



On the particular line in question, it was decided, by the time the different preliminary lines were nearly connected, that a 0.5% grade was possible for the whole length of the line, and instructions were given to make this the ruling grade on the final location.

Instructions were given the locating engineers to spend all the time necessary on investigations, to be sure they had the best line through the country traversed before putting in the location, on the ground. The writer recalls one stretch of line, about 16 miles in length, where he spent nearly three weeks, running more than 80 miles of preliminaries, besides the original preliminary and projected location, before the final line was decided on. A second projected location saved a mile of distance over the first, besides eliminating much curvature and rise and fall, and, but for the very positive instructions received to exhaust every possibility, and the receipt, about this time, of a letter from the Principal Assistant Engineer, who knew the difficult nature of the country, reiterating his caution, this line would have been run in. Other lines were run, the final location effecting a saving of more than \$30 000 in estimated cost of construction, and eliminating many degrees of curvature and more rise and fall.

It seems hardly possible, in view of this, which is only one case out of thousands, that anyone contemplating the construction of a railroad should hesitate to spend sufficient money on surveys, but all engineers of any extended experience know how difficult it often is to get either sufficient time or money to do this work thoroughly; and, as a result, how very much more the cost of the needless construction is likely to be than that of the surveys. Still, the writer believes it is often the fault of engineers in charge of work that this is so. Men now-a-days investing their money in any project of merit are as a rule level-headed business men who would be willing to furnish all the money necessary for proper surveys, if the matter were presented to them in the proper light.

As the final located line was run in, it was inked in on the 400-ft. map, radii of curves were drawn, stations of P. C. and P. T. marked, and calculated courses of tangents from observations of Polaris, length of tangents, the degree of curve, central angle, and the length of semi-tangents noted at each curve; drainage areas, as definitely determined by the topographer, were dotted in, and areas noted; as were also property lines and owners' names, thus making the map a complete record (see Plate XIII).