

near Lake Brunner, and a short tunnel in the Arnold Valley, there are no works worth mentioning.

Altogether there are twenty-four tunnels on the Arthur's Pass route, 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 16½ 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 is very much less than on the Hurunui route, still it forms a considerable item. In addition to ordinary stream and river bridges, there are fourteen iron viaducts over 50 feet in height, the total length of which is 72 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 Arthur's Pass route is ninety-five miles. The estimated cost, including rolling-stock and all other charges necessary to complete the line, is £1,505,000—say, £15,900 a mile.

*Arthur's Pass Route, Alternative Line.*—As in the case of the Hurunui route, an alternative line, with steep gradients, has been surveyed over Arthur's Pass: it is 3 miles 34 chains long. The eastern incline is 1 mile 36 chains long, with gradients ranging from 1 in 7 to 1 in 50. There are 8 chains of level at the top, after which comes the western incline, 1 mile 70 chains, with gradients from 1 in 5 to 1 in 50. With the exception of a short flat curve at each end, the summit line is straight throughout.

The works on the line are very heavy. They consist of four tunnels, 29 chains long; four trestlework viaducts; a large amount of rock-cutting; and high retaining-walls.

The estimated saving to be effected in making a surface-line, instead of a long tunnel, at Arthur's Pass, is £177,000; and the value of the works on it, to be ultimately abandoned, is £130,000.

So far as the alignment and the arrangement of the inclines are concerned, the surface-line is quite workable, and the one system of rope-traction could be adopted throughout. Furthermore, the machinery to work the inclines might possibly be driven by water-power, of which there is an abundant supply. On the other hand, the saving to be effected in the first instance is scarcely worth considering when compared with the amount to be ultimately thrown away, and the inconvenience and expense of a break in the traffic.

*Lake Lyndon Route.*—This route commences near Hororata, on the surveyed Canterbury Interior main line, four miles from Homebush and thirty-nine miles from Christchurch. For about eight miles it follows the Canterbury interior line, then strikes up the Rakaia Valley to Windwhistle, and from thence along the slopes of the Big Ben Range, and by the Upper Acheron Valley, to Lake Lyndon. After this it follows generally the course of the Hokitika Road, past Castlehill, Craigieburn, and Lake Pearson to the Cass, where it merges into the more direct Arthur's Pass route by Waimakariri Gorge, already described.

The line commences at Hororata at a level of 630 feet, and, with few interruptions, rises to 2,700 feet at the Lake Lyndon Saddle. Then comes a fall to 2,220 feet near the Broken River, a rise to 2,520 feet at the Craigieburn Saddle, and finally a fall to 1,910 feet at the Cass.

The object in surveying the Lake Lyndon deviation was to avoid the heavy works in the Waimakariri Gorge on the direct route. The anticipations with reference to it have not been realized: the works are much heavier than was expected, and on the direct route they are much lighter; consequently the balance even in cost is in favour of the latter. For this reason it is unnecessary to discuss the Lake Lyndon line in detail. All the works are heavier than on the Waimakariri route, the bridging in particular being very much in excess.

The heaviest bridging occurs at the head-waters of the Selwyn, where there is a break in the range. A better line might possibly be got by following the Selwyn all the way down from this point to the White Cliffs; but, under any circumstances, the balance of advantages will be largely in favour of the direct Waimakariri route.

Taking the Lake Lyndon route and its continuations as a through line from Christchurch to Brunnerton, the total length of railway to make is 126 miles, and the cost completed and fully equipped is estimated at £1,994,000—say, £15,800 a mile.

*Amuri Pass Route.*—This line, of which a complete survey has not been made, leaves the Canibai Gorge route at the confluence of the Doubtful and Lewis, follows up the Doubtful to its source in the Amuri Pass, and by a long tunnel reaches the head-waters of the Ahaura. The descent westward is made by the southern slopes of the Ahaura, the river-bed being reached near the Tutaekuri Junction. The Ahaura Valley is then followed down to the Kopara Flats, where the line strikes off to the Kopara Lakes; from thence it reaches the Grey Valley by the Nelson Creek or the Arnold.

The length of the tunnelling through the main range on the Amuri route is much the same as at Arthur's Pass; but the works on the western incline will, in all probability, be considerably lighter, for the slope of the mountains is flatter and more regular. There will, however, be heavy bridging on a long double-back at the Tutaekuri. The portions of the line not already referred to, not included in other routes, pass through very easy country.

Without a complete survey it is impossible to give a decided opinion on the subject; but the probabilities are that this will be found one of the cheapest routes. The distance to make is about 104 miles, and an approximate estimate £1,300,000, or £12,500 per mile.

As will be seen further on, the great objection to the Amuri Pass route is that it does not shorten the distance between any of the principal points that require to be connected.