

towards Featherston (in the final location this grade would be put all on the straight, a flatter grade being put where the curve occurs); grade tunnel to Featherston, 1 in 40; sharpest curve on this grade, 10 chains radius. In addition to the tunnel 143 chains long, the other works of any note are a bridge across the Pakuratahi River, also bridges over the Rimutaka, Tidswell's, Beal's, and Cave's Creeks. There are no particularly heavy earthworks. The line joins the existing railway about 23 chains south of the Featherston Station. Its length is about 9 miles 66 chains, and the estimated cost is £181,200.

To get a grade of 1 in 55, with perhaps somewhat sharper curves than 10 chains radius, it would be necessary to lengthen the deviation and join the existing railway about three-quarters of a mile beyond the Featherston Station. This would increase the cost of this deviation to about £194,000, as estimated by Mr. Dobson; but I think this amount is rather little.

The grades obtainable on either of the above lines do not compare favourably with those obtainable by the Tauherenikau route, and I have examined the country between Abbott's Creek and Fernside and Woodside Stations to ascertain approximately what grades could be got by running the line either to Fernside Station or to Woodside Station—in this latter case crossing the Tauherenikau River at as high a level as possible in order to get the flattest possible grade.

If a line were constructed from the Road Saddle Tunnel down the left side of Abbott's Creek, and along the hillsides beyond Featherston to Fernside Station, the continuous grade obtainable, assuming the grade through the tunnel was 1 in 70 on the straight, would be about 1 in 75; with the grades where on curves flattened proportionately to the curvature, this line would probably give a working gradient no worse than 1 in 66 on the straight, depending on the relative amount of straight to curved line in the section. The works would be much heavier than for the 1-in-55 line; in addition to larger bridges or viaducts being required for the tributaries of Abbott's Creek, a viaduct of about 150 ft. in height and of considerable length would be required over Boar Bush Creek behind Featherston. On the hillsides to the south of this creek there is a large slip, or, rather, dislocation of the ground, reaching up to about the grade-level; but I do not know that this would be an important factor, as probably a moderate cutting would take the line back into solid ground. The cost of this alternative deviation, Kaitoke to Fernside, may be taken as £260,000. Better grades than those on the trial line would be required between Kaitoke and the Summit Tunnel to get approximately balanced grades for the probable up- and down-country traffic. Though not quite so good, this route approaches very nearly the Tauherenikau route as regards grades.

If, as another alternative, a line were constructed like the preceding from the Road Summit Tunnel, down the hillsides on the left bank of Abbott's Creek, then along the hillsides between Featherston and the Tauherenikau River, crossing the river at a level of 70 ft. to 80 ft. above the level of Woodside Station, and then running along the terraces and flats to Woodside, the continuous grade obtainable, assuming that the grade in the Summit Tunnel is 1 in 90 on the straight, would be about 1 in 95. With the grades on the curves suitably and proportionately flattened, according to the sharpness of the curve, it is probable that a working gradient of 1 in 82, or perhaps better, could be obtained by careful location of the line, depending on the relative lengths of curved and straight line on the section between the Summit Tunnel and the Tauherenikau River crossing. The bridges over Tidswell's Creek, Beal's Creek, Cave's Creek would become viaducts of some size, and the viaduct required to cross Boar Bush Creek would be 250 ft. high, though the line could, I think, be run up the gully to avoid the viaduct; also there would be either a smaller viaduct or a high bank required for a gully about halfway between Featherston and the Tauherenikau. There would likely be some short tunnels required at some of the gullies; the bridges or viaducts might be considerably reduced by these tunnels, but I have not assumed that this would be so in the approximate estimate given below. The worst part of the country along which this alternative route runs is, I think, that around the sides of Cave's Creek. The hillsides are much more favourable, I think, for railway-construction than those along which it is proposed to construct some portions of the Midland Railway, and more so than some other places where railways have been already constructed in New Zealand. The best grades from Woodside to Kaitoke are obtainable by this route, and the worst parts of the line would be safer than the worst parts along the Tauherenikau route. The cost of construction from Pakuratahi to Woodside would be very heavy—say, £350,000. In this I have included a sum of £25,000 for short tunnels in addition to the cost of the Summit Tunnel, and £93,000 for bridges and viaducts. There would be some difficulty in getting grades from the Upper Hutt to the Summit sufficiently flat to avoid the use of assistant engines with the present ratio of up- to down-country traffic on a line with so flat a gradient as this one between Woodside and the Summit Tunnel. A possible variation of this route would be to run up Boar Bush Gully and tunnel through to Cave's Creek watershed; this would make the grade steeper, perhaps not much better than the grade via the Tauherenikau; but I have no reliable data for determining the grades or the amount of tunnelling required.

The line via the Tauherenikau would branch off from the Abbott's Creek route at a point about two miles and three-quarters beyond Kaitoke. After crossing the Rimutaka Creek by a small bridge this line runs for a little over two miles along the spurs and intervening flats, until the tunnel through the main range is reached. This length of line is fairly easy, and should only require moderate banks and cuttings, and a number of culverts. If put on the grade suggested by Mr. Dobson, the tunnel would be about 70 chains long. It will probably be through slate rock, and will require to be lined throughout. If, however, the tunnel grade is made to fall instead of rise to the south end, the saving in rise and fall, curvature, and length of line between the Pakuratahi and the tunnel will be likely to justify the lengthening of the tunnel sufficiently to give an easy up-grade from the south to the north end; this will also be of considerable advantage in constructing the tunnel. At the north end there is a large creek, which will be likely to give trouble similar to that experienced at the ends of the Spooner's Range Tunnel. The approach cutting at this end will be long, through a piece of comparatively flat ground; the upper end of this flat forms the virtual summit for this route. Beyond the tunnel the line will run down the right bank of a tributary of the Tauherenikau to its junction with the river. At the end of the