

to be done. Here the water was allowed to drain away, leaving the gravel thoroughly settled in the new position. The filling was confined within the proper limits by means of logs laid in rows one above the other, & thus the embankment rose, tier above tier, the slope being kept well within the angle of repose, & the logs soon sprouting & forming a network of roots, firmly binding the mass together.

Mountain Creek is the point at which a large amount of filling has been done on this plan in a most successful & economic way. Water is obtained from the creek some 2 miles above, & is led down in a flume, 2 ft. high & 4 ft. broad, to the flume-box, which is 206 ft. above the railway track. From this point an iron pipe 14 ins. in diameter, of  $\frac{3}{8}$ -in. thick metal, leads the water to the monitor, which is provided with nozzles ranging from 3 ins. to 6 ins. in diameter. The small-sized nozzles are used for breaking up the mass of gravel, while the

be taken up in order to prevent wreckage by the avalanches, & so each spring the work must practically be constructed again. Nine men in all are required to conduct the filling; 1 at the monitor, 2 to keep the sluices clear, & 6 to prepare & lay the logs at the edge of the filling & to level off the material as it falls. The total filling at this point will aggregate 300,000 cubic yards, of which 225,000 were put in place between June, 1897, & June, 1899, leaving but 75,000 yet to be filled.\* A light steel trestle will complete the work connecting the two fillings, thus effecting a permanent solution of a very difficult problem. This method of hydraulic filling was first employed in the mountain division of the C.P.R. under the direction of Superintendent E. J. Duchesnay, C.E. It is a pity that this method cannot be employed to advantage in many other localities where great fillings are necessary.

The highest point reached by the railway in the Selkirk range is at Selkirk Summit, 4,-

used in the Selkirks (see figure 1); but the snowfall being lighter, the same difficulties do not have to be encountered. Some very heavy tunneling & cutting were required in the valleys of the Thompson & Fraser Rivers, a good part of which was constructed by the Government in the early days of the development of the country.

Thus the Rocky Mountain system is crossed after passing three summits, which, if their altitude is not great, still in location & construction required the greatest patience & skill on the part of the engineers intrusted with the task.

\* Since the above was written the hydraulic fill at Mountain Creek has been completed, & the balance of the fill will be done by steam shovel, as it cannot be reached by sluice boxes. The centre or main steel span over the stream was erected last year, & two more steel spans adjoining it will be erected this

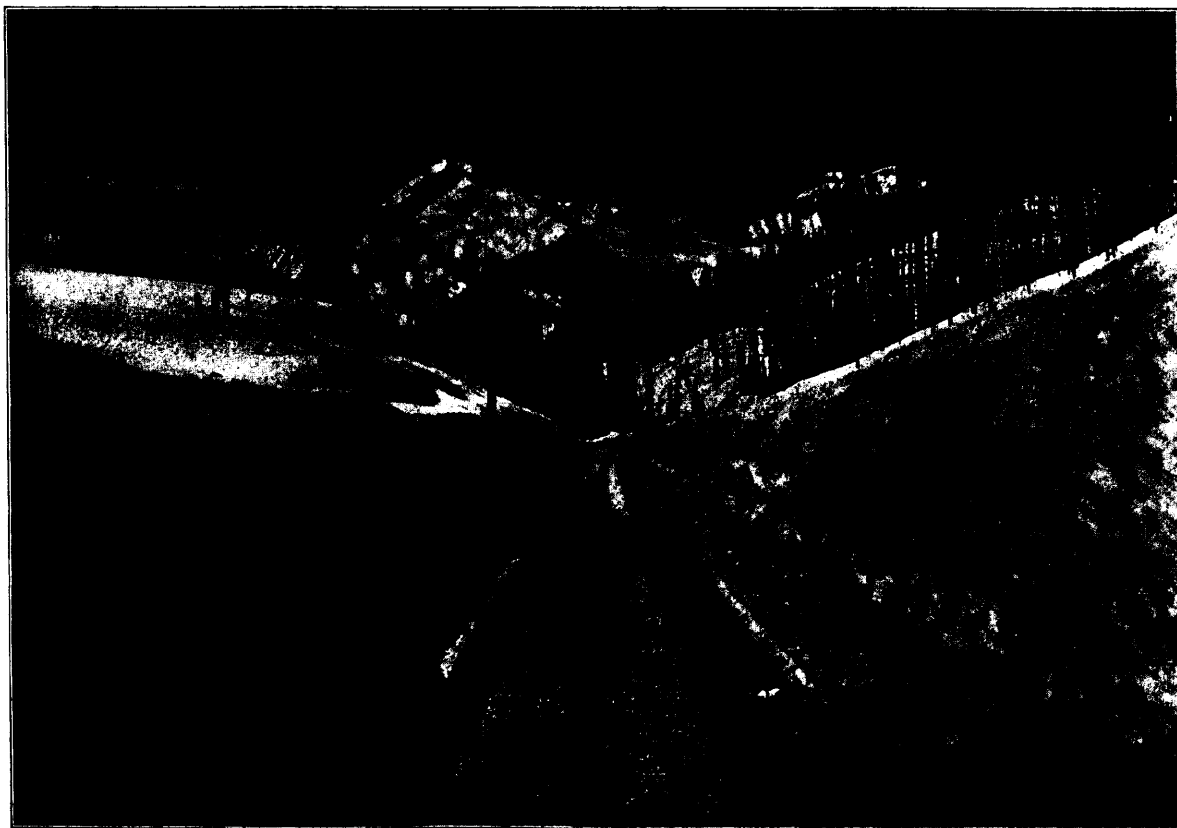


FIGURE 3.—SNOW-CUTTING ON THE C.P.R. IN KICKING HORSE PASS, BRITISH COLUMBIA. (SEE PAGE 258.)

larger ones, furnish an increased volume of water to flush the sluices. Boulders 18 ins. in diameter are readily moved without assistance, but two men with hooks are constantly on the lookout to clear any obstructions. The sluice has a grade of about 1 in 10, conveys the material beneath the railroad track & deposits it in a great pile at the center of the area being filled. (See figure 8.) From this point it is gradually washed down until stopped by the row of logs at the edge, which, however, allow the water to flow off freely. The sides are made to slope at an angle of 37° 40', which is well within the angle of repose, but, in addition to this, the sprouting of the logs at the edge of the filling has formed a strong network of roots, binding the whole mass firmly together. (See figures 8 & 9.)

The cost of this filling is about one-half that of the ordinary way, but it is here carried on under great disadvantages. Not only must the work be entirely suspended between Oct. & June, but the sluices & fixtures must

303 ft. above tide. From this point the railway steadily descends, following the Illecillewaet River. The first routes surveyed lay on the slopes of Mt. Cheops, to the right; but these necessitating a steeper grade than the Government would allow, a change was made to the left side, & the length was increased by a great sweep up the valley of the Illecillewaet to within a mile & a half of the Great Glacier of the Selkirks. Then, following the slopes of Mt. Abbott, & executing a double loop like a letter S, the level of the stream was reached, which was followed as far as its junction with the Columbia River at Revelstoke. This is a divisional point on the railway, & the crews & engines are changed. The pass over the Gold range is not high, & offers very little of special interest, while in crossing the Coast range the railway follows the canyons of the Frazer & Thompson Rivers, thus avoiding a summit. A few sheds are necessary on the western slope of the Gold range, of similar construction to those

fall. The remaining two spans are expected to be replaced early next spring.

The foregoing paper was read before the Engineers' Club of Philadelphia, to whose officers we are indebted for the use of several of the illustrations.

#### Why Not Borrow a Hand Car?

The following unique advertisement appeared recently in a St. John, N.B., paper:—

Hampton & St. Martin's Ry. Co.

On & after Tuesday, Aug. 28, 1900, train on the above railway will be cancelled until further notice, on account of some repairs being made to engine.

E. G. EVANS,  
Superintendent.