The Lethbridge Viaduct

The Longest and Highest Bridge in the World

By W. McD. Tait.

STRETCHING across the Continent of America from the Atlantic to the Pacific, curving around the rocky shores of Lake Superior, crossing the prairies of the last great west, and climbing or tunneling the crest of the continent in the Rockies and Selkirks, lies the narrow steel pathway of the Canadian Pacific Railway. As you loll back in a luxurious arm chair of the observation car of a transcontinental train, after having been served with tea, perhaps in the same manner that you would be served in your own home or at your favorite club, you do not realize and even little care about the enormous cost of the road of steel over which you are speeding. Your chief thought, if you have one regarding the railway, is that the track is smooth and the streams and gorges safely bridged.

Before this great railway constructed a viaduct across the Belly River at Lethbridge in Southern Alberta, the westbound train on the Crow's Nest Branch, zigzagging across sloughs, wiggling link by link like a measuring worm around deep-cut ravines, crawled across twenty wooden bridges in the St. Mary's river bottom ere it reached the Blood Reserve of the Blackfeet Indians. The traveller, peering through the coach window at the browned hills to the north and heaving sea of prairie to the south, feels that civilization is receding farther and farther rearward, and that the fenceless fields of the last west have been reached. An owl flops up from a knoll by the roadside, and buzzards and eagles are lilting overhead in a sort of dreary enjoyment of desolation. A lone coyote is retreating beyond the hills, and equines of nondescript breeding, with patches of white and brown for coloring, are feeding at intervals on the prairie grass. Indian encampments, with blanketed braves and red-skirted squaws lounging against the white tepees, only increased the impression of utter primitiveness.

Yet, this is the environment of one of the wonders of the world. It is here that the Canadian Pacific Railway has constructed a bridge, the combined dimensions of which make it the greatest in the world.

Up till 1894, Lethbridge City was the western terminus of a narrow gauge railway between that city and Dunmore Junction on the main Canadian Pacific Railway line near Medicine Hat. This narrow gauge road, owned by the Alberta Railway and Coal Company, was taken over by the Canadian Pacific Railway and standardized when the Crow's Nest Branch was built by them during 1897 and 1898. This line connects Medicine Hat, "the Gas City," with Kootenai Landing on the south end of Kootenai Lake in British Columbia, and parallels the main line about 100 miles south of it.

On the line constructed in 1897 and 1898, Lethbridge City was reached by a spur track of 1½ miles, making the total distance from Lethbridge to Macleod, the junction with the Calgary and Edmonton branch, 38½ miles. This line had curves as sharp as 7 degrees (819 feet radius) and an actual grade of 1 per cent (52.8 feet per mile). Only two streams were crossed, but on low levels, requiring 18 other tressels and bridges across the mouth of coulees and ravines which were tributary to the main gorge. The aggregate length of these bridges was 12,063 feet or 2.8 miles, and the lumber required for their construction measured 15,000,000 feet board measure. One of them was 2,933 feet long and a number were over 100 feet high. The earth work was heavy and, during the spring and high-water season, required constant watching.

If this line were to be maintained, these bridges would require to have been rebuilt at an estimated cost of $1,065,000. In consideration of these circumstances, the rapid increase in traffic, and the fact that the original charter of the Crow's Nest branch required the construction of a line from Lethbridge City, it was decided to have surveys made to ascertain if it would be possible to secure a straighter line with lower grades between this city and Macleod. Extensive surveys were made and finally a suitable one was located approximately 31¾ miles long, with a grade of 0.4 per cent. On this line were two heavy high-level crossings, the greater of which was over the Belly river, and required a viaduct 5,327 or 1 mile and 47 feet long and 307 feet high. This gave a virtual maximum grade of four-tenths of 1 per cent or 21.12 feet per mile and a curvature of 3 degrees, or 1,910 feet radius.

The saving affected by the new location as compared with the old was as follows: 5.26 miles of line, 1,735 degrees of curvature, eliminating 37 curves and 401 feet less rise and fall, thereby securing a 0.4 grade. On the supposition of an increase of 20 per cent in traffic above the preceding year, these changes so reduced the cost of operating trains as to pay interest at the rate of 4 per cent on an investment of $3,625,000. If to this amount here is added the cost of replacing old bridges with permanent structures, viz., $1,065,000, a total of $4,690,000 would be obtained. This amount represents the capital expenditure which would be justified, while the estimated cost of the change of line was $2,048,700.

The new bridge was designed by C. N. Monsarrat, now chairman of the board of engineers for the Quebec Bridge. There are four great types of bridges: Swing, for low level crossing of streams, which must be cleared periodically for navigation; cantilever, where a stream must be crossed, and it is impossible to use false-work or temporary wooden scaffolding during erection of steel; suspension, for gorges upon whose sides heavy cables can be anchored and the bridge hung on these; deck lattice or plate girder, where it is possible, to construct piers to support the steel. Of these types the design chosen for the Lethbridge Viaduct was a plate girder carried on rigidly braced, riveted, steel towers. This type was selected because, considering the great height of the structure and the difficulty of erecting false-work owing to prevailing high winds in Southern Alberta, it could be erected more easily.

Many difficulties were encountered in the erection of the foundations of concrete. Extreme floods in the spring and early summer of construction caused the water in the Belly river to rise a foot higher than ever before in the experience of men of Alberta. This flood submerged the coffer dams, deposited enough silt to fill them, and carried away some of the contractor's plant.

One of the unique machines used on this bridge was an erection traveller, built entirely of steel, and capable of lifting to position pieces of 10 tons weight. To provide for the safety and convenience of workmen, assembling cages were used one on either side of the bridge. For the purpose of signalling to the various engines on the main traveller, a system of telephones was installed, with a telephone booth placed in the middle of the assembling cage. Each engine operator wore a headpiece holding a receiver and mouth-piece. This method of signalling proved very efficient, the operator in the booth being very close to the workmen engaged in the erecting and in a position to watch all the tackles used for the raising of tower material. Riveting hammers driven by compressed air were used throughout the work and approximately 328,000 field rivets were driven in the structure.

Actual work on the steel took just 300 working days, but during the winter of erection a strike among the men was responsible for the loss of two weeks. In one month 2,300 tons of steel was set in place of 735 lineal feet of structure completed. This constituted a record for rapid work in the construction of steel. No accident of any import to the machinery occurred during all the period of construction. On one occasion one of the