THE GREAT NORTHWEST.

III.

SCIENTISTS declare that Niagara pours 670,000 tons of water over the falls every minute, and Lyell estimates that the limestone ledge over which it flows is wearing down at the rate of one foot a year. Persons who live there, however, and make frequent observations, assert that his estimate is too great. Niagara has cut its way from Queenstown, a distance of seven miles, to the present site of the falls. Accepting the estimate of Lyell as correct, the work has been going on for 35,000 years. On the Colorado River there are canyons nearly one mile in depth, evidently worn down by the water, about one-fifth of the distance being through solid granite.

It seems fitting at this point to call attention to the law which regulates the power exerted by water when in motion, whether slow or swift. According to Hopkins, the force varies so that if the swiftness of the current be doubled the power exerted will be increased sixty-four fold. I will give some examples: A current running three inches a second will move only fine clay; six inches a second, fine sand; one foot per second, gravel. Assuming that a current that is running two miles an hour (which is about three feet a second) would move a stone weighing two pounds, then a current of four miles an hour would move one weighing 128 pounds; eight miles an hour, one weighing over four tons; sixteen miles an hour, over 256 tons; and thirty-two miles an hour, about 17,000 tons. From these data the reader may form some idea of the power of the waves, like terrible battering rams, that battered a passage through the Cascades and, overcoming every obstacle, opened a pathway to the ocean.

To make the matter still more plain to those not familiar with geology, a few words in regard to the effects of erosion and its *modus operandi* are necessary. The first visible effects of erosion may be seen in the imprint of the rain drop. Next the drops unite and form the rill; the rill makes its furrow. Rills unite and form rivulets; rivulets make a gully on the side of a hill or mountain. Rivulets combine and form torrents; torrents excavate deep gorges in the declivities. Torrents unite and form rivers; the rivers transport clay, sand, pebbles, stones, logs, trees, etc., bearing them towards the ocean. By reason of the thumping, scraping and friction there is a constant wear, not only upon the materials thus borne along, but upon the bed and banks of the river. When these materials are ground down fine the remains are called silt, detritus and sediment. The grinding is mainly effected by the friction of one article upon another. Among the incidents of erosion are "pot holes," often seen in the surface of a bed of hard rocks. Any obstruction causes the water to move in a whirl, carrying around stones and pebbles, and grinding basins or "pot holes" in the solid rock. One of these on White River is fifteen feet deep and nearly sixty feet in circumference.

If the swiftness of a river current is greatly diminished towards its mouth, then in accordance with the law regulating the power of running water, the bed of the river will be gradually raised in consequence of the deposit of the silt brought down from the mountains, where the river takes its rise. The Mississippi affords an illustration of this process; also examples of a "delta," a very important factor to be considered in the problem of navigating the Columbia River. The detritus of the river is borne to the ocean and deposited on the bottom, sometimes near the river's mouth and sometimes carried out to sea for hundreds of miles, as in case of the Amazon. No matter where deposited, the action of the flood tide drives the silt back towards the mouth of the river. Extensive flats will in time be formed, and as they rise above the surface of the river several mouths will branch from the river, cutting the flats into triangles, called "deltas," from the fourth letter of the Greek alphabet, *delta*. The Columbia is comparatively a young river, only a few million of years old, and as yet the deltas have not had time to form. It has different "channels," or "passages," to the ocean, and all have heard of the magnitude of the Columbia River Bar. If not arrested by artificial means, it is only a question of time when the Columbia, like the Nile, Ganges, Amazon, etc., will have its delta. Some have suggested dredging. This is about as sensible as the act of a poor idiot who had his boat, which was loaded with stone, sunk in the mill pond, and thought to raise it by dipping up the water over it and emptying it below the dam. The jetty is the only natural remedy.

Other conditions being equal, the size of the deltas depends upon the age of the river—that is, the length of time the region of country around the river has been above the water. Hence the deltas of a river, like the grains of a tree, are indicative of its age. The deltas of the Ganges are the largest, their base on the ocean being 200 miles. Those of the Nile are next in size, and finally the deltas of the Mississippi. We thus perceive that our Columbia, typical of the American nation, is a giant in strength and proportions, yet in years but a youth, the deltas not yet formed.

The great struggle is ended. The Columbia has triumphed over all opposition and is now master of the situation. Standing in one of its deep canyons and gazing upward, almost perpendicularly, along the face of the solid rock, fully 4,000 feet, to where the clouds seem to kiss the summit, one cannot but be amazed at contemplating the eons of time that must have elapsed while our majestic river was cutting its passage from the top of the Cascades to its present bed. Yet it is still in its infancy, as compared with the rivers of the far distant Orient. This rugged gorge, this narrow pathway for the Columbia, the labor of millions of years, is gradually closing up! How gloomy and yet how sublime the thought! Several years ago the Oregon Steam Navigation Company constructed railroads around the Cascades of the Columbia, and more than once the company has been obliged to readjust the rails and repair the road between the upper and lower Cascades, on account of the displacement caused by the closing of the gorge. But