

which has been done in recent years—is a tribute to the advent of the engineer as a director of a type of construction which requires the planning and organizing ability of which usually only the trained engineer is capable.

Confronted with the problems of organization required for the successful economical completion of the long Alpine tunnels, Europeans long ago realized that these were problems for the engineer, and were not of the kind which could be put through solely by "pick, shovel, and pluck," or mere driving power, unaided by a trained mind to plan and execute.

The writer fully recognizes the value of the qualities of the contractor, especially those of the railway contractor, which are very necessary, and which engineers seldom possess. The need of planning, of co-ordinating the work of the organization with the plans, the successful modification of the plans to fit both the conditions and the organization as they develop, are, however, essentially qualifications which the properly trained engineer alone possesses.

Though this is not the first tunnel driven in North America which has demonstrated the ability of the engineer as an organizer along lines which require this necessary co-ordination of planning with execution, it is the latest and most successful, and the writer believes that the realization of this phase, of the conduct of the operations which have resulted so successfully, is of quite as great importance as the recognition of the successful application and improvement in the "pioneer heading" method, important as this latter is as a demonstration of efficiency.

The paper is filled with instances which show the careful, continuous study of conditions and improvements in details as the work progressed. Many of these latter are not altogether new; some of them have been advocated by the writer and others; but as their general application to tunnelling is by no means common, even yet, it seems permissible, even at the risk of repetition, to refer briefly to some of them:

Ventilation is a *sine qua non*.

Bonus system used.

Hammer drills used entirely, columns carefully set with relation to line and grade, holes pointed by clinometer.

Three helpers were used for each two drills.

Fuse was used instead of batteries for blasting.

Water was used to wet down the muck pile and wash the dirt from the sides, roof, and face.

Muckers have brief rest between each carload.

Mucking sheets were used.

There is also one statement full of significance to those who have had much tunnel experience, namely, that "the plant was properly put in and properly looked after, and caused practically no delay." This epitomizes the attitude of those responsible for the conduct of the work, and indicates one of the most important reasons for the success attained.

Lazarus White: The pioneer tunnel was of quite a small bore, and, as Mr. Dennis has stated, it served primarily for ventilation, because through it any quantity of air was sent around the heading, and blew out the smoke. The tunnel was both the driest and the best ventilated of any the speaker has visited. On account of the extensive blasting that was done, it must be realized that the ventilation had to be well nigh perfect, because from fifteen to twenty rounds were set off in succession in order to break up the rock ahead of the steam shovel.

In any ordinary method of tunnel ventilation, this would have made the work difficult, if not impracticable,

but, with this pioneer tunnel, the air was sent around and blown through the main tunnel. There was an immense fan in the pioneer heading through which there was always a strong wind blowing.

Another feature, not brought out very strongly in the paper, which contributed very largely to the success of this tunnel, was the drills used. The speaker believes they were little water-fed drills. With these it was possible to maintain the high rate of progress in the heading, and they contributed very largely to the success of the work.

The wooden water pipe, used for ventilation, served its purpose well, and was much superior to the ordinary iron pipe. It was well laid, and the joints were so tight that the exhaust could be conducted through it.

T. Kennard Thomson: The speaker understands that the report of the late Virgil G. Bogue, M.Am.Soc.C.E., is a masterpiece of one of the foremost of old-time railroad engineers, and it would seem that its publication in full, in connection with this paper, would be of great value to other engineers and students. For that reason it is hoped that the author will prevail on the Canadian Pacific Railway Company to allow its publication in full.

One reason for haste in those days was to get some return on the money as soon as possible, and an even more important reason was the fear that, if the road was not quickly completed, a turn of the political wheel might prevent it from being finished for many years.

In addition to the commercial reasons for haste in constructing the Rogers Pass Tunnel, the fear of snow slides may have been another incentive—the author has stated that the snowfall there is from 30 to 50 ft. a year. The speaker assisted in the design of the first snowsheds on this road. These were to be constructed in cuts on the hillsides in such a way that the snow slides or avalanches would never strike directly on the roof of the shed, but merely shoot or slide over it. Some of these designs were modified by others, so that the roofs projected up too far, with disastrous results in every case. Trees adjacent to a snow slide would often be cut off as if by a knife about 20 ft. above the ground, or at the surface of the standing snow, by the force of the wind generated by the falling avalanche. Nothing can be built to stop those giant snow slides after they have fallen from 3,000 to 5,000 ft. The snow and ice piled up in winter many feet, and even after the intense heat of August a depth of some 30 ft. or more would be left.

## STEWART COMPANY SUES SUB-CONTRACTOR.

Action to recover \$169,619.73 in connection with the Toronto Harbor sub-contract has been entered at Osgoode Hall by the Canadian Stewart Co. against I. A. Hodge, of Syracuse, N.Y. In February, 1914, the Canadian Stewart Company, who are the main contractors on the harbor work, let a sub-contract to Mr. Hodge for part of the ship channel, and the Stewart Company allege that the work was so negligently done that the greater portion of it was rejected by the Minister of Public Works and the material supplied for the work by the Stewart Company was lost. It is further alleged that Mr. Hodge refused to remedy the conditions complained of.

R. S. Lea, consulting engineer, of Montreal, is suing the city of Medicine Hat for commission as consulting engineer on the installation of the city's waterworks, the cost of which was between six and seven thousand dollars. The commission, which was at the rate of 5 per cent. on the cost of installation, has been paid by the city, except a balance of about \$6,000, and it is for this amount that the plaintiff has entered suit.