TUNNELING AT ROGER'S PASS.

At a sectional meeting of the Canadian Society of Civil Engineers, held in Montreal on January 12th, Mr. J. G. Sullivan, chief engineer of western lines for the Canadian Pacific Railway, read a short paper descriptive of the construction of the Roger's Pass tunnel up to the meeting of the east and west headings on December 20th last. This important work is referred to on another page in several paragraphs of the address of Mr. F. C. Gamble, retiring president of the Society. Several articles have previously appeared in *The Canadian Engineer*, descriptive of the scheme, of which the tunnel is a part, for the reduction of grades, elimination of curvature, removal of snowsheds, and shortening of track, in the mountain division of the line.

In his address, Mr. Sullivan first reviews the development in traffic which ended in the decision of the company with respect to double tracking and grade reduction, and which directly resulted in the conclusion to proceed at once with the driving of the tunnel. The paper contains a number of interesting quotations from correspondence covering methods and speeds of driving and discussing the adoption of the pioneer tunnel method suggested by Mr. A. C. Dennis, superintendent for Foley Bros., Welch and Stewart, the contractors to whom the contract was afterwards awarded.

The principles worked out together by Mr. Sullivan and Mr. Dennis are those which have resulted in the record progress that has been achieved. The function of the pioneer bore has already been fully explained in these columns, and we present the following paragraphs from Mr. Sullivan's paper relating to the manner in which the work is carried out, it being remembered by the reader that the primary object of the bore is to facilitate blasting at any point in the tunnel without interfering with operations at other points.

The pioneer tunnel at the east end is located 50 feet to the north of the centre line of the main tunnel, and the pioneer at the west end is 50 feet south of the centre line of the main tunnel. The mode of operation is as follows: The drilling in the small headings is done in the usual manner, using in general Leyner drills, making an advance of 6 or 7 feet for each round of holes. The muck is shovelled by hand from steel plates into half-yard cars and hauled back, either by a mule or small compressed air locomotives, the latter being used after the haul got to be a considerable distance. The muck from the headings is carried out through cross-cuts into the pioneer tunnel, where it is carried back to a cross-cut, and there carried out on a trestle over the standard gauge tracks in the main tunnel and dumped into standard gauge cars, from which point it is removed to the fills in a similar manner to the muck loaded by steam shovels in the enlargement. The muck from the heading on the west end in a similar manner goes into the pioneer tunnel at a cross-cut, crosses back to the main tunnel in a cross-cut, where it is dumped into standard gauge cars. In the enlargement of the main tunnel the drilling is done well ahead of the shooting. At first the radial holes were drilled at right angles to the axis of the tunnel. This did not give the best results, and it was changed to a drilling showing an inclination of about one in four away from the direction in which the tunnel is being driven. The muck is all loaded by steam shovels into standard gauge 12-yard capacity dump cars. The shovels have dippers of 1½ cu. yds. capacity and are worked by compressed air. The cars are hauled to the mouth of the tunnel by standard gauge compressed air locomotives and from there by standard steam locomotives.

Doors are put in the cross-cuts between the pioneer and the centre heading. All of these doors are kept closed back of the shovel, and when shooting takes place in the enlargement of the tunnel the door at the first cross-cut beyond point of shooting is opened. This creates a very strong draught back over a pile of freshly shot muck and makes conditions such that the men can return to work in ten or fifteen minutes after a shot. The shooting of the muck in the enlargement of the main tunnel is done in the following manner: One round of holes is shot at a time, the holes in the bottom of the tunnel being shot in advance of the holes on the sides or on top. In some cases the top holes are not shot until all of the bottom holes have been shot out. Usually six or seven rounds of holes are shot before the steam shovel starts cleaning up the muck, that is, a distance of 30 ft. to 35 ft. The shooting is generally continued until the tunnel becomes so full of muck that no more shooting can be done. The largest amount that was ever shot at one time was on November 20, 1915, when 84 feet was shot in eleven hours.

In conclusion, Mr. Sullivan states that all expectations as to speed have been more than realized, and that for any rock tunnel where the rock is of sufficient hardness to stand until after the mucking has been done, this method can be worked successfully and a speed of three miles per year can easily be made at a much less cost than tunnels driven at the same speed by the European method; and furthermore, the radial shooting has proven that a great deal less over break can be expected from this method than where holes are put in parallel with the axis of the tunnel.

AN UNUSUAL RAILWAY IN THE WEST.

The Hudson Bay Company owns a very unique and serviceable little railway which it constructed about 60 years ago on Grand Island, in the Athabasca River. It is a portage railway whereby some dangerous rapids are avoided by the passenger and freight traffic on the river. According to the Engineering News, the railway has shown a profit of $1,000,000 in 60 years' service although its cost, including equipment, was less than $1,000.

The track consists of strap or bar-iron rails on wood stringers laid upon wood ties. The equipment consists of two flat cars. The freight rate is $2.50 per ton, the men handling their own goods and shoving the cars along the line.

A scow going inland (downstream) lands its cargo at the upper end of the island and then goes down the rapids in about 70 seconds. The vertical descent is about 65 feet. In the quiet (but swift) water below, the crew hold the boat with the oars till they can pick up a timber thrown out from shore and attached to a light line. With this a heavier cable is pulled out, and the boat then hauled to shore for reloading. A boat coming out upstream is either taken through the rapids by tracking or is hauled across on the railway.

Mr. Alcide Chausse, city architect of Montreal, presents the following figures relating to building in a number of Canadian cities in 1915, as compared with figures for the previous year:—

	1914.	1915.
Montreal	$17,394,244	$7,486,221
Toronto	20,684,288	6,651,889
Winnipeg	12,160,950	1,826,300
Ottawa	4,397,920	1,605,160
Hamilton	3,703,865	1,523,248
Vancouver	4,484,476	1,504,300
London	1,837,735	1,207,630
Halifax	879,320	1,063,985