

jecting stone of the wall, as much at home as in the old place. From this it can be seen that its affection for locality is very strong. Notwithstanding Scops' long absence it is as tame as ever, taking its food from my hand, and behaving in the old manner. Its plumage at this time (Oct. 31, 1867) is perfect, most of the feathers having recently changed. It is mostly *gray*; there are but few marks of red, and but a faint wash of cream-color on the back, *not red*.

In your book on the "Birds of New England" are given two instances of this bird's first plumage being in the *red*; but my bird's is decidedly in the *gray*. If it is red at all, it must be at some time hereafter. You also mention one occurrence of the young bird in the gray plumage, and, to give an additional example, I would, for the benefit of students, add one from my own experience.

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## ROCK RUINS.

BY A. HYATT.

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I WAS accosted once by a gray-headed patriarch, sitting at the door of his farm-house, with these words: "I have heard of you, and wished to see you; my neighbors tell me that you are a rock-hunter." After many questions he continued: "I have read nothing but this,"—holding up the well-thumbed family Bible,— "and seen nothing but that,"—pointing to the extensive landscape the house afforded,— "and yet," said he, "a long life spent with them both before me, has given me more to think about than I can master. The rains pour down their floods upon these hills till every little hollow holds a muddy rivulet which empties into that silver thread you see yonder, until it too is a broad, yellow current. It has struck me, stranger, that those rains, in the hands of the Almighty, are the instruments which have cut

and shaped these hills about us, and that great valley yonder. Do you men who study rocks think so too?"

The old man, without other help than his own eyes and an appreciative love of nature, fostered by the daily contemplation of a fine landscape, had unconsciously retraced the primary steps of geological history, and rediscovered the fact that water is one of the great agents of change upon the earth's surface.

He had seen it working, and comprehended how it was slowly, but with irresistible power, melting down hills, furrowing out valleys, and casting the muddy flow through a thousand channels into the sea. The patient contemplation of a view such as one often meets with,—a quiet valley sleeping between parallel ranges of hills, with wrinkled sides and bald summits, had taught him this.

When we should wish, however, to describe the effect of water upon the face of our continent, it is not best to begin with such complicated examples, but good sense dictates the introduction of a few special cases wherein water is evidently the sole agent of change. Thus a ladder is presented to the mind by which it may climb to the comprehension of the panorama, instead of being presented at once with general laws, and then carried down backward upon the rounds of fact and explanation.

Perhaps but very few of the thousands who annually reach that Mecca of the travelling public, Niagara, are aware that it furnishes one of these examples, and is so often a theme for geological writers and lecturers. Visitors pay the extortionate prices of admission to its various points of view, are made giddy by the mad whirl of the rapids, stunned by the roar of the water, and awe-struck by the vibrations of the earth, and yet do not intelligently comprehend the meaning of all this turmoil and uproar. They read in the guide-books the meagre notice of the fact, that the cataract was once at Lewiston and has eaten its way back through the solid rock to its present position. Some accept the state-

ment as children a fairy tale, some doubt without the ability to give a valid reason, and some, fearing the sudden destruction of their dream-land, refuse to analyze the glories of the river. They shrink from familiarity with nature, lest water should prove itself nothing but water, and stone nothing but stone, entirely ignorant of the fact, that the close observer, whether poet, artist, or naturalist, is the only one who seeks the spirit of the beautiful with success. He alone grasps the internal creative thought, the soul embodied in the landscape, without which the rocks, rivers, and mountains, with their green garlands, are comparatively expressionless forms, like faces without eyes.

Along the sides of the gorge at Niagara a few of the great layers which make up the body of the continent are seen rising one after another, overlapping at the surface like tiles on a nearly horizontal roof;\* the inclination of the layers, in fact, being only about twenty-five feet to the mile, in a southerly direction.

Out of the cloud and foam of the cataract appear two layers, each about eighty feet thick, the upper one (8) of limestone, the under (7) of shale. Still farther northward, above the debris that has accumulated at the foot of the cliffs, runs a thinner layer of limestone (6), and, continuing in the same direction, we find a layer of green shale (5) succeeded soon by one of light-colored sandstone (4), and lastly a mass of red sandstone (3).

Thus, when we reach Suspension Bridge it is comparatively easy even for an unpractised eye to analyze the cliff. Attracted by the emerald curtain of the great fall, few vouchsafe more than a passing glance down the chasm, and yet in autumn this view is one of rare beauty. The alternate bands of color in the rocks blend with the fringe of golden and scarlet trees upon the *talus* at their feet, and from every crevice graceful vines hang their lace-work of flaming foliage. The painted walls and their gorgeous ta-

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\* Vide 8, 8', 9, and 10 in the wood-cut.

pestries rise nearly three hundred feet on either side, and, at that dizzy depth, the river glides on, a flood of green and silver, till the harder rocks in the shallower channel beyond obstruct the current and hurl its waves fifteen feet in the air.

Below the whirlpool these harder rocks appear as a light-colored, gritty sandstone (2), underlaid by a soft red sandstone (1). Even to the most superficial observer it is evident that all these layers were at one time continuous and filled the gorge, just as it is now apparent that the higher limestone and shale are continuous under the fall (*d, f*).

The recession of the present falls is an established fact. Father Hennepin, one of the early French explorers, described and figured Niagara as early as 1678. Then it had three distinct parts instead of two, as at present. On the Canada side a tabular rock of great size extended out interrupting and turning a portion of the overflow in an easterly direction, making a third fall at right angles, but continuous with the horse-shoe. About seventy years afterwards, a Danish naturalist, Kalm, records the disappearance of this rock, and describes the fall as having about the same general outline as at present. His sketch, however, does not differ materially from Father Hennepin's, except in the absence of the third fall. Parts of Table Rock fell successively in 1818, 1828, and 1829, and Kalm speaks of the descent of portions of this rock, which extended under the water previous to his visit in 1750.

All these changes were on the Canada side, and, as has been already noticed by Professor Jules Marcou, that part of the cataract recedes the most rapidly. The volume of water is much greater, some twenty-five feet in depth in the centre of the horse-shoe curve, and the mass of debris, which is so picturesque along the base of the American side, is entirely wanting, the layers of rock being carved out perpendicularly, probably to a considerable depth below the surface

of the river. Professor Jules Marcou, who visited Niagara in 1848-49 and 1850, remarked not only the changes which occurred in the Table Rock,\* part of which fell in 1850, but observed also the increasing angularity of the curve at the centre of the horse-shoe, and the gradual deepening of the water. It seems certain that either the size of the river has greatly decreased since Father Hennepin's visit, or else this part of the horse-shoe fall is much deeper and the sides shallower than formerly. In 1850, according to Professor Marcou, the curve was passably regular; in 1863, it was very much deeper, and notched near the centre. He also noticed that a large block, some six or seven feet in diameter, which had stood near the Terrapin Tower, had been engulfed, and together with it a long line of boulders figured by Professor Hall in his map of 1842. In 1852, portions of the cliff at this point fell, making a sensible difference in its outline, and probably caused the disappearance of the boulders.

The manner in which the tables of rock are undermined is as well known as the recession of the cataract itself. Every visitor is informed that the water, dashing against the lower layer of soft shale (7), cuts out cavernous hollows like the "Cave of the Winds," and presently the projecting tables of limestone above (8), becoming too weak to support themselves, and the great weight of the river, are precipitated in immense masses to the bottom.

These huge fragments, with every point and fractured edge rounded and smoothed by the ceaseless bombardment of the water, lie in huge piles under the American fall. There is no continuous flow, but a succession of blows, and one standing near them, feeling this distinct pulsation, as wave after wave rushes over the precipice and descends with a deafening roar upon the polished surfaces, no longer wonders that the rocks are worn slippery, but rather that they

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\*This is a tabular extension of the upper limestone on the Canadian side close to the cataract. It once extended out some distance, and was probably the last remnant of the lateral precipice over which the third fall turned in Father Hennepin's time.

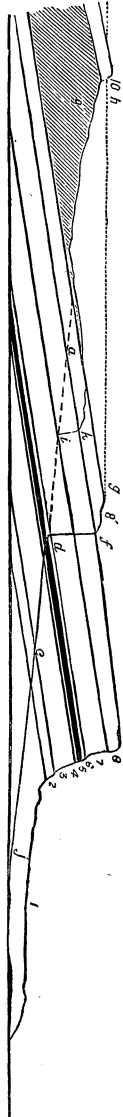
are not shattered like brittle glass under a trip-hammer, and swept away.

We must, however, even before this exhibition of power, remember that water is not the only instrument which is carving out the softer shales. Wherever these are uncovered, as in the "Cave of the Winds," they are cased in ice during the winter. Experience has taught us all how the frost loosens the bricks of the side-walks, throws down massive stone-walls, and bursts our water-pipes. All these effects are not due to any miraculous power possessed by frost, but to the fact that water when freezing expands and forces room for its increasing volume. In the crevices of the shale it acts quietly but with resistless force between the layers, like millions of minute wedges lifting and loosening the edges of the rock-beds, which are thus rendered an easy prey to the waves, if they do not fall of themselves in the early spring. Goat Island recedes almost as fast as the cataract itself, and yet frost alone is the workman that undermines its rocky face.

The future of the cataract may be read in the structure of the rocks, as well as its past. Professor Hall, who has studied it more carefully than any other geologist, predicts that Niagara is slowly but surely destroying itself. Thousands of years hence and the cataract will have eaten its way back until the solid limestone layers, which are now on its verge, will be at its base (*i, k*). Here it will probably remain for a long time almost stationary. The lower portion being as hard as the upper, will not be eaten out into caves and hollows as at present, but, being less exposed, will give way even more slowly than the upper limestones. These last, however, notwithstanding their hardness, will be gradually worn down, as the hard layers (2) are at the whirlpool (*c*), or the limestones on the bed of the stream above the present fall (8') to the ascending level of the river bed, as at *d* in the wood-cut. The softer layers of greenish marl, marked 9, will have been already levelled,

Section of the strata along the Niagara River, from Lake Ontario to Lake Erie.

Lake Ontario.



## EXPLANATIONS.

- 1, Red shaly sandstone and marl, which may be seen in the bank of the river at Lewiston (*j*).
  - 2, Gray quartzose sandstone.
  - 3, Red shaly sandstone like No. 1 (with thin courses of sandstone near the top).
  - 4, Gray and mottled sandstone, constituting, with those below, the Medina Group.
  - 5, A thin mass of green shale.
  - 6, Compact gray limestone, which with No. 5 constitutes the Clinton Group at this place.
  - 7, Soft argillo-calcareous shale.
  - 8, Limestone.
  - 8', The upper thin-bedded limestone, which, together with 7 and 8, constitutes the Niagara group.
  - 9, Onondaga salt group of shales and marls, including the hydraulic limestone, or beds of passage to the next rock.
  - 10, Onondaga and Corniferous limestones.
- All these layers, from 1-10 inclusive, belong to the upper Silurian system.
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- h, g, f, d, c, j*, This line represents the present surface of the river from Lake Erie to Lewiston, a distance of about twenty-one miles.
- b, g*, The present surface of the river, between Lake Erie and the Falls.
- d, f*, The perpendicular fall, over the Niagara limestone and shale.
- f, g*, The rapids, where within a mile there is a descent of fifty-two feet over the upper thin-bedded portion of the Niagara limestone.
- c*, The whirlpool.
- d, c, j*, Present level of the river where it has cut its way down through all the layers from 1 to 8' inclusive.
- i, k*, The position of the falls and rapids after a recession of two miles.
- a, i, d*, Future level of the river bed, as the falls gradually wear away the rocky layers.
- The cut and most of the explanations are from Professor Hall's Report on the Geology of New York.

and Niagara, with perhaps a slight descent over the limestones (10) at the outlet of Lake Erie, will be uninterrupted in its course to Lake Ontario.

According to the estimate of Sir Charles Lyell, about thirty-five thousand years ago the falls were at Lewiston. Now they are seven miles away, and have yet two miles to traverse, each step harder and more difficult as the shale becomes thinner, before they reach the point (*i*), where, should they preserve their present structure, they will not be over one hundred feet high. Following out Sir Charles Lyell's estimate, this would take ten thousand years, even if no allowance was made for the gradual retardation caused by the disappearance of the shale. Although these calculations are based upon the observed rate of retrogression of the falls, they can only be very rough approximations, until sufficient time has elapsed for other observations to be made and compared with the monuments erected by Professor Hall in 1842. They are, however, sufficiently close and reliable to show that Niagara was not carved out in a day, nor yet in a thousand years; but that for tens of thousands of years the steady rush of the river has ground the rocks to powder, and swept away, piece by piece, the solid layers, until the gorge it has cut is now seven miles long, from two to three hundred and fifty feet deep, and eight to twenty-four hundred feet wide at the top.

Of late, the public have been alarmed by the statement that about half a mile back of the horse-shoe, the motions of the stream indicate a breach in the upper limestone, and speculations are indulged in that through this hole a subterranean stream is eating away the underlying shale with great rapidity. The sagacious inhabitants, who have given birth to this story, predict the probable destruction of the great cataract by the caving in of the tables of limestone (*8'*) with such rapidity that the whole will form only a rapid. It is difficult to understand, first, how such a breach could have been made; second, how if made it could swallow



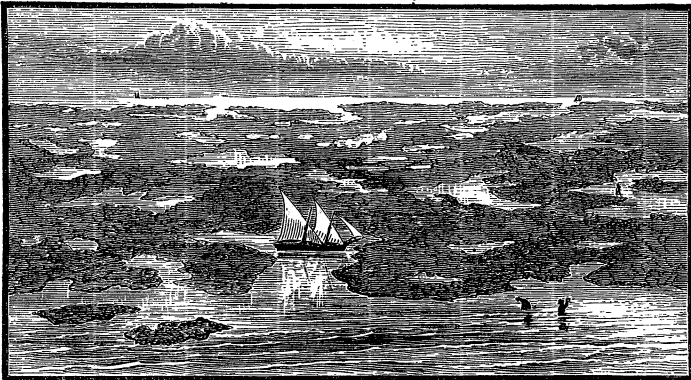
enough of the river to eat away any considerable portion of the shale underneath; and third, if it did both of these impracticabilities, how the subterranean stream could break down the face of the fall faster than the water could carry off the fragments and maintain the face of the precipice perpendicular. We do not desire, however, to deprive either the guides or the oldest inhabitants of their time-honored privilege of astonishing the public, but they should remember and take warning from the fate of the "reliable contraband;" they may, even as he did, lose their hold upon the credulity of the public.

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### THE CRUISE OF THE "ABROLHOS."

BY C. FRED. HARTT.

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RECIFE DO LIXO, ABROLHOS, AT LOW TIDE.

AFTER one has travelled up and down the Brazilian coast and become familiar with the long sea-beaches, bordered with ridges or domes of sand, that almost uninterruptedly stretch from the Amazonas to Cape Frio, and with the ever-thundering Atlantic surf that draws its foamy line around those lonely shores, it seems strange to see at Caravellas a