27,236 train miles at 22 cents ....$	5,991.92
54,913.7 pusher miles at 25 cents	13,728.40
NOTE—25 cents to cover engine crew wages, cost of repairs to pusher locomotives and extra cost of maintenance account of running pushers.	
Extra cost maintenance of way, 4.42 miles at $200 plus 27,236 train miles at 20 cents	6,331.20
Extra cost, maintenance of way, account of extra number of degrees of curvature, assuming that 400° of curvature per mile would increase rate at 20 cents per train mile for maintenance by 30%.	
6,162 trains × 2,447° × 1/40 cents	3,769.60
Special maintenance, account 4½ miles snow sheds	85,000.00
Extra cost, maintenance of equipment 27,236 train miles at 21 cents	5,719.56
Extra cost maintenance of equipment, account of extra number of degrees of curvature, assuming that 400° of curvature per mile would increase rate of 21 cents per train mile by 40%.	
6,162 trains × 2,447° × 21/1,000 cents	3,166.47
Total annual saving in cost of operation.	$170,635.61

The rate at which traffic has been increasing would indicate that shortly after the work of constructing the tunnel was completed the traffic would have doubled. In this case, if no further economics were made in methods of operating this section of track, the annual saving on account of operating over tunnel line would be,

$85,635.61 × 2 plus $85,000 = $356,271.22

In arriving at the above figures no account is taken of whether line was single or double track and for comparative figures it was assumed that methods of operation would be the same. Now, as a matter of fact, the present single track line with double the present traffic would make the business too congested for economical single track operation. Therefore, it was apparent that it was time to study the question of double tracking the present line or seeking a new line for double track. It was decided to double track on the five-mile tunnel location with grades as noted above. Now, to operate successfully a five-mile tunnel we will require the installation of an electric plant and the purchase of electric locomotives. All the details of the proposed electrification have not as yet been worked out, but even if they were, the reader is not interested in the details of cost. He can see at once that the problem was to find out if the cost of operating and maintaining the tunnel line, taking into account the extra costs of operating on account of having a short section of electric operation and extra cost of maintaining tracks in the tunnel, plus the interest on the cost of building the new double track line including the cost of electrifying the tunnel would be less than the cost of operating and maintaining a double track line on the present location plus the interest on the cost of building the second track. The figures would not have been very decisive one way or the other were it not for the fact that there is now 4½ miles of wooden snow sheds on the present location which will be all done away with on the new location. The maintenance and cost of renewals of these sheds cost between $85,000 and $100,000 per year. To maintain and renew a double track wooden shed would probably cost at least 50% more than the above, so that with a saving of about $125,000 per year in maintenance and renewals of snow sheds and a calculated saving in operation and maintenance of $171,271.22 on a traffic that surely will be reached in the near future, there was no doubt as to the proper course to pursue.

As to the details of figuring economics of railway location, the writer is well aware that it is impossible to devise any method that will show absolutely that saving in cost of operating one line over another, but he believes that the method herein followed, namely, that of comparing cost of fuel on the basis of work done rather than on a train-mile or any other unit is much more logical and will give more reliable results than other methods that have been followed. The train-mile is possibly the best unit for comparison in cost of wages and for cost of maintenance of equipment. In figuring maintenance of way a fixed sum should be taken plus a rate per daily train rather than a fixed rate alone per train-mile, for the reason that a certain amount of expense must be incurred regardless of whether trains are run or not. The fixed sum of $200 per mile taken in this problem is probably about one-half the actual sum that would be assumed if the entire cost of maintenance was to be included in this fixed sum per mile plus the rate per train mile for the reason that cost of maintenance of terminals and other items are not affected by the details of location between fixed terminals.

Frictional resistance, normal conditions, warm weather, modern freight equipment, speed between 7 and 35 miles an hour,

$R = 2.2\,T + 121.6\,C.$

R = total resistance on level tangent.

T = total weight cars and contents in tons.

C = total number of cars in train.

This amounts to 4 lbs. per ton to 8 lbs. per ton, depending on whether cars are fully loaded or empty. This is equivalent to a rise of from 10 ft. to 20 ft. per mile. For mixed traffic a conservative estimate is train resistance equals rise of 15 ft. per mile.

It may appear that the rate of 25 cts. per actual pusher-mile covering the cost of repairs and engine crew wages and extra cost of maintenance is too high, but as a matter of fact it is very conservative for the repairs, maintenance and renewals of the locomotives alone will run somewhere between 7 cts. and 10 cts. per mile and we have had cases where the engine crew wages alone averaged 25 cts. per mile for the actual mileage run, on account of delays to the pusher.

The progress made since the commencement of operations was reviewed in an article in *The Canadian Engineer* for October 1st, 1914. A few weeks ago reference was made to the establishment by the contractors of a new record for hard rock tunneling of 817 feet in 30 days, with a maximum footage of 37 feet in a single day.

C.P.R. FREIGHT TERMINAL AT QUEBEC.

The Canadian Pacific Railway has under construction at Quebec a large freight terminal, consisting of an inbound shed 50 ft. x 600 ft.; an outbound shed, 30 ft. x 300 ft., with a transfer platform, 300 ft. in length between. The W. S. Downing-Cook Co. have the contract, and Mr. S. G. Newton is their superintendent on the work. Steel is furnished by the Dominion Bridge Co. Terminals were designed by the building and construction department of the C.P.R., of which department Mr. D. H. Mapes is superintendent.

The foundation and floors of the two sheds are of reinforced concrete, supported on Raymond concrete piles.