

and the ultimate fragments small. Maungapohatu is of a close and rather fine-grained sandstone, with horizontal stratification. This is the only building-stone observed in the route, and it is of fair quality. There are, on the slopes below the north-east end of the mountain, masses of loose, angular stone, from the size of a house downwards, and which, from the smooth and often perpendicular sides and sharp arrises, show the material to be fit to stand the very severe frosts and humid weather of that district. After leaving Maungapohatu, and all the way to the Galatea Plains, no rocks but those of clay-slate were seen. These are of the very loosest structure, as a rule. Some harder bands are to be found, but, from the polyhedral nature of the ultimate fragments, this rock is all easily excavated. From Galatea to Rotorua the country is of the pumice and rhyolite-rock formation, too well known to need any description. Nothing in the shape of river-gravel or sand was to be seen in any part of the route, and, for ballast, dependence would have to be placed on the clay-slate rock, abundance of which would arise out of the cuttings and on deposits of pumice-gravel on the Kaingaroa Plains. Machine-broken limestone would probably have to be used on Section 1. All over the forest country, underneath the surface soil, is to be found either the common small yellow pumice-gravel or a few inches of fine clean grey sand, both evidently subaerial deposits. Very little of the pumice is to be observed east of Maungapohatu, and generally it is only in patches, but the grey sand is almost universal.

The timbers on the line are, from Ngutuwhera to Maungapohatu, a distance of nearly thirty miles, principally black birch (*Fagus fusca*), very suitable for sleepers and bridges. From Maungapohatu to Galatea Plains the forests are of mixed tawa bush, and of little value for railway-work. Near Te Whaiti there is a valuable totara forest, which is Government property.

As regards formation, Section 1 calls for very little remark. It is the ordinary work required in alluvial plains, but much care would have to be given to guard against slips. Almost the whole of Section 2 would be in side-cutting along the slopes of hills and mountains, many of which are as steep as $1\frac{1}{2}$ to 1. The full width of formation must be in the solid, and in many places the rock will not stand steeper than 1 to 1, although, excepting in the upper strata of sand and soil, $\frac{1}{2}$ to 1 may be taken as the rock-batter over three-fourths of the length. In many places the spurs are so narrow between the ravines that, even with $1\frac{1}{2}$ chains minimum of curvature, short tunnels of 30 to 40 yards in length must be put in, but, without setting out the line, the number of these cannot be determined. On Section 3 little need be said, excepting that much care and judgment would be necessary in locating the line, and forming through the hot springs and pools of Kakarama and near Whakarewarewa.

Bridges.—As a whole, the route is particularly light in bridge-work; there are no extensive viaducts, anything worthy of the name being almost confined to Section 1. I append a tabulated list of bridges, which, I believe, will include all waterways above 10 ft. span, and from which a sufficiently close estimate may be made.

GISBORNE-OPOTIKI ROUTE.

On the completion of the reconnaissance as above described, and in pursuance of instructions in your memorandum of the 21st February, I left for Opotiki to take up the work of exploration for a line of railway from Gisborne to that place.

This route has, from an exploration point of view, great advantages over that through the Urewera forests. There is a road right through, about half of which is bridle-track, and the rest fit for wheel traffic. There are places of public accommodation at Poututu (twenty-seven miles) and Motu (fifty-seven miles). Thence northwards to Opotiki, 112 miles from Gisborne, I was greatly indebted to the hospitality and great kindness of the only two settlers in the bush for accommodation, and breaking what would otherwise and in the circumstances have been a very long journey. From near the Motu Bridge, fifty-two miles from Opotiki southwards, the country is settled, and the original bush may be said to be cleared. The main ridge of the country is about ten miles south of the Motu Township, and is there low and flat compared with the Huiarau saddles. It is very little higher than the Mamaku summit, on the Auckland and Rotorua Railway, and from this point southwards the country is clear, and I was enabled to do more in four days than I could accomplish in a month at Maungapohatu. In traversing the bridle-track north of Motu, one is enabled to closely see and get familiar with ravines and spurs, in all respects similar to those through which the railway would have to pass. And, to any one experienced in laying out railways in broken country, it is conclusively evident that a limit of $7\frac{1}{2}$ or even 5 chains radius would be prohibitory.

DESCRIPTION OF THE LINE.

As mentioned in the first part of this report, a length of about twenty-five miles out from Gisborne is common to both routes. Starting, then, from the point of divergence, about three miles below the confluence of the Wharekopae and the Waikohu, the line would keep up the north-east bank of the Waikohu to Poututu. At or near that place the rise to the summit would commence, and preferably a regular and continuous grade, equivalent to an average of 1 in 50, excepting where necessarily broken for stations, would be continued round the spurs and slopes of the Waikohu into the valley of the Rangiriri to a crossing-place on that stream, thence back along the dividing ridge between the Rangiriri and the Kokokupara round the southern end of this ridge, and on to the saddle of the main range, which is here only about 2,000 ft. high. The line might cross the divide on the surface, but it would be more convenient to make a 20 ft. cutting and pass the road over the railway.

On crossing the saddle the line is in the Motu drainage, and descends to the Motu Township with a grade of 1 in 102; but, although the Motu is a Bay of Plenty river, there is no possibility of a suitable route being found down its valley. It is nearly seventy miles to the sea, and twenty-five more along the beach to Opotiki. On the other hand, the road route from Motu to Opotiki is, for our purposes, also impracticable, passing over three high ridges, with long and tortuous ravines between.