COMPLETION OF A TRANSCONTINENTAL LINE OF PRECISE LEVELS.

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THE driving of the last spike in a transcontinental line of railway has usually been marked by some sort of ceremony on the part of the builders. No formalities took place, however, in connection with the last "shot" on the Geodetic Survey's first complete line of precise levels from the Atlantic to the Pacific. This was taken at Port Arthur, Ont., on October 17th last and closed a gap of about 300 miles which had existed at the beginning of the season; a similar gap of about the same length had been closed only a few days before in British Columbia. The finishing of the above links gives an unbroken line from the automatic tide gauge at Halifax to the automatic tide gauge at Vancouver.

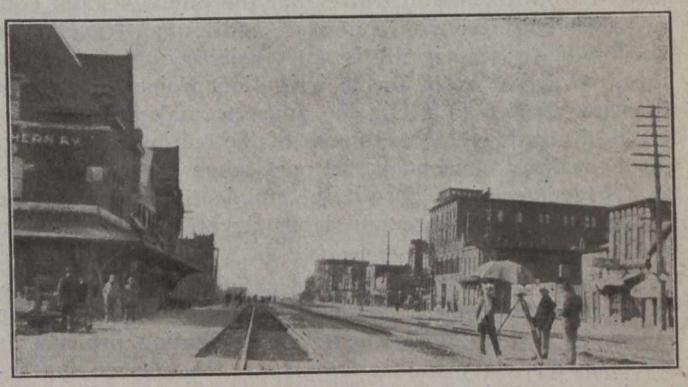
Doubtless the first question to arise in the reader's mind will be as to the agreement obtained between the instrumental levels and mean sea level at the respective coasts. This enquiry cannot be answered offhand for the reason that for about 40 per cent. of the distance two or more lines of levelling have been completed, and circuits have thus been formed which give different elevations to the junction points, depending upon which route is used. Some fifteen circuits occur directly along the transcontinental line, not counting a number of others lying at a greater or less distance from it.

The system of levels is not sufficiently advanced to justify making an adjustment to determine the most probable elevations by utilizing the various circuits; it has, therefore, been deemed the fairest way to carry the elevations along from coast to coast by using the shortest route in every case where there is a choice of routes. The shortest line may in some cases be the first one levelled and in other cases the last. This, however, is not a matter of importance, as the same methods have been followed throughout the work, and consequently the same "weight" may be assigned to all the levelling. In this respect the work of the Geodetic Survey of Canada, having all been done within comparatively recent years, differs from some of the other countries in which the geodetic levelling is composed of work done by methods differing one from another.

Starting with an elevation of zero for mean sea level at Halifax as determined by the officials of the Tidal and Current Survey, Department of the Naval Service, and carrying along the elevations continuously by the most direct route, the level of the Pacific ocean at Vancouver is found to be 1.17 feet. Supposing mean sea level to be the same on the two coasts, this difference may be set down to errors in the levelling. Since some 60 per cent. of the line has not been duplicated by a second line it may be that additional levelling will disclose errors that will increase this amount, or, on the other hand, will reduce it. However, as all levelling has been done twice (independently forward and backward), and, as a number of checks have been obtained by means of water transfers on the Great Lakes and by connections at several points with the levels of the United States Coast and Geodetic Survey, it seems reasonable to assume that there will not be any very large change.

An article by the writer in *The Canadian Engineer* of April 20th and 27th, 1916, described in detail the territory covered, the datum planes used, and the methods employed by the Geodetic Survey in the extension of precise levelling. The fact was brought out that the levelling had been based upon three intermediate points besides the two coastal stations—Halifax and Vancouver—two of these points having been determined by the United States Survey. Publications have been issued by us each year for several years past giving the direct instrumental elevations along the lines in all five districts. It may be noted that the greatest difference at any bench-mark between the published elevation and the new "short-line" elevation is no greater than the above-mentioned closing error of 1.17 feet.

A word as to the route followed by this line, which, with the exception of two or three short jumps across country, lies along the railways for its whole distance. Starting at Halifax, the route of the Dominion Atlantic Railway is followed to Truro, thence the Canadian Government railways through Moncton and Edmundston,



Last Sight Being Taken at Port Arthur, October 17th, 1916.

N.G., and to a point about 95 miles west. From here we go across country to St. Philippe-de-Neri, Que., on the Intercolonial, and follow this and the Grand Trunk through Levis and Richmond to St. Hyacinthe. A combination of C.P.R. and G.T.R. lines then carries us along—south of Montreal and Ottawa—through Farnham, St. Johns, Lacolle and Coteau, Que., and Smith's Falls, Ont., till we reach Arnprior. The route is then by G.T.R. to Parry Sound, Ont., C.P.R. to Sault Ste. Marie and Algoma Central Railway to Franz—the junction with the C.P.R. main line. The latter is then followed to Port Arthur and the C.N.R. to Emerson, Man. From this point we go across country a few miles to Gretna, Man., and then follow the C.P.R. to Kamloops, B.C., the line chosen passing through Estevan, Moose Jaw, Lethbridge and Calgary. From Kamloops the C.N.R. is followed to within a short distance of Vancouver and the balance of the line lies along the Great Northern Railway.

The length of the route selected is a little over 4,000 miles, all of which lies in Canada with the exception of about 44 miles, for which distance the C.N.R. between Port Arthur and Emerson passes through the State of Minnesota.

Publications giving precise elevations of bench-marks, etc., on many of the above and other lines are available for distribution for the asking.

The combined population of the municipalities now served by the Ontario-Hydro Electric Commission through the medium of its various systems is 1,137,795.