

the extent, in such case, to which temporary structures may be admitted, and it would be impossible to make a fair comparison of the several lines unless the estimates were based on precisely the same standard. Accordingly, it is considered advisable, as has already been stated, to take the standard of the Intercolonial Railway, where solid and permanent works generally prevail. The characteristics of a railway have much to do with its capacity for business, and the cost of maintaining and operating it. The route which will in the highest degree admit of low gradients, easy alignment, and permanently firm road bed, at the least annual outlay, is the one most capable of transporting cheaply. In this respect, there can scarcely be a doubt as to Route No. 2, terminating at Burrard Inlet, being the best."

That was the state of things in 1877. We had an average piece of canyon taken and a location survey made of it, and the cost of that fourteen miles was taken as the average cost of the seventy miles of that class of work of which it formed a part; but we had not materials, as the engineer says, of forming anything like an accurate judgment of the character of the work itself, nor had we any materials to ascertain what the cost would be, so far as it depended on the price of labor. With this imperfect information and taking the cost of labor on the Intercolonial as the standard, he estimates \$35,000,000 as the cost from Yellow Head Pass to Burrard Inlet. But a very great step in advance was taken during the next year, when the report of Mr. Smith, acting Chief Engineer, shows what had been done to ascertain more particularly what the cost would be, as far as that could be ascertained, from the class of the work irrespective of the price of labor. The engineer, in stating on what his estimates of the cost of the British Columbia section, according to the various routes, were based, states:

"The estimates, as stated in the report, 'includes everything deemed necessary to complete the grading of the railway, with solid embankments, iron bridges, and, generally, with durable structures equal in point of character to those on the Intercolonial line.

"Also the cost of ballasting, permanent way, rolling stock, stations, shops, snow sheds and fences, indeed all the supplemental expenses indispensable to the construction and completion of a line similarly equipped and equal in efficiency and permanency to the Intercolonial Railway, and basing the calculations of cost on precisely the same data, the same value of material, and the same average value of skilled and unskilled labor, as obtained on that work."

"There is great probability that these estimates will prove to be too low for the class of work referred to, as the price of labor of all kinds rules much higher on the Pacific slope than on the route of the Intercolonial Railway. The cost, however, can be kept down by using stone and iron only for the larger structures, and culverts under high embankments. There is plenty of timber to be had alongside the line for constructing and renewing the lighter structures when necessary. But, as the increase of cost, if any, would be proportionate on each route, these estimates were believed to present as fair a comparison of the several routes as could be arrived at with the data then obtained.

"These data, however, being imperfect, owing to the loss of plans and profiles of a portion of the route No. 5, in the fire of 1874, which destroyed the Engineers' Offices at Ottawa, it was deemed advisable to have a re-survey made, and during the past season seven parties have been engaged in that work. A very close location survey has been made, and every effort has been employed in the endeavor to reduce the cost of construction to a minimum. By the introduction of a large number of exceptionally sharp curves a considerable quantity of tunnelling and rock excavation has been avoided; further, the line has been carried at points so close to the rivers as to require protection works against floods, while the inclination of the slopes, instead of being $1\frac{1}{2}$ to 1, as on the other routes, has been frequently increased to 1 to 1, in order to reduce the amount of excavation."

With this information, with this too low estimate of the cost of labor, the work was estimated by the Chief Engineer to cost, through the Yellow Head Pass by way of the Fraser and Thompson Rivers to Fort Moody, \$36,500,000, if carried to English Bay it would be \$37,100,000. This is Mr. Smith's estimate, made upon a survey location of the whole line. I gave the data upon which Mr. Fleming based his estimate, and they were obviously very imperfect, but now we have a close location survey, and pretty full information of the details upon which Mr. Smith bases his estimates. Upon page forty-nine of the report of the acting Chief Engineer, he says:

"The gradients on all the three routes may be considered favorable for a mountainous country, the maximum being 1 per 100 or 52.80 feet per mile, with the exception of a portion of the Bute and Dean Inlet routes, in passing through the Cascade Mountains, where the gradients vary from 60 to 110 feet per mile, &c."

But I need not refer at greater length to this portion of the report as those routes are not now in question. The appendix to which I referred contains the report of Mr. Cambie the Engineer in charge of the surveys in British Columbia. He points out that in the case of this particular route, which is designated No. 2, it will be necessary to add the cost of continuing the line to Coal Harbor in Burrard Inlet, a distance of twelve miles, say \$600,000, or to English Bay, fifteen miles, at a cost of \$900,000. The reasons given are that Fort Moody, though a good harbor for its size, is very small, and wholly inadequate for the trans-continental traffic, and, therefore, for the purposes of a through line to carry across the continent the commerce of the east, we must add according as we take the twelve miles or the fifteen miles additional, the sum of \$690,000 or \$900,000 to the cost. The present plan, however, only contemplates the construction of the line to Fort Moody, as a terminal point. So that we may adhere to the estimate of \$36,500,000, which I have already given. Then, Sir, as to the grades which were resorted to in order to get the estimate down to \$36,500,000. There were on the route which we have now in question, a considerable number of low class grades, to which I will not refer at length; but I may say that upon the grades rising east from .70 to .80 there are 33.20 miles, or 6.74 per cent. of the whole; between .80 and 1.00 there are 66.06 miles, or 13.42 per cent., which is the highest grade upon the route. Rising west there are between .60 and .70, 11 miles; between .70 and .80, 8.55 miles; between .80 and 1.00, 27.74 miles. The lengths of the curvatures were found very considerable, the total percentage of curvature being 42.10 upon the whole distance of 493 miles, but that is not all or the chief part. Taking 4° curves as a minimum, we find that of curves over 4° and under 5° there were 36.75 miles, over 5° and under 6° 3.11 miles; over 6° and under 7°, 1.25 miles; over 7° and under 8°, .16 of a mile, giving curves as sharp as 716 feet upon the system of construction proposed so long ago as 1878, producing the estimates as to cost, which I have referred upon a basis as to labor to which I have also referred. Then Sir, we reach the next report—the special report of Mr. Fleming, with reference to the proposed contracts for the central section—the Yale-Kamloops section. In this report which is dated 22nd November 1879, and is based upon the probable cost of the road under the tenders that were submitted to the department and ultimately sanctioned by the House, he says:

"Those who made the surveys and calculations, inform me that the quantities are very full, and that in actual execution they can be largely reduced."

That is a perfectly legitimate subject of reduction without altering the character of the work. He goes on:

"I am convinced, moreover, that by making an extremely careful study of final location, by sharpening the curvature in some places, by generally adjusting the alignment to the sinuosities, and sudden and great inequality of the ground, by substituting the cheaper classes of work for the more costly, whenever it can be done, and by doing no work whatever that is not absolutely necessary, a very marked reduction can be made."

I read this because it gives us, as I say, two modes upon which a further saving beyond that which the engineer contemplated: first, "that the quantities are very full," and, secondly, by a modification of design which, altering so seriously the character of the work, would alter very seriously the cost to the country of the work. This is to be done by "sharpening the curvature," "by using great judgment in adjusting the alignment to the sinuosities and sudden and great inequalities of ground," "by substituting the cheaper classes of work for the more costly" and by "doing no work whatever that is not absolutely necessary." On the 22nd of November, 1879, these were the suggestions of the Chief Engineer to the hon. Minister, accompanying his report, recommending the letting of those contracts. That is the last stage of the year 1879, and now