and I did not reach the Pass until January 8th, the work being greatly delayed by rain and consequent freshes.

Considering it most advisable to act on your suggestion "that the main difficulty would probably be found at the summit, where the chain of the Alps is passed," I proceeded at once to survey that part, and now submit to you a description of the locality, to facilitate your judgment of the results arrived at.

The so-called face of the Pass consists on the north of a perpendicular face of rock, very broken and irregular, about 600 feet in height, at the head of the Arahura Valley, which at that point is not more than 100 feet in width. A stream descending from the lake on the top of the Pass, and fed by the Mount Harman Range, falls over and between broken ledges of clay-slate, and sandstone rock, forming a junction with a large creek, flowing south-westerly through an immense chasm extending to the foot of the "Twin Peaks," a lofty mountain on the southward. The sides of this gorge rise nearly vertically to a height of 700 feet; the width is from 20 to 25 chains, and is separated from the eastern watershed by a narrow saddle, at an elevation of 5,300 feet above the sea. The section exposed on the north side and at its head, consists of slate with irregular bands of sandstone rock, dipping towards W. by N. about 75°, while on the Pass side the strata are vertical or else much contorted. On looking for the cause of this difference, I found that while the strata of the Twin Peak Range preserved the same dip generally, and, coming from the westward, struck across the south face of the Pass, that on the Mount Harman Range continued only to the western side of that hill, where a narrow belt of vertical strata shows itself, rising on a high peak marked on plan as Mount Axis, on the eastern side of which the strata of Mount Harman dip, about 70° E. by S. This line of vertical strata extends through the low ridge on the north side of the Pass, becoming more and more contorted towards the head of the chasm mentioned, where it is crossed by the strata of the Twin Peak Range.

The effect of this disturbance has been to render the rocks of which the Pass is composed so dislocated and full of joints, crossing in every direction, that the disintegration which takes place in this locality is immense. I append two sections—one on the line of the Mount Harman Range, the other on a line from Mount Axis to saddle at head of Great Chasm.

Although the narrow face at the north side of the Pass would appear to offer some facility for the mouth of a line of tunnel, the junction of the stream flowing from the Twin Peaks renders it impracticable on account of the immense quantity of snow which, collecting in the gorge of that stream in the winter, melts in the spring, bringing down avalanches of a large size.

For about 50 chains northerly, down the Arahura, the valley is only from 150 to 300 feet across, with high and steep faces at the foot of the spurs on each side; it then opens out, the sides on the right being nearly vertical, while on the left the spurs run up from the river bed at a general inclination of 8° or 10° to the foot of the steeper slopes of the range.

A 10-feet track, constructed nearly eight years ago along this side, is in good repair, except at the gully crossings, where but little work was originally attempted. The hill sides consist of yellow clay, containing boulders, small stones, and laminæ of slate and flaggy sandstone, with a surface soil of decayed vegetation of from 12 to 18 inches in depth, covered with alpine scrub, interspersed with Kawhaka, timber growing in many places to a fair size.

The south side of the Pass consists of a bold and steep face, extending from the Twin Peak Range on the westward to the Mount Harman Range on the eastward, in a continuous line for one mile and three-quarters. From its summit to about 800 feet, the rocks are very steep, and at its foot a talus has accumulated reaching to the river bed, which is 1,400 feet below, at a distance of only 40 chains from summit edge.

The only point available on this (Canterbury) side for constructive works is at a spot near the junction of the two streams forming the head waters of the Wilberforce branch of the Rakaia River. The talus here rests on a substratum of yellow clay, containing boulders, gravel, and laminæ of slate and sandstone, which rises to a height of 90 feet above the river bed, and is the only part on this side not liable to be swept by the *débris* brought down from the summit, the rocks of which are clay slates and sandstone, with felspar, in a high state of segregation—blue slates preponderating—the whole shattered to such an extent that large masses are brought down on the melting of the winter snows.

Finding the level on the Canterbury side thus fixed, I proceeded to collect data sufficient to enable me to run a line of direction across the Pass, and, on levelling, found that at the corresponding point on the Westland side a tunnel would run out about 30 chains below the north face in the narrow part of the valley before described, and immediately above a large slip on the hill side.

From previous observations at various seasons, and applying them now to the question of a railway line in this locality, I am of opinion that the valley for a distance of 50 chains from the north face will be subject to snow slips, more especially on the left-hand side where this outlet would be, owing to the steep face (rising at an angle of 44°) lying immediately under the upper slopes of the hills.

Assuming that in a long tunnel in a locality such as this a curve would be injudicious, I find that at the angle of intersection of the valley with tunnel line, the length of tangent to a curve of even a 10-chain radius would be 5·47 links, while the greatest distance obtainable from face of tunnel to the river bed would not be more than 300 links.

On the Canterbury side, owing to the more favourable angle made by the tunnel line and the greater width of the valley, there would be no great difficulty in getting away.

The next highest available point on the Westland side for the outlet of a tunnel is about 30 chains lower down the Arahura, in the more open part of the valley previously described; and on running line No. 2 for the purpose of obtaining a section, and checking the general accuracy of the work, I found that a point on the same level as that on the Canterbury side would be at such a height as to render it impracticable to construct any works except at an enormous expense, the gradient at the upper portion of this valley for the first three miles being exceedingly steep. Other circumstances being favourable, this probably might be overcome by a series of inclines traversing the left side,—which is of a formidable nature; but the increased cost of bridges and other works would be immense, and on account of the high elevation of the district above the sea, the depth of snow in winter would probably entail a considerable length of snow sheds.