

Was a Pioneer Tunnel Advisable at Rogers Pass ?

J. G. Sullivan, M.Can.Soc.C.E., Chief Engineer, Western Lines, Canadian Pacific Railway, has favored us with a copy of a letter he has written *Engineering News*, New York, in answer to an article on the above mentioned subject, which was published in that paper and reproduced in *Canadian Railway and Marine World* for February. Mr. Sullivan's letter is as follows:

Your criticisms and questions would appear logical and reasonable, if, as you seem to think, they were based on the idea that speed was the only object we had in mind, but the most important factor, and the one that must govern all good engineering, is the factor of economy, and this was the sole factor that was considered in making our decision. Time was a factor in this larger question of economy, but much smaller than some others. We considered time to be worth approximately \$750 a day. In a circular letter sent out to contractors inviting them to bid, dated April 8, 1913, the following statements appeared.

"The necessity for this tunnel is so great and the expenditure so large that it would be worth considerable money to this company to have the tunnel completed as soon as possible. Therefore, everything also being equal, the party who will guarantee completion in the shortest time will be the party who will receive the work."

"I would be glad if you would give us prices on the European method of tunneling, which is to drive a very small heading and take out the bench, working from several headings into this small drift. Tunnels in Europe have been driven by this method at two or three times the speed that any tunnel was ever driven in the U. S. or Canada, and I would like to be able to place before the management figures for doing this work according to this method. I would be glad if you would state in your proposal the amount per day that you would be willing to have inserted in a contract to be paid as a bonus for time saved over the agreed time, the same amount to be exacted as a penalty for the time lost, being the time between the fixed day of completion and the actual date of completion. We are of the opinion that this sum should be about \$750 a day."

The writer, however, was aware at this time that the chances of American contractors tendering a reasonable figure on the European method was very remote, in fact, after having studied some of the prices paid for labor in some of the large Swiss and Italian tunnels, we were forced to the conclusion that theirs was not a practicable method for this country, where labor is so expensive. On March 13, 1913, the writer reported to the management his ideas on this subject. To quote from that report:

"Referring to the progress that we hope to make in the driving of the Rogers Pass tunnel. I advised you in my report of Oct. 22, regarding the relative speeds of driving tunnels on the American continent compared with those that have been driven through the Alps. I have given the matter considerable study since and have come to the conclusion that the European method of driving a small lower heading and stopping out the remainder of the tunnel is too expensive on this side on account of the difference in the cost of labor."

I then described in general the methods which we proposed and which we have

practically followed out. The method desired was one by which we would be able to handle the minimum amount of material by hand and the maximum amount by steam shovel. By driving a heading in the centre of the excavation required for the completed tunnel, making this heading just large enough so that we could handle in the same, steel that would reach from the perimeter of this advance heading to the perimeter of the completed tunnel, and then drilling holes at right angles to the axis of the tunnel, enabling us to shoot at once the entire section required for the enlargement of the tunnel and this shooting was done in the following manner. Six holes at the bottom of the tunnel, having been previously shot out, they would load six holes in the next ring back in the bottom and all the side holes of the first ring up to a point a little over half way up the sides of the tunnel. This would continue until the tunnel began to fill up, and then some of the advance rings in upper portion of the tunnel would be shot and this process continued until the tunnel was choked full of muck. There was usually shot, about six rounds (or 30) of holes before the steam shovel started to clean up. In some of the harder rocks that shot well, they were able to shoot a greater distance. The most shooting done at one time up to date was 84 feet. This method enabled us to handle about 85 per cent. of the total excavation of the tunnel proper with steam shovels. This was the prime object to be obtained, and how that could be done without interfering with the work of the shovel was solved by driving the pioneer heading or tunnel, to be used as a by-pass for removing the muck from pioneer and advance headings; for ventilating ducts; air, water pressure pipes, etc., the result being that work was carried on continuously at all points, irrespective of shooting at other points, work only stopping at the local points at which shooting was being done. As there were no air pipes or water pipes, or any obstruction whatever passing over the muck pile in front of the shovel, the shovel was able to excavate 85 per cent. of the total excavation almost as easily as if it had been an open cut.

Our expectations have been more than realized, as is proved by the speed and the cost of the work. The cost of driving this tunnel through rock, including in this price the cost of driving 19,610 lin. ft. of pioneer tunnel; 12 cross cuts each about 40 ft. long; installation of plant including freight on same; the proportionate cost of building about 5 miles of temporary railway tracks, and other overhead charges plus 10 per cent. on all expenditures, will amount to a little less than \$5 a cubic yard for tunnel excavation in the tunnel proper. I may add further, that in reply to my invitation of April 8, 1913, the contractors who are doing the work, having in mind the method which was later adopted and which was suggested by myself and one of their engineers, bid \$6.10 a cubic yard with a time limit of 42 months from date of signing contract. Other responsible and supposedly expert tunnel contractors bid from \$8 to \$11.25 a cubic yard, with time limits varying from 42 to 48 months. I do not know what method these latter contractors proposed to employ but I always presumed it would be some modification of the European method. We also received an estimate of \$5.50 a cubic

yard for tunnel excavation from a very reputable American expert tunnel contracting firm who would do the work on a percentage basis and would be willing to forfeit a large portion of their percentage if they did not keep the price within the estimate. They however, estimated the time at 58 months. At the speed they promised for driving tunnel in rock, and figuring the time it took our contractors to get into rock at both ends on account of heavy cuts, it would have taken them 8 or 9 months longer than the estimate, or something over 5½ years. The method that they proposed to employ was to remove tunnel right from a face, loading muck by steam shovel.

Now, as far as speed is concerned, on account of large cuts and soft ground at the approaches, the shovel doing the enlargement work did not reach the rock on the east end until Jan. 1, 1915, and on the west end until Feb. 1, 1916. On Dec. 19, 1915, when the heading was completed, the shovels were two miles apart. Had the conditions been such that we could have got into the tunnel proper at earlier dates, I do not think there is any European record that would not have been broken. We are driving the tunnel at the rate of better than three miles a year for the last year. During Jan. 1916, the shovel in the east end made an advance of 946 lin. ft.

In conclusion, I wish to say, that in Europe, where drill runners, as I understand, get 90 cents to \$1.25 a day, and laborers something like 75 cents, the method followed in driving the Loetschberg tunnel may be economic as well as rapid, but all the evidence that we have goes to show that where we have to pay from \$4 to \$5.50 for drill runners and \$2.25 to \$3 for laborers, per day, the method we have adopted is by far the most economical.

New African Railway. A railway which will be of immense importance in time of peace was built with remarkable speed primarily for the purpose of facilitating the invasion of German Southwest Africa by the troops under General Botha. It connects the railway systems of Southwest Africa and the Union of South Africa, extending 300 miles from Kalkfontein in the former to Prieska on the Orange River in the latter. The new line saves many hundred miles of travel between points in South Africa and those in Southwest Africa as compared with the old route by rail to Cape Town and thence by boat to the ports of the late German colony now under British military control. Through trains are now running from South African points to Walfish Bay.

Light Railways for War Purposes.—By the use of light railways, the Germans have been enabled to run lines close up to the trenches. A network of such lines has been built throughout the occupied territory in Belgium and France, thus relieving road traffic and generally assisting in the handling of supplies and men. The lines are narrow gauge, and consist of high grade steel rails of light weight, and the whole is built up in sections, so that track is laid on the level in practically a ready made manner.

The National Union of Railway Men, of Great Britain, announced recently that it had lost 1,020 members by death in the war.