

tion danger, but will be found to be the cause of a wave motion, when under traffic, that materially increases the tractive effort required, and renders it extremely difficult to maintain the track in good condition.

It would appear superfluous to remark on the necessity of always considering construction during location, were it not that many locations are made which require material alteration before the line can be built. It may be said that no engineer who has not had previous experience in location, construction and operation is capable of making a first-class location. There is unfortunately no line of work in which the best workmanship is more likely to escape general observation, an appreciation of which fact is perhaps the reason that so many capable railroad engineers have taken up other branches of their profession.

A most vigorous denunciation of a location, apparently without regard to construction difficulties, will be found in "Eighty Years' Progress in Canada," a volume published in 1863. It came from the pen of Mr. T. C. Keefer, and expressed his opinion of the ability displayed in the location of the Great Western Railway between Niagara Falls and the head of the Dundas Valley during the early fifties.

A notable case occurred on the extension of the B. and O. lines northward down the Monongahela Valley from Morgantown, West Va. The river is subject to great floods, and it was considered necessary to keep the grade line well above flood level, the location being made a short distance up on the side hills of the valley. In places the profile showed a succession of short, sharp cuttings through points running out from the main hill. The material in these cuttings was in reality nothing but the debris of forgotten slides, but this was not noticed either by the location or the construction engineers. When the winter came every slide started to move again, as its supports had been cut through, and a heavy yardage of most difficult material had to be removed from the finished roadbed. On another West Virginia road it was found necessary to relocate some miles of the line, because it was fitted so closely to the contours of the side hill that it would have been impracticable to obtain a full width roadbed, although the centre line showed an excellent profile. In a minor degree, it will be found possible to shift many locations, so as to materially reduce the cost of construction, either by obtaining a smaller yardage or by locating through material that can be more