With a sharper curve than 10-chains radius—say, 8 or 9 chains—and a flatter grade to compensate for the sharper curves, the length of tunnel could be materially reduced, but to what extent it is not possible to say without a survey. The best curvature and grade to adopt could only be determined after a trial survey had been made, the essential point being that the gradient and curves adopted for the tunnel would be such that it could be easily worked by the Abt or Fell engines acting as adhesion locomotives only; so that the tunnel could be quickly traversed by any train which these engines could haul up the 1-in-15 grades above and below the tunnel.

We have no reliable information on which to base an estimate of the cost of this alternative proposal; it will probably cost several thousand pounds more than the switchback line, and the cost of maintenance would no doubt be greater, on account of the hillsides being apparently less stable along the left banks of the Rolleston and Otira than on the right banks, where it is proposed to locate the switchback line.

B. It is possible to amend the location of the switchback line so that the switchback can be eliminated, while the length of the line is only increased by about 12 chains. The line would turn by a loop near the proposed switchback. The loop would be partly in tunnel. Where the line is in tunnel the grade would be reduced, so that trains can be hauled through the tunnel by the locomotives acting only as adhesion engines, at such a speed as not to cause unendurable inconvenience to the train-men or passengers. As the length of tunnel required would not be more than 36 chains on a 1-in-60 grade, with 7½-chain curves, it should not be more difficult to work than the New Zealand tunnels already referred to under alternative *A*. After passing through the loop tunnel the line would be continued on the 1-in-15 grade to the summit. A passing-siding can be provided on a back-shunt at the loop, to take the place of the switchback siding, in the same manner as is proposed for several of the other stations, or by lengthening the loop, as found best when the line is relocated.

This alternative possesses all the advantages of working possessed by alternative *A*, and the line will be on more stable country, where the cost of ordinary maintenance may reasonably be expected to be less, and there should be less chance also of interruption of traffic by heavy slips. The bridges would be more expensive than on the line discussed under alternative *A*. The actual length to be run by a train on this line would be about 6 chains more than on the switchback, which is immaterial.

C. If the switchback line were constructed as proposed by the company, it would always be possible to eliminate the switchback at any time, if circumstances justified the expenditure, by constructing a tunnel on a flatter grade than the 1-in-15 incline, so that the trains would turn on a loop, as under alternative *B*. Instead of being reversed on the switchback, the trains would be run through the tunnel quickly, as above proposed, to avoid inconvenience or danger. This would cost £25,000 to £30,000. This is a modification of alternative *B*, but if the switchback line is constructed it should be so located that the tunnel of alternative *B* can be reverted to at any time if the switchback is found to be troublesome and a hindrance to traffic.

The principal objection to the switchback is the loss of time there would be with trains run with single engines only, the van and engine having to change ends. With trains run with two engines, one at each end, this objection would not hold, and for heavy traffic we think this would generally be the type of train run. For both types of train there would also always be the loss of time due to running in and out of the siding, which would not, however, be so great as the loss due to changing ends.

We therefore recommend that the switchback line generally be adhered to, with the addition of the curved loop mentioned above, which will then give the line all the advantages claimed for that on the left bank of the Rolleston. If in the first instance it is deemed advisable for the sake of economy to construct the switchback, the line should be constructed so that the loop of alternative *B* can be reverted to at any time.

The cost of alternative *A* may be taken at £65,000; of alternative *B* at £70,000; and of the switchback line at £60,000, for the sake of approximate comparison.

Some of the other tunnels on the 1-in-15 grades between the switchback and the summit are of considerable length. We are strongly of opinion that all these tunnels should be reduced to a maximum length of, say, 5 chains each. These long tunnels, we feel certain, would be found to be as unworkable as the long tunnel proposed as an alternative to the switchback. It seems quite feasible to break up the longer tunnels into shorter lengths by shifting the centre line of the railway towards the Otira. Some viaducts would likely be required between the short lengths of tunnels; but though the line might not be quite so safe on a viaduct as in a tunnel, yet, as it is necessary that it should be workable, we unhesitatingly recommend that this alteration be made. These tunnels must all necessarily be on the 1-in-15 grade.

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NOTE.—Mr. J. H. Lowe, Chief Engineer, Working Railways, was invited to act on this Committee, and attended the first meeting, but was unable, through illness, to attend further. It was then arranged for Mr. Coom to take his place.

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