

The Marlborough country within the area affected by the railways consists of sedimentary rocks intermediate between the clay-slates of the main range and the sand- and lime-stones of the coal-bearing formations. The low country on the West Coast consists chiefly of alluvial deposits, in terraces and river-flats, overlying papa or blue reef—a soft argillaceous sandstone. All the principal alluvial gold-diggings occur in these deposits, the papa being the bed-rock.

## DESCRIPTION OF LINES.

### EAST AND WEST COAST RAILWAY.

*Surveys.*—Most of the following particulars descriptive of this line appeared in my report of the 12th September, 1884, under the head of “Arthur’s Pass Route.”

As already stated, a careful detailed survey of the line has been made; consequently the information on the subject is very complete.

Except in the summit tunnel again referred to, the ruling gradient of the line as laid off is 1 in 50, and the sharpest curve is  $7\frac{1}{2}$  chains radius.

*Route.*—Commencing at Springfield Railway-station, 43 miles 66 chains from Christchurch, the East and West Coast line sweeps across an open terrace to the Kowhai Bush, and strikes the Waimakariri River near Paterson’s Creek. The Waimakariri is then followed up to the Broken River, which is crossed close to the mouth and followed up to Sloven Creek. The course thence is by the Sloven Valley, St. Bernard Saddle, and Lake Sarah to the Cass. The Waimakariri is crossed near Goldney’s Saddle, and followed up to the Bealey, which in turn brings the line to the main range at Arthur’s Pass. The saddle is pierced by a long tunnel coming out in the Otira Gorge, near the foot of the “Zigzag.” From this point the line follows the southern slopes of the Otira and Teremakau Valleys to a point near Jackson’s accommodation-house, where the Teremakau is crossed. The northern bank of the river is then followed to Bruce’s Paddock, after which there is a straight run to the head of Lake Brunner. The line skirts the western side of the lake to the Hohonu Creek, and, sweeping round the spur into the valley of the Arnould, follows it down to the Grey. A junction is made with the West Coast-Nelson Railway near Stillwater, 1 mile 30 chains from Brunnerton.

*Levels.*—The East and West Coast line commences at a level of 1,260ft. at Springfield, and rises, with very few downward gradients, to 2,040ft. at St. Bernard’s Saddle. Thence to the Waimakariri there is a fall, with long undulations, to 1,800ft., the level at the crossing, after which the rise right to the main range is almost without interruption, the level at the summit being 2,530ft. The descent westward begins at the eastern end of the tunnel, and continues for about seventeen miles, till the Teremakau River-bed is reached, at a level of 690ft. After this comes a gradual fall to 300ft. along the shores of Lake Brunner, a rise to 480ft. opposite the foot of the lake, and finally a fall to 100ft. at the terminating point in the Grey Valley.

*Gradients and Curves.*—On the eastern side of the range there are a number of 1-in-50 gradients, some of them combined with sharp curves; but they are all in favour of the traffic from the West Coast, which will, of course, be much heavier than that from the east. There are three inclines of 1 in 50, with flat curves, against the heavy traffic, their aggregate length being  $2\frac{1}{4}$  miles. They can, however, be eliminated at a very small cost; and the same remark applies to two similar inclines three-quarters of a mile long in the Teremakau Valley, on the western side. Leaving out the long incline on the western slope of the main range, there is no necessity to have any gradient steeper than 1 in 60 against the heavy traffic, and at a moderate outlay the ruling gradient might be still further reduced—say, to 1 in 65 or 70. This would concentrate all the heavy gradients into one place, which is a very great desideratum, for the incline is far enough away from Brunnerton and long enough to be a locomotive stage in itself. Auxiliary power can therefore be used to the best advantage.

The incline on the western side of the main range has a continuous gradient of 1 in 50 for fourteen miles, in combination with  $7\frac{1}{2}$ -chain curves, and it cannot be materially improved at anything like a reasonable cost.

In order to get better places to enter, and a level piece for the commencement of an alternative line over the summit, the gradient of the long tunnel at Arthur’s Pass was increased to 1 in 44. This, on a straight line, is quite as easy as the 1-in-50 on  $7\frac{1}{2}$ -chain curves in the open. Still, if considered desirable, the 1-in-44 can be made into 1 in 50 without materially increasing the work.

*Works.*—The rough country on the East and West Coast Railway commences soon after leaving Springfield; but there are no special works in the first five miles except a large viaduct and heavy earthworks at the crossing of the Kowhai. The line strikes the Waimakariri Gorge at the 6th mile, and from thence to the Sloven Valley, at the 14th mile, the country is very difficult, and the works exceptionally heavy. From Sloven Creek to the head of the Bealey, a length of thirty miles, the works are very light: there are only two heavy cuttings on the whole distance. The Arthur’s Pass summit tunnel is nearly  $3\frac{1}{4}$  miles long, and the works on the western incline are exceedingly heavy. The remainder of the line from the Teremakau to Brunnerton runs through very easy country. With the exception of a few small cuttings near Lake Brunner, and a short tunnel in the Arnould Valley, there are no works worth mentioning.

Altogether there are twenty-four tunnels on the East and West Coast line, of the aggregate length of 5 miles 30 chains 7 yards: eleven on the eastern side, 1 mile 35 chains 20 yards; the summit tunnel, 3 miles  $16\frac{1}{2}$  chains; and twelve on the Westland side, 57 chains 20 yards. One of the tunnels on the eastern side is 24 chains long, and there are three between 15 and 20 chains; but all the others on the line are 11 chains and under.

The bridging also forms a considerable item. In addition to ordinary stream and river bridges, there are fourteen iron viaducts over 50ft. in height, the total length of which is 72 chains.

*Cost.*—Including the small section, 1 mile 30 chains, between Stillwater and Brunnerton, partly made, the total length of railway to make between the two coasts of the Island is ninety-five miles.