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

Creek summit at mile 30.2. This is the highest
elevation attained by the railway. From mile
30.2 to mile 30.4 is level. At mile 30.4 a con-
tinuous downward grade to the Kettle River
commences. From 30.4 to 32.6 the maximum
downward grade, compensated for curvature,
is 1.8 per 100. From 32.6 to Kettle River at
mile 53.2, the downward grade, compensated
for curvature, is uniformly 2.2 per 100. From
mile 53.2 to mile 53.6 the grade rises at the
rate of 0.26 per 100. From mile 53.6 to Cas-
cade City at mile 55, the grade, compensated
for curvature, rises uniformly at the rate of
2.2 per 100. From mile 55 to mile 59.3 grades
undulate, the maximum being 0.5 per 100.
From mile 59.3 to Grand Forks at mile 67.2,
grades undulate, the maximum being 1.5 per
100. All grades over 1.5 per 100 are com-
pensated for curvature at the rate of 4 one-hun-
dredths of a foot in each 100 ft. for each de-
gree of curvature, that is to say, that in a 14-
degree curve, having a tangential grade of
2.2 per 100, the grade on the curve is reduced
56 one-hundredths of a foot, which subtracted
from the original grade of 2.2 per 100, leaves
1.66 per 100 as the compensated grade on the
curve. The total rise of the railway from
West Robson to McRae Creek summit is 2,-
590 ft., the total fall from McRae Creek sum-
mit to Kettle River is 2,440 ft., & the total
rise from Kettle River to Grand Forks is 136
ft.

All embankments at formation level are 14
ft. in width, with side slopes of 1½ to 1 in
earth, sand & gravel, & 1 to 1 in loose rock.
On side-hill these slopes reach the flats below
in most cases. In a few instances, however,
the vertical nature of the side-hill has rendered
it necessary to retain embankments by crib-
work or dry stone walls. The toes of all em-
bankments are well above the high-water
mark of the waters adjacent to them, except
at miles 56 & 57, where well-executed rip-rap
has been added as a protection.

All excavations are 18 ft. wide at formation
level with side slopes in earth & sand of 1 to
1, & in rock of ¼ to 1. In hard-pan cuts the
slopes have been executed to suit the stability
of the material. All excavations have been
excellently made & present a thoroughly fin-
ished appearance, except where ballasting
material has been borrowed.

There are two places only at which timber
crib-work has been erected for the purpose of
retaining embankments. The rock in the im-
mediate vicinity is decayed, & this is the rea-
son given for their construction. They occur
at mile 47 & are of excellent design. They
are each 60 ft. long & from 12 to 15 ft. high.
The plan of these structures shows inside &
outside batter of walls to be ¼ to 1. Each
crib is 7 by 7 ft. inside horizontal measure-
ment, & consists of 12 in. round logs dove-
tailed & box-jointed, & secured with tree-nails
2 in. diam. & 20 ins. long, & with wrought
iron drift-bolts ¾ in. diam. & 22 ins. long.
Each drift-bolt penetrates through one log &
at least 6 ins. into the log below.

Rock slopes occur on the steep side-hills of
Arrow Lake, Bull-Dog Creek, McRae Creek,
& Christina Lake. There are 29 in all, vary-
ing from 30 to 270 ft. in length, & from 10 to
40 ft. in height. Combined they cover a total
length of 2,640 ft. The rear wall is vertical,
& the front wall batters at the rate of 1 in 3.
The top of the wall is 3 ft. wide. The filling
behind the wall is broken rock. In all cases
the foundations are on solid rock. The stones

comprising the walls are of large size & are
roughly shaped into rectangular blocks; a
very solid & permanent dry rock wall has thus
been obtained.

Excellent provision for the passage of
streams & surface drainage across the track
has been made by means of log culverts, bal-
last boxes, rock & log drains. The total
number of log culverts is 156. They are of
the usual log culvert pattern, having solid
cedar or fir walls & covering, secured by
tree-nails & drift-bolts, the whole resting on
round sills in pairs from 5 to 8 ft. apart, the
spaces between the sills being filled flush with
broken rock. The workmanship on these
structures is excellent. Rock drains, log
drains, & ballast boxes are of the usual de-
sign.

The road-bed from West Robson to Grand
Forks has been three-quarters ballasted with
material either hauled considerable distances
or borrowed from the faces of adjacent ex-
cavations & embankments. For a new railway
the ballasting so far done is very much super-
ior to, & greatly in excess of, that usually
found. Much more, however, will require to
be done to place the road-bed in standard
condition. The hauled ballast is excellent,
being either coarse gravel or broken rock,
but the greater portion of that obtained from
slope faces is not ballast but merely earth
filling.

There are five tunnels. All have been care-
fully pierced, & present unusually uniform sur-
faces. The design & specified dimensions
have been closely adhered to, & are as fol-
lows: width at formation level & at spring of
roof, 16 ft.; clear centre height above forma-
tion level, 23 ft. 2¼ ins.; & above rail level,
21 ft. 6 ins., ballast being 9 ins. deep. The
nature of the rock through which the tunnels
pass is granitic, & is of such solidity that but
little timbering, 200 ft. in all, has been re-
quired. On curves from 8 to 14 degrees, the
centre lines of the tunnels have been placed 7
ins. off the centre line of the road-bed; on 6
degree curves, 5 ins.; & on 4 degree curves,
3 ins. Following is a list of tunnels:

Mile	ft.	from portal to portal.
12	187	"
15	291	"
22	3,004	"
36	329	"

Combined these tunnels cover a total dis-
tance of 4,004 ft.

No safety switchbacks have as yet been con-
structed. In a railway having so many miles
of grades exceeding 2 per 100, safety switch-
backs are a necessity & should be built with-
out delay. Owing to the length of time re-
quired to construct the long tunnel at mile 22,
& the desire of the railway company to open
the railway for traffic, a temporary switchback
was constructed over the mountain at that
point. It consisted of 10 switches, 5 on the
east slope & 5 on the west slope. The total
rise from the east portal of the tunnel was 507
ft., & from the west portal 403 ft. The grade
both ascending & descending was uniformly
4 per 100, & curves varied up to 22 degrees.
The total length of the switchback from main
line to main line was 5.12 miles, & the time
occupied in traversing it by trains was one
hour. The steep grade, & the temporary
character of the work, necessitated extreme
care on the part of the officials operating it.

From West Robson to mile 5.4 & from mile
50.5 to mile 67 at Grand Forks there are no
trestles. Between miles 5.4 & 50.5 trestles
have been constructed to a most unusual ex-
tent. The location of the line in this respect
has been made with an undue regard to econ-
omy, & should the railway become a trunk
line many of these structures must be elimin-
ated. Every trestle is an element of danger,
& the only excuse in the present instance is
the immense cost of obtaining a more solid
road-bed by throwing the alignment further
into the side hill. There are in all 49 timber
trestles, covering a distance of 13,140 ft. or 5¼