of the river is here high and firm, whereby the whole mass of water must have been concentrated into a single channel of greater depth at the top of the Fall than it could have had at any other point. And here the mighty column exerted its most terrific force, rolling over the precipice in one broad, vertical curve, water falling into water, and lifting up, perpetually, that snowy veil of mist and spray which constitutes at any point its crowning beauty.