APPENDIX F.

MIDLAND RAILWAY.

FINAL REPORT OF MR. VIRGIL G. BOGUE, C.E., ON THE ARTHUR'S PASS PROBLEM.

SIR,— New York, 14th July, 1904.

In the first report on the Arthur's Pass problem which I had the honour to make to you, under date of the 17th February, 1902, it was recommended that certain surveys be made, and it was remarked that, "In making the surveys the situation should be studied with care, so as to get the best out of it, and in this connection I take the liberty of suggesting that the map of the survey, at least of the part from the summit tunnel to Otira, should be a contour map, on a scale of 100 ft. to an inch. On such map the effect of slight changes of gradient can be tried, and the best possible location determined."

The surveys thus referred to were made by your engineer, Mr. Dobson, also the maps, profiles, and estimates, which, under cover of a short report to you by Mr. P. S. Hay, Superintending Engineer, and a letter of transmittal from the Under-Secretary, Mr. H. J. H. Blow, were sent to me on the 29th September, 1903. They were promptly received, as per my letter of the 31st October following. These were followed by a subsequent letter from the Under-Secretary, enclosing, as per request of my said letter of 31st October, some details of the estimates.

In order that the record may be quite complete, Mr. Hay's report and the several letters and estimates, &c., referred to appear herewith as an appendix, also the maps and profiles have been reduced to smaller scales, and prints thereof are also appended, all being submitted as part of this report.

In supplementary reports which I made to you, the first dated the 16th May, 1902, and the second 27th June, 1903, some data and information were presented which had especial bearing on working-costs of suggested routes, also on tunnel-ventilation and electric traction as applied in long tunnels. These supplementary reports as to working-costs confirmed my original report in its conclusions that, on the whole, and so far as could then be known, line B 1 would be the best.

The surveys, however, have demonstrated the fact that the cost of line B 1 would exceed the amount assumed by me in the sum of £30,000. They have also disclosed the situation respecting line A 4, referred to by Mr. Hay, which was discussed in a tentative way by Messrs. Hay, Dobson, and myself, but without any conclusion at the time, that enough information relative thereto could be presented to make it worthy of mention, in a formal report.

The outcome has fully justified the expenditure of time and money required by the surveys, &c., since we now have in line A 4 a route upon which I am satisfied all can unite as the best that can be had, as will be outlined in the following pages.

TRAFFIC AND ASSISTANT LOCOMOTIVES.

For the same volume of traffic and train-lengths assumed and used in my former reports, I have estimated the variable elements of the working-costs of these lines, making use of more recent data relating to fuel-consumption per locomotive-mile and the effect of rise and fall and curvature on maintenance-costs. In doing this, I have simplified my former methods where possible.

For the gradients of the several lines discussed in this report, full-rated trains arriving at Otira from the west with a single locomotive will reach the summit with the help of one assistant locomotive of the same class. The assistant locomotive is assumed to be detached at the summit and returned light to Otira, one locomotive being sufficient to haul the west-bound trains up the grade from Bealey to the summit.

With the lines of lesser gradients there will be some surplus of motive power by this arrangement; but, with the method of computing motive-power costs used, this will not materially affect the comparisons.

GRADE AND TRAIN-RESISTANCE.

The resistance due to gradient—20 lb. per ton of 2,000 lb. per each per-cent. of grade—is added to the train-resistance, which for the speed assumed of ten miles per hour on maximum grades, or twelve miles per hour on lesser grades, is taken at 6·58 lb. per long ton, as in previous reports, this figure not varying materially between speeds of seven and a half and fifteen miles per hour. For slower speeds the train-resistance increases slightly, and also increases constantly at higher speeds, its minimum occurring at a speed of about twelve miles per hour.

RESISTANCE DUE TO CURVATURE.

Most of the curvature of the several lines occurs between Otira and the summit, but its distribution as between one side of the summit and the other is not given in the data. In order to get a uniform comparison fair to all lines, it is assumed that all of the curve-resistance would take place between Otira and the summit.

The curvature given in Mr. Hay's report is therefore reduced to an equivalent grade on straight track, extending over a distance equal to the percentage of line curved, at the rate of four-one-hundredths of a foot per degree of curve.

For each line and weight of train, Tables II to IX, inclusive, give the length in miles of each rate of grade, the speed used for each grade, the total resistance due to grade, friction, &c., and the total resistance due to curvature, also the total resistance of the west-bound train from Bealey to the summit.