

GEOLOGY

AND

RECESSION OF THE FALLS.

Sir Charles Lyell says, "The first feature which strikes you in this region is the escarpment, or line of inland cliffs, one of which runs to a great distance east from Queenston. On the Canada side it has a height of more than three hundred feet. The first question which occurs when we consider the nature of the country, is, how cliffs were produced; why do we so suddenly step from this range to the gypseous marls, and then so suddenly to the subjacent shale and sandstone. We have similar lines of escarpment in all countries, especially where the rock is limestone; and they are considered to be ancient sea-cliffs, which have become more gentle in their slope as the country has emerged from the ocean. You may perhaps ask if the Ontario may not once have stood at a higher level, and the cliffs been produced by its action, instead of that of the ocean. Some of you may have passed along the ridge road, as it is called,—that remarkable bank of sand which exists parallel, or nearly so, to the present borders of Lake

Ontario, at a considerable height above it. I perfectly agree with the general opinion respecting this, that it was the ancient boundary of Lake Ontario. In some parts of it fresh-water shells have been found. You cannot explain the escarpment by the aid of the action of the lake, for it extends farther, and not in the same direction. When the land emerged gradually from the sea, as it is now doing, the sea would naturally create those sea-cliffs, and during the upheaval they would of course become inland. In Europe, proofs that limestone rocks have been washed away are abundant. In Greece, in the Morea, this is especially conspicuous. We have there three limestones one above the other, at various distances from the sea. Along the line you may see littoral caves worn out by the action of the waves. The action of the salt spray, which has effected a sort of chemical decomposition, is easily to be observed. So completely is this the case with each of these lines that you cannot doubt for an instant that here is a series of inland cliffs; and this phenomenon being so certain in the Morea, leads us by analogy to infer that these escarpments of the district were produced by a similar cause.

"It is not disputed that there is some change going on at the Falls, even now. There occurs, as we know, occasionally a falling down of fragments of rock, as may be seen at Goat Island. The shale at the bot-

tom is destroyed in consequence of the action of the spray and frost; the limestone, being thus undermined, falls down; and it has been believed that in this way there has been a recession of about fifty yards in about forty years; but this is now generally admitted to have been overstated. There is at least a probable recession of about one foot every year: though part of the fall may go back faster than this; yet, if you regard the whole river, even this probably will be something of an exaggeration. Our observations upon this point are necessarily imperfect; and when we reflect that fifty years ago the country was perfectly wild, and inhabited by bears, wolves, and here and there a hunter, we shall think it surprising that we have any observations at all, even for such a period back. We have an account of the Falls, given by Father Hennepin, a French missionary, who gives an exaggerated description of them, and yet one which is tolerably correct. He represents a cascade as falling from the Canada side across the other two. He says that between Lake Erie and Lake Ontario there is a vast and wonderful waterfall; after speaking of this, he says there is a third cascade at the left of the other two, falling from west to east, the others falling from south to north. He several times alludes to the third cascade, which he says was smaller than the other two. Now, those who consider that because Father Hennepin

gave the height of the Falls at six hundred feet, small value is to be attached to his testimony respecting any part of the country, do him injustice. I think it perfectly evident that there must have been such a third cascade, falling from west to east, as that to which he alludes.

“A Danish naturalist, who came in the year 1750 to this country and visited the Falls, of which he has also given us a description, which was published in the Gentleman’s Magazine in 1751, also gives a view of the Falls. In its general features his description agrees well with that of Father Hennepin. He went seventy-three years after him, and there was then no third cascade. But the point where Father Hennepin had put his cascade he had marked, and says that ‘that is the place where the water was forced out of its direct course by a prodigious rock, which turned the water and obliged it to fall across the Falls.’ He goes on to say, that only a few years before, there had been a downfall of that rock; which was undoubtedly part of the Table Rock; and after that the cascade ceased to flow. Now, it does not appear whether he had ever seen Hennepin’s account or not: he only mentions the fact that there had been a third cascade; and it is a striking confirmation of the accuracy of Father Hennepin’s description. We find these two observers, at an interval of seventy years apart, remarking on the very kind of change

which we now remark as having taken place within the last fifty years; an undermining of the rock, and a falling down of the limestone, and a consequent obliteration of the fall. Every one who has visited the Falls, on inquiring of the guides about the changes that have taken place, may have been told that the American Fall has become more crescent-shaped than it was thirty years ago, when it was nearly straight. The centre has given way, and now there is an indentation of nearly thirty feet. The Horse Shoe Fall also has been considerably altered. It is not of so regular a crescent shape as formerly, but has a more jagged outline, especially near Goat Island: it has less of the horse-shoe shape, from which it derives its name, than when it was given. It is quite certain that things there are not stationary; and the great question is whether, by this action, the whole Falls have been reduced in this manner. From representations made by other travelers, I was desirous of ascertaining whether fresh-water remains were found on Goat Island, as had been said; for it would be striking if on this island there should be a stratum of twenty-five feet of sand and loam, pebbles and fresh-water shells. They were found there, and I made a collection of several species of shells found on the island: among them were the *planorbis*, a small *valvata*, and several other kinds. They were of kinds generally

found living in the rapids in the river above, or in the lake.

“In digging a mill-race there, only a few years since, there were found a great number of shells, and also a tooth of a mastodon, some twelve or thirteen feet below the surface. It was the common Ohio mastodon, and must have been buried beneath these twelve or thirteen feet of fresh-water deposits, one layer at a time, each containing different shells. In answer to my question, whether similar shells were ever found lower down, the guide said he would take me to a place, half a mile below, where the strata had been laid open. We found there deposited in the rock a small quantity of fresh-water shells, showing that this old deposition extended down to that distance. Here we have proofs that the river once stood at a higher level and in a tranquil state; and there is every appearance of the rock having been like a solid barrier to hold the waters back in a lake-like state, so that they might throw down those fresh-water deposits at that height. You will understand this better if you consider that if the Falls go on receding, no matter at what rate,—an inch, a foot, a yard, a year,—in the course of time the whole must recede considerably from its present condition. What proofs should we have of this afterward? You will easily see that if the river should cut its way back to a certain point, the effect

would be to remove the rocky barrier, the limestone of the rapids, which has been sufficient to pond the river back. But if the river cuts its way back, this barrier could no longer exist; the channel would be deepened, and the deposits existing high and dry upon the land would become proof of the recession. This kind of proof we have, that the Falls have receded three miles from the Whirlpool, the limestone having been higher at the Whirlpool than the river at the Falls. It may be well to say that the beds all dip to the south, at the rate of about twenty-five feet in a mile. In seven miles the dip causes a general rise of the platform to the north, so that when at the top of the cliff you are at a greater height than the level of Lake Erie; and if the Falls were formerly at Queenston, their height was probably near double what they now are.

“Mr. Hall suggested that at that time the whole fall was not at one place, and I think it quite likely that such was the case. There is reason to believe that one fall was upon the quartzose sand below, and the other on the Protean bed. The upper part would of course recede faster than the lower, because it is softer, as is seen to be the case at Rochester; but the limestone, becoming thicker and harder, would recede more slowly. There may have been several falls, as at Rochester, each one of them being

less high than at present, and yet the whole being nearly double its present height.

“I told you that the river fell about one hundred feet between the base of the Falls and Lewiston: so that the bed slopes at that rate. This slope of the river, and then the upward slope of the platform, are the reasons why the Falls are now of less height than formerly: so when we carry ourselves back in imagination to the time when the river had not receded so far, we have a barrier of limestone much higher. The valley in which the river then flowed must have been much narrower than its present ravine. The distance now from the Canada to the American side is about three-quarters of a mile, whereas at half a mile below it is only half that distance.

“Farther investigations, by tracing the fresh-water deposits lower, will give more precise information. You might suppose that if we find the remains of a mastodon in a fresh-water deposit so lately laid dry as that near the village of Niagara, and only twelve feet below the surface, the mastodon has lived in the country at a modern period; you might think that a few centuries would have been sufficient for the accumulation of twelve feet of shelly sandstone and limestone, and that it may have been recently that this mastodon was buried, when the barrier was at the Whirlpool, before this

twelve feet of fluviatile strata were deposited. Yet these strata are older than the Whirlpool.

“ Among the objections to the supposition that the ravine was cut out by the Niagara, one is, that at the place called the Devil’s Hole, or the Bloody Run, the ravine must have been cut by some more powerful cause than by a slight stream.

“ But this I regard as no objection at all, for on examining the nature of the soil, &c., I am convinced that even the small stream which now flows would have been perfectly competent to cut out the ravine, and that we need look for no more powerful cause.

“ Suppose the Falls once to have been near Queens-ton, they would recede differently at different times,—faster when the soft shale was at the base, at other times slowly, when the hard sandstone was to be cut through. First of all comes the quartzose sandstone for a certain distance; then the Falls recede slowly, but more rapidly when it came to the soft shales. Then comes the sandstone again at the base, which now extends to the Whirlpool, and here the movement was slow. It probably stood for ages at the Whirlpool. Then for another period it receded more rapidly; and it is probable that for the last mile its recession has been comparatively slow, because the Protean group, and about twenty feet of sandstone, making about fifty feet of hard rock at the base, were to be cut through. It is cer-

tain that the movement now is at a faster rate, as the shale is exposed.”

The above reasoning perfectly coincides with the opinion of Dr. Dwight, and others who have devoted any time to the subject, and strangers, as far as the author has been enabled to learn, have come to the same conclusion.

The following fragment, written in the Register of the Point View Garden, at Niagara Falls, on Sunday, August 1, 1847, by Dr. BAXLEY, of Baltimore, illustrates the profound impressions produced on the mind and heart by this most wonderful work of nature.

A Sabbath at Niagara.

Here, near the temple of Almighty God,
The soul, wrapp'd in humility, bows down
In awe and reverence. 'Tis meet that man,
The creature, beholding the bold displays
Of power stupendous, wisdom infinite,
Should look, through nature's grandest witness, up
To nature's God. And deeming here all time
A Sabbath, yet on this day appointed
Holy to Him who rear'd these rocky walls,
Buttress'd below by tide-wash'd massive piles,
Entablatured with beetling battlements
And corniced with a waving wilderness
Of verdure,—who outspread yon azure roof,
Now softly mellow'd with ethereal tint,
Or darken'd by the thunder's messenger,
Gilded anon by lightning's gleams, or now

Radiant with starry hosts, whose mirror'd beams
 Carpet the billowy floor with silvery light,—
 Who raised yon altar, and upon its brow
 Of emerald, in characters of light,
 Inscribed, e'en with his own right hand, "To God!"
 Where ministering birds, with notes attuned
 To an eternal anthem, hymn his praise,
 And bear on dewy wings a pearly cloud
 Of incense up toward the Almighty's throne,
 Fit worshippers in nature's holiest fane,—
 Who guards the portal of this sacred place
 With ever-heaving sea of snowy foam,
 Whose tempest voice to man presumptuous calls,
 "Thus, and no farther, shalt thou go," and points
 To ceaseless whirling tides, the awful
 Maelstrom of Niagara, dread emblem of
 Th' eternal doom of man, vain man, who seeks
 To pass the limit of assign'd command,
 And moral law,—

E'en on this Sabbath day,
 Here, near God's own great temple, would we bow
 In humble praise and prayer; and, while the lip
 Rests silent, would the soul its homage give,
 And favor seek; petitioning that in
 The devious path of life so may we move,
 That when these rocks shall melt with fervid heat,
 When the rich garniture of teeming earth
 Shall vanish, leaving no trace of brightness
 Or of beauty to tell that it once was,
 This restless tide no longer flow, and its
 Deep cadence cease, when the blue dome that spans
 The earth shall pale away, and radiant spheres
 No longer shed abroad their hallow'd light,
 Then may the hope that rests upon His word
 Who ne'er was false to man, who hangs his bow

Upon the cloud, and spreads it night and day
 Upon his altar's incense, token to man
 Alike of his redeeming power and will,—
 Then may the hope that on his word relies,
 Nurtured by love and rectitude, grow strong
 In trust and prescience of a home "not made
 With hands, eternal in the heavens!"
 AUGUST 1, 1847.

To Niagara.

WRITTEN AT THE FIRST SIGHT OF ITS FALLS, 1838, BY J. S. BUCKINGHAM.
 Hail! Sovereign of the World of Floods! whose majesty and
 might
 First dazzles,—then enraptures,—then o'erawes the aching
 sight:
 The pomp of kings and emperors, in every clime and zone,
 Grows dim beneath the splendor of thy glorious watery
 throne.

No fleets can stop thy progress,—no armies bid thee stay,—
 But onward—onward—onward—thy march still holds its
 way;
 The rising mist that veils thee as thine herald goes before,
 And the music that proclaims thee is the thundering cata-
 ract's roar.

Thy diadem is an emerald green, of the clearest, purest hue,
 Set round with waves of snow-white foam and spray of
 feathery dew,
 While tresses of the brightest pearls float o'er thy ample
 sheet,
 And the rainbow lays its gorgeous gems in tribute at thy
 feet.

Thy reign is of the ancient days,—thy sceptre from on high;
Thy birth was when the morning stars together sang with
joy;

The sun, the moon, and all the orbs that shine upon thee
now

Saw the first wreath of glory which twined thine infant
brow.

And from that hour to this, in which I gaze upon thy
stream,

From age to age,—in winter's frost, or summer's sultry
beam,—

By day, by night,—without a pause,—thy waves, with loud
acclaim,

In ceaseless sounds have still proclaimed the Great Eternal
Name.

For whether on thy forest banks the Indian of the wood,
Or, since his days, the red man's foe, on his fatherland has
stood,—

Whoe'er has seen thine incense rise, or heard thy torrent's
roar,

Must have bent before the God of all, to worship and adore.

Accept then, O Supremely Great!—O Infinite!—O God!

From this primeval altar—the green and virgin sod—

The humble homage that my soul in gratitude would pay

To thee! whose shield has guarded me thro' all my wander-
ing way.

For, if the ocean be as naught in the hollow of thy hand,
And the stars of the bright firmament, in thy balance, grains
of sand,

If Niagara's flood seem great, to us who lowly bow,

O Great Creator of the whole! how passing great art thou!

Yet, tho' thy power is greater here than finite mind may scan,
Still greater is thy mercy shown to weak dependent man.

For him thou cloth'st the fertile fields with herbs and fruit
and seed,

For him the woods, the lakes, supply his daily, hourly need.

Around, on high,—or far or near,—the universal whole
Proclaim thy glory, as the orbs in their fix'd courses roll.
And from creation's grateful voice thy hymn ascends above,
While Heaven re-echoes back the chorus, God is love.

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The great stairway is free to visitors, as are all the Ferry grounds, buildings, &c.

Cave of the Winds.

THIS point of interest is unequalled by any locality about the Falls. It is approached from Goat Island on the American side. To those wishing to go behind the sheet of water, a passage through the Cave of the Winds far excels one behind the Fall at Table Rock. This fact is universally confirmed by all who have experienced both. Strangers should visit this cave before hiring a carriage to convey them to the Canada side. By so doing, they will save expense, and be better pleased with their tour than they can be elsewhere.

W. C. WARREN.

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