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NEXT ANNUAL MEETING at Montreal, Oct. 16, 1900.

planted by more substantial steel. Some tunnel work was required on this part of the line. No difficulty has been experienced with that through rock, but morainic material & clay were encountered in several instances, & gave endless trouble, owing to the expansion of the loose masses. In one case the tunnel caved in entirely, & it became necessary to cross the river twice or to construct a curve of exceedingly short radius to pass around it. The latter plan was chosen, & a curve of 23° was constructed. At first, in order to pass this curve, all the cars were uncoupled & fastened together with short chains, but after a slight adjustment this has been rendered unnecessary.

In these narrow canyons, occupied almost entirely by rivers, freshets are of constant occurrence, & often do great damage. Contrary to what we are accustomed to in the East, sudden rises in water are not often the result of heavy rainstorms. While, of course, these have some effect, yet the porous character of the soil absorbs a large part of this water. The rapid melting of the snow-fields & ice masses caused by a spell of warm, moist weather is almost entirely responsible for these freshets, which, on this account, may occur at any period of the summer months, & may last for days, or perhaps weeks. The melting caused by the heat of an ordinary day is sufficient to change a brooklet to a raging torrent, while the effect on a river of larger proportions is much more marked. These rapid changes in the height of water have required a much more permanent construction of embankments than would otherwise appear necessary, & in this & other canyons the river has been controlled by walls of solid masonry, on which the tracks are laid, thus insuring against accident even during the most severe disturbances.

At Golden the railway suddenly emerges from the narrow canyon of the Lower Kicking Horse into the broad, level valley of the Columbia River. Here the mountain ranges are on either side—the Rockies on the right & the Selkirks on the left. At this point the course of the Columbia River is a little west of north, until, finding a pass through the Selkirk range, it completely reverses its direction & flows south to the international boundary. By following the river an easy grade could have been obtained for the railway, but the cost of tunnelling & bridging would have been very great. It was, therefore, decided to shorten the distance some 80 miles—or about one-third—by cutting directly across the Selkirk range to the Columbia River beyond. The passes through this range were entirely unknown until the explorations of the engineers in laying out the line of the railway. The Indians, owing to some superstitious belief, would not enter the mountains, & prior to 1883, when Major A. B. Rogers discovered the pass that now bears his name, the foot of man had seldom crossed their slopes. After following the level valley of the Columbia for a number of miles the railway crosses the river on a fine bridge, & as the valley rapidly narrows, clings to the side far above the water. At Beaver Mouth, which, as its name indicates, is situated at the point where the Beaver joins the Columbia, the latter river is left on the right, still flowing in a northerly direction, & the winding course of the Beaver is followed. Extensive sawmills are situated at this point, until recently driven by water-power from a stream on the side of the foot-hills led down in a flume & carried directly under the railway by a great inverted siphon. Now steam has exerted itself, & the flume, once quite the wonder of the traveller, is rapidly going to decay. After leaving Beaver Mouth the canyon becomes very narrow, & at places the stream is spanned by a single log thrown across from bank to bank.

The difficulties in crossing the Selkirk range lay not so much in the steepness of the grades, which do not exceed 2.2%, or in the cost of actual construction, as in the precautions it was necessary to take against the immense snowfall & terrible avalanches. The average yearly snowfall between 1895 & 1898 was 31 ft., while in the winter of 1898-99 the recorded fall was 43 ft. 8½ in. These amounts were obtained after careful measurements on the platform at Glacier House, & there is no doubt as to their accuracy. The fall from October, 1898, to May, 1899, in totals for each month, is as follows:

1898.				
October			10	inches.
November	8	feet	4½	"
December	6	"	6	"
1899.				
January	9	"	2	"
February	6	"	9	"
March	6	"	2	"
April	3	"	7	"
May	2	"	4	"
Total fall	43	feet	8½	inches.

By the aid of rotary snow-plows any depth of snow that has fallen directly from the sky & is not intermingled with rocks, mud & tree-trunks may be dug out & thrown to a considerable distance from the track. Points that are not liable to be covered with avalanches are thus left unprotected, & there is seldom serious difficulty in keeping the road open, even during the most severe storms. Where many rocks or trees are mingled with the snow, or where the snow has been compacted to ice, the problem is a much more serious one, & great labor is involved in blasting out the confused mass & clearing it away by hand. (See figure 4, pg. 263.)

The immense banks of snow that are formed on the mountain-sides frequently slip from their insecure positions & go thundering to the valley below, carrying with them masses of rocks, trees & earth. These snow avalanches & those composed of wet mud & stones are most dreaded by the railway company, & it has been in an endeavor to reduce their power of destruction that costly structures in the form of snow-sheds & bridges have been erected.

Wood was used almost exclusively in the first construction of the division crossing the mountains. Timber was abundant, & in this way the road was opened for traffic many months before it would otherwise have been possible. No provision was at first made for protection from snow, but during the winter of 1885-86 a corps of engineers was kept constantly on the ground observing where the worst slides took place, & how structures should be built to withstand them. During the following summer 35 sheds were constructed at the summits of the Selkirk & Gold ranges, but the winter of 1886-87 being unusually severe, they were increased the next summer to 53, with a total length of over 6 miles. This mileage has been added to slightly from time to time as occasion arose.

The sheds, as constructed, are of two principal types, according to the severity of the avalanches to be withstood by them & the position in which they occur. To protect the track from the ordinary snowfall only, the "level fall shed," a comparatively light structure, meets all requirements; but on the steep slopes of the mountains immense cribwork & deflectors are necessary. The latter are of two principal types: those that must withstand avalanches from one side only, & those that may be attacked from both. (See figure