Although no special difficulty is met with on the eastern side of the range on the Hurunui route, there is a large amount of heavy work, more particularly at the Waitoha Saddle and Upper Hurunui Gorge. The summit tunnel is longer than at any of the other passes, and the works on the western incline are very much heavier, the heaviest on any equal length of railway hitherto surveyed in the colony. Practically there is simply an alternation of tunnel and viaduct for a considerable distance. In 12 miles there are nearly 8½ miles of these two works.

Including a small one of 5 chains 20 yards in the Arnold Valley, there are in all thirty-four tunnels on the Hurunui line, of the aggregate length of 9 miles 60½ chains: seven on the eastern side, 1 mile 19 chains 17 yards; the summit tunnel 3 miles 35 chains 7 yards; and twenty-six on the Westland side, 5 miles 5 chains 9 yards. One of the latter is 1 mile 32½ chains, and another 76 chains long; altogether there are eight tunnels on the line 20 chains and upwards.

The item bridging is also a very heavy one. In addition to ordinary stream and river bridges, there are nine iron and thirteen timber viaducts over 50 feet in height, the total length of which is 1 mile 30 chains.

Including the continuation of the line from Bruce's Paddock to Stillwater, and 1 mile 30 chains between Stillwater and Brunnerton, the total length of railway to make by the Hurunui route is 101 miles. The estimated cost, including rolling-stock and all other charges necessary to complete the line, is £1,408,000—say, £14,000 a mile.

Hurunui Route, Alternative Line.—With the view of obviating or postponing the construction of the long tunnel an alternative line has been surveyed over the Hurunui Pass. It is 3 miles 55 chains long. The eastern incline is 2 miles 55 chains, with gradients ranging generally from 1 in 9½ to 1 in 41. There are 25 chains of level on the top, after which comes the western incline of 55 chains, with gradients from 1 in 2 to 1 in 14; the average for the first 30 chains being 1 in 2·3. Although the general direction is tolerably straight, there are a considerable number of 10-chain curves on the summit line, which will increase the difficulty of working.

The line has four tunnels, the total length of which is 38 chains 17 yards, but the other works are comparatively light.

The estimated saving to be effected in making a surface line, instead of a long tunnel, at the Hurunui Pass is £280,000, and the value of the works on it ultimately to be abandoned, £88,000.

From the peculiarity in the alignment and levels of the summit line the cost of working would be very great. There must be a rope traction at the western incline, but this method cannot well be extended to the eastern one, which is better adapted for a Fell locomotive; and to have three systems at work on the one railway is simply out of the question.

Arthur's Pass Route.—As the section onwards from Bruce's Paddock is a direct continuation of the Arthur's Pass Route the two will be considered together as the through line. The plan and sections accompanying this report are also prepared on this basis.

Commencing at Springfield Railway Station, 43 miles 66 chains from Christchurch, the Arthur's Pass line sweeps across the 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 from 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 Arnold, follows it down to the Grey. A junction is made with the authorized Greymouth–Nelson Creek Railway, near Stillwater, 1 mile 30 chains from Brunnerton.

The Arthur's Pass line commences at a level of 1,260 feet at Springfield, and rises, with very few downward gradients, to 2,040 feet at St. Bernard's Saddle. Thence to the Waimakariri there is a fall, with long undulations, to 1,800 feet, the level at the crossing, after which the rise right to the main range is almost without interruption, the level at the summit being 2,530 feet. 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 690 feet. After this comes a gradual fall to 300 feet along the shores of Lake Brunner, a rise to 480 feet opposite the foot of the lake, and finally a fall to 100 feet at the terminating point in the Grey Valley.

In order to get better places to enter, and a level piece for the commencement of the summit line, the gradient of the long tunnel at Arthur's Pass has been increased to 1 in 44. This, on a straight line, is quite as easy as the 1 in 50 on 7½-chain curves in the open. Still, if considered desirable, the 1 in 44 could be made into 1 in 50 without materially increasing the work.

The rough country on the Arthur's Pass route 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 sixth mile, and from thence to the Sloven Valley, at the fourteenth 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 were only two heavy cuttings on the whole distance. The Arthur's Pass summit tunnel is somewhat shorter than the Hurunui one, and, although still exceedingly heavy, the works on the western incline bear no comparison with the corresponding ones on the Hurunui route. The continuation of the line from the Teremakau to Brunnerton, common to both the Hurunui and Arthur's Pass routes, runs through very easy country. With the exception of a few small cuttings