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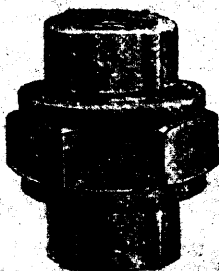
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THE CANADIAN PACIFIC RAILWAY. From Laggan to Revelstoke, British Columbia.

By William S. Vaux, Junr.

It is to one of the most difficult sections on the road to construct & maintain, lying between Laggan & Revelstoke in B.C., & embracing a mileage of but 147 miles, that I wish to draw your attention in this paper, & to explain some of the features of operation which must appeal to every traveller over the line.

The Rocky Mountain system, as it stretches northward, converges & contracts, until in B.C. it exceeds but little a breadth of 500 miles, being composed of four principal ranges — the Rocky, the Selkirk, the Gold & the Coast. In the construction of the railway it became necessary to cross all four of these

agreement permitting the construction of the road.

While the actual summit is at Stephen, the nominal one is at Laggan, a divisional point on the railway. Here engines are changed, & the whole train is given a thorough inspection before descending the steep grade of the Kicking Horse Pass. Once over the summit, there is a short space of comparative level, and then the increased grade of 4.4% is reached, down which the train is allowed to move at a very slow rate. Brakemen are stationed at ever platform, & it is amusing to see them at times jump from the cars & run alongside to watch the working of the brakes. Engines specially designed for the heavy grades are used between Field & Hector, & it is not at all uncommon for four of these to be required to take the east-bound express to the summit of the pass. This particular part of the road, nine miles in length, was constructed as a "temporary line" of much steeper grade than

scrapers. Some extracts from the record of the watchman at Hector Station may be of interest as giving an idea of the amount of snow expected during the winter months. While snow sometimes falls in every month in the year, the records usually begin about the first of November & end the middle of March, the average for this period for the past five years being 27 ft. 4 ins. On Aug. 15, 1890, during a heavy snowstorm that extended over this entire region, 12 ins. of snow fell at Hector. During the winter of 1897-98 the snowfall was 41 ft., while in 1898-99 but 23 ft. fell. It is an interesting fact that when the fall in the Rockies is heavy, the fall in the Selkirks is often light, & vice versa. The amount of snow that may fall in a very short time is sometimes almost incredible, & it is not unknown for 100 ins. to be recorded in two weeks, while in a single week 57 ins. have been observed. (See figure 3, page 261.)

Field, at the foot of the pass, is situated by

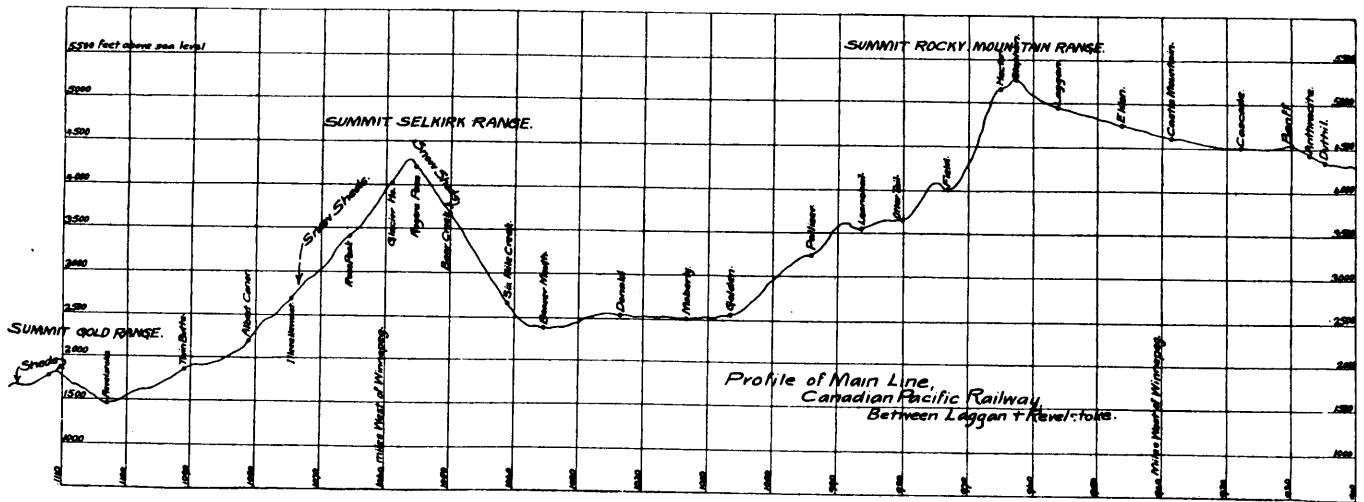


FIGURE 1.—PROFILE OF CANADIAN PACIFIC RAILWAY, BETWEEN LAGGAN AND REVELSTOKE, BRITISH COLUMBIA.

ranges. The canyon of the Fraser River where it crosses the Coast Range being used by the railway, a high pass was not necessary at that point, but the other ranges, being greater in altitude & more continuous, required heavy grades & passes in valleys several thousand feet above sea level. A number of routes were surveyed, it being desired to keep at least 100 miles from the International Boundary, & as far south as possible, in order to avoid the severe winters of the far north, & at no place to exceed a grade of 1%. After crossing a wide expanse of prairie the eastern slope of the Rocky Mountain range is ascended without difficulty through the comparatively level valley of the Bow River, almost to its source. The height of land is reached in a narrow valley, 5,296 ft. above sea level, on each side of which great snow-capped mountains stand as sentinels. At no point does the grade exceed 1%, the limit prescribed by the Government in its

that allowed by the Government. The contract route lies upon the almost perpendicular sides of Mt. Stephen to the left, & would involve extensive tunnelling, as well as passing directly beneath the forefoot of a glacier on this stupendous mountain, from which at times great masses of ice fall to the valley below. At intervals on the grade are located blind sidings running up the mountain-side at a steep grade. The switches of these sidings are tended by watchmen, who, on the signal of the engineer, throw the switches & allow the train to pass, when they are again opened. By this means a runaway car would be diverted from the main track before it had gone a sufficient distance to do serious damage.

The snowfall in this pass is heavy, but does not give the trouble experienced in the Selkirk range to the west. One reason for this is the absence of snow-slides across the track, & while the falls at times are very heavy, they can be readily handled by the plows &

the side of the Kicking Horse River, which is here a broad, muddy stream occupying but a fraction of its bed. The pass & river, like many other localities of the neighborhood, take their name from a peculiar incident. When Dr. James Hector, a member of the Palliser expedition, traversed the pass in 1858, he was so unfortunate as to be kicked in the chest by his riding horse while trying to catch a pack animal that had escaped. Being partly disabled, the party was obliged to camp for a number of days to await his recovery, & Kicking Horse was adopted as the name of the river & pass where the accident occurred.

After leaving Field several small ascents are encountered, but the general grade is downward until the lower canyon of the Kicking Horse is reached. Hemmed in on both sides by very steep rocky sides, there often is little room left for the railway beside the river, & it is forced to cross & recross on wooden Howe truss bridges, which will soon be sup-

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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 foothills 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.		to inches.	
October	.....	8 feet	4½ "
November	.....	6 "	6 "
December	.....	6 "	6 "
1899.			
January	.....	9 "	2 "
February	.....	6 "	2 "
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

5, pg. 265.) An avalanche does not stop at the bottom of the valley, but often sweeps up the opposite side, doing double damage because coming from a direction least expected. The sheds must accordingly in many instances be made of sufficient strength to withstand avalanches from either direction. Cases are on record where laborers on the tracks have been killed by not heeding an avalanche on the opposite side of the valley, which they supposed was too far below them to be dangerous.

The avalanche itself is not the only destructive agent in these regions. Currents of air are set up by the swift downward motion of the mass, & often do great damage, as they extend over a wide area & have immense power. They are called "snow flurries," & at times have sufficient power to twist off the trunks of full-grown trees, perhaps 50 ft. from the ground, leaving only the stumps standing. After the passage of a "snow flurry" the leaves are burned brown, as though subjected to great heat.

In the construction of the snow-sheds the strongest materials were used, & these were found close at hand in the forests. Cedar timbers, mostly 12 x 12 ins., formed the cribwork, but Douglas fir (Oregon pine) was employed in members subjected to severe transverse strains. The bents, usually spaced about five ft. centers, were built up of 12x15 in. timbers, securely braced & drift bolted together. Above the shed the ground is cleaned & leveled, with the object of giving the avalanche an upward motion, thus tending to shoot across the track. An idea may be gotten of the immense power of these avalanches from the fact that comparatively new sheds have been entirely demolished during the breaking up of an unusually severe winter.

In order to guard against destruction by fire systematic measures have been adopted. Where it is necessary to protect a long piece of track from avalanches, the sheds are divided into several short sections, with open spaces of about 200 ft. between them. These open spaces are protected by heavy V-shaped fences of cribwork placed above. (See figures 5 & 6.)

An avalanche striking one of these fences is deflected to the right & left upon the sections of the shed, & so passes, without doing harm, to the valley below. The open spaces also allow the sheds to clear of smoke very rapidly, which in winter, when all the small openings are filled with snow, would otherwise require hours. A complete system of sluices & piping leads water from the streams above to the tops of the sheds, & in case of the occurrence of fire, the watchman, who is always on duty, will be able to control it promptly. In many cases a temporary

track is laid beside the shed, which is used in summer, thus greatly reducing the fire risk, & allowing the passengers to see to better advantage some of the finest scenery.

ravines are crossed, which at first were spanned by wooden trestles, these now being replaced by more permanent structures. The largest of these crosses Stony Creek. It was originally built of continuous

Howe trusses, having spans of 33, 161, 172 & 86 ft. respectively, & supported on wooden trestle towers 200 ft. high, resting on concrete footings. While still in good condition in 1893, it was decided to replace it with steel, a continuous arch of 336 ft. span & 300 ft. above the chasm being completed just before a destructive forest fire swept over the region. (See figure 7, pg. 269.) Several other bridges have been reconstructed in a most substantial way, one of the principal factors in the design being to allow the avalanches of mud & snow to pass safely beneath them. In the old wooden bridges, a few examples of which still remain, the "flurry" caused by the slide passing beneath was withstood by heavy rods of iron anchored to "dead men" on the upper side of the valley. Cribwork to the right & left deflected the side so that it passed between the supports instead of carrying them with it. But even with the most substantial construction & care in design it has not been possible to save some of the bridges from total destruction. The structure spanning Cascade Creek was swept away six times before it was replaced by a single arch of masonry, which, it is expected, will withstand all attacks. It is an interesting fact that this entire stream emerges from the ground a few hundred feet above the line of the railway.

While in many cases it was possible to span the courses of streams by bridges, a number were of such width that long trestlework became necessary. The problem of reconstructing these was a very serious one, owing to the cost of labor & the difficulty of moving material on the steep grades. At certain points, however, it was only possible slowly to fill in an embankment from cars loaded with gravel obtained from cuttings. This method is being pursued in the case of the trestlework at The Loop, where many hundreds of thousands of yards will be required. The operation is necessarily slow, & its completion may not be expected for many years to come.

A much more expeditious & satisfactory method, & at the same time one which costs but about one-half of the dumping method, has been employed in two or three cases where abundant water-power was at hand, & also immense banks of gravel or morainic material. Reversing the methods followed by the goldwashers of California, water was brought down from the streams above under great pressure, & with it the gravel & boulders were washed into large sluices, which carried them to the points where the filling was

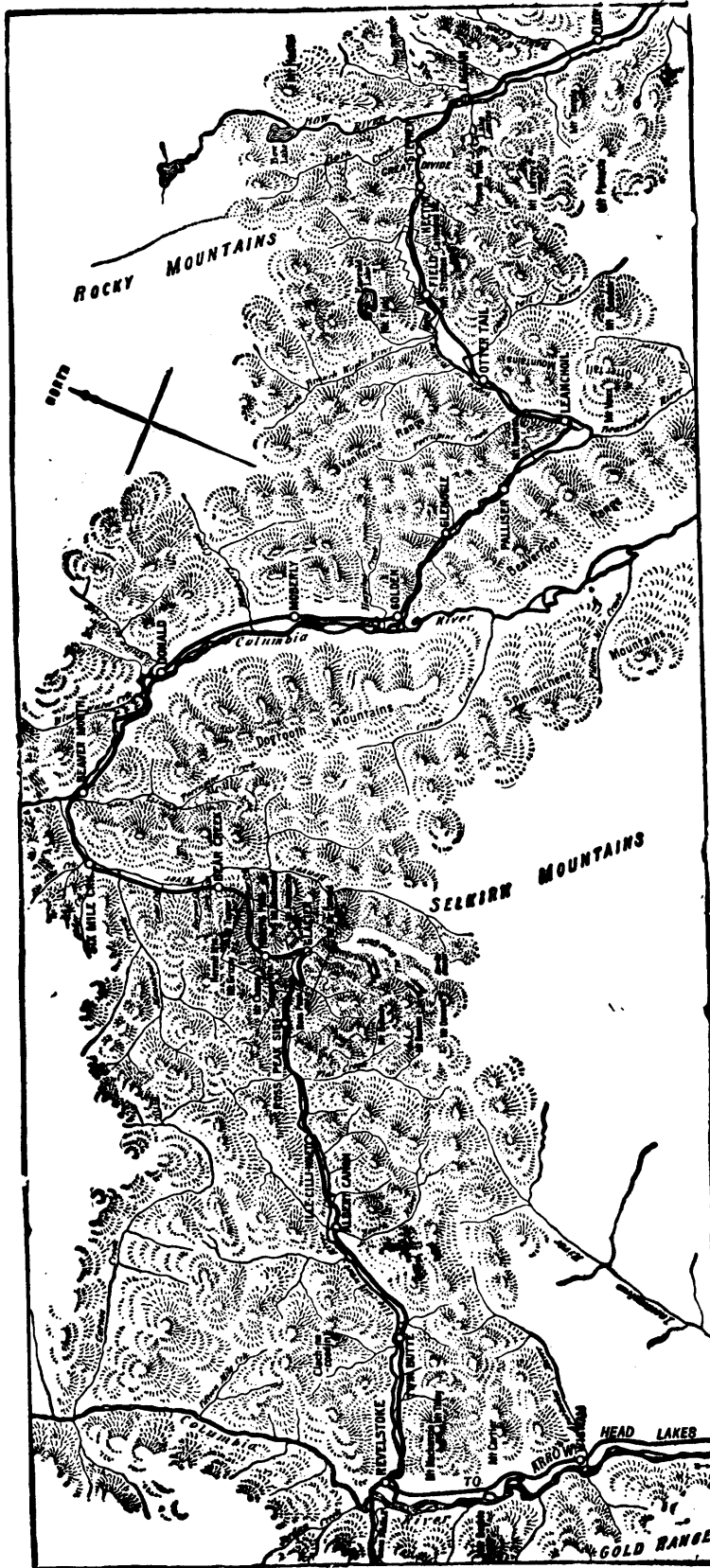


FIGURE 2.—MAP OF THE C.P.R. BETWEEN LAGGAN AND REVELSTOKE, B.C.

Where avalanches cannot be made to pass over the track, bridges are provided, so that they may go beneath them. On the east slope of the Rogers Pass grade several great

down from the streams above under great pressure, & with it the gravel & boulders were washed into large sluices, which carried them to the points where the filling was

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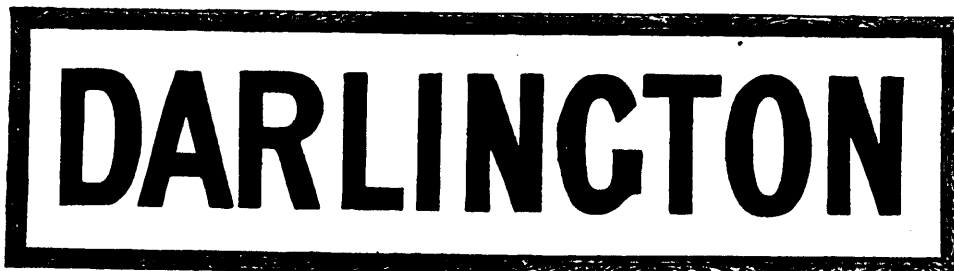
Mr. H. P. Timmerman, General Superintendent of the Atlantic Division of the Canadian Pacific Ry., writes,—“The enameled iron station names supplied by the Acton Burrows Co., in 1898, for a number of stations on this division, have proved very satisfactory. The letters are well formed & distinct, & the signs present a clean, bright appearance, being just as good now as when they were new.”



Style no. 2, as used on the Grand Trunk Ry. System. Black letters on white ground. This sign is 14 ins. high by 7 ft. long. Length varies with number of letters in name of station.



Style no. 3, as used on the Pennsylvania Railroad. White letters on black ground. This sign is 12 ins. high by 6 ft. long. Length varies with number of letters in name of station.



Style no. 4, as used on the Northeastern Railway of England. Dark brown letters on light ground, framed in wood. This sign is 6 x 18 ft.

These signs have long been used on most European railways, & for a number of years on the Pennsylvania R.R., the New York Central & Hudson River R.R., the Manhattan Elevated R.R., the Long Island R.R., & many other lines in the United States. They are also being extensively used in Canada & are giving complete satisfaction as the best outdoor signs produced. They can be made in any color, size, or shape. Estimates promptly furnished on application.

The Acton Burrows Co., 29 Melinda Street, Toronto.

Sole Agents for Canada for The Imperial Enamel Co. of Birmingham, England.

to be done. Here the water was allowed to drain away, leaving the gravel thoroughly settled in the new position. The filling was confined within the proper limits by means of logs laid in rows one above the other, & thus the embankment rose, tier above tier, the slope being kept well within the angle of repose, & the logs soon sprouting & forming a network of roots, firmly binding the mass together.

Mountain Creek is the point at which a large amount of filling has been done on this plan in a most successful & economic way. Water is obtained from the creek some 2 miles above, & is led down in a flume, 2 ft. high & 4 ft. broad, to the flume-box, which is 206 ft. above the railway track. From this point an iron pipe 14 ins. in diameter, of $\frac{3}{8}$ -in. thick metal, leads the water to the monitor, which is provided with nozzles ranging from 3 ins. to 6 ins. in diameter. The small-sized nozzles are used for breaking up the mass of gravel, while the

be taken up in order to prevent wreckage by the avalanches, & so each spring the work must practically be constructed again. Nine men in all are required to conduct the filling; 1 at the monitor, 2 to keep the sluices clear, & 6 to prepare & lay the logs at the edge of the filling & to level off the material as it falls. The total filling at this point will aggregate 300,000 cubic yards, of which 225,000 were put in place between June, 1897, & June, 1899, leaving but 75,000 yet to be filled.* A light steel trestle will complete the work connecting the two fillings, thus effecting a permanent solution of a very difficult problem. This method of hydraulic filling was first employed in the mountain division of the C.P.R. under the direction of Superintendent E. J. Duchesnay, C.E. It is a pity that this method cannot be employed to advantage in many other localities where great fillings are necessary.

The highest point reached by the railway in the Selkirk range is at Selkirk Summit, 4,-

used in the Selkirks (see figure 1); but the snowfall being lighter, the same difficulties do not have to be encountered. Some very heavy tunneling & cutting were required in the valleys of the Thompson & Fraser Rivers, a good part of which was constructed by the Government in the early days of the development of the country.

Thus the Rocky Mountain system is crossed after passing three summits, which, if their altitude is not great, still in location & construction required the greatest patience & skill on the part of the engineers intrusted with the task.

* Since the above was written the hydraulic fill at Mountain Creek has been completed, & the balance of the fill will be done by steam shovel, as it cannot be reached by sluice boxes. The centre or main steel span over the stream was erected last year, & two more steel spans adjoining it will be erected this



FIGURE 3.—SNOW-CUTTING ON THE C.P.R. IN KICKING HORSE PASS, BRITISH COLUMBIA. (SEE PAGE 258.)

larger ones furnish an increased volume of water to flush the sluices. Boulders 18 ins. in diameter are readily moved without assistance, but two men with hooks are constantly on the lookout to clear any obstructions. The sluice has a grade of about 1 in 10, conveys the material beneath the railroad track & deposits it in a great pile at the center of the area being filled. (See figure 8.) From this point it is gradually washed down until stopped by the row of logs at the edge, which, however, allow the water to flow off freely. The sides are made to slope at an angle of 37° 40', which is well within the angle of repose, but, in addition to this, the sprouting of the logs at the edge of the filling has formed a strong network of roots, binding the whole mass firmly together. (See figures 8 & 9.)

The cost of this filling is about one-half that of the ordinary way, but it is here carried on under great disadvantages. Not only must the work be entirely suspended between Oct. & June, but the sluices & fixtures must

303 ft. above tide. From this point the railway steadily descends, following the Illecillewaet River. The first routes surveyed lay on the slopes of Mt. Cheops, to the right; but these necessitating a steeper grade than the Government would allow, a change was made to the left side, & the length was increased by a great sweep up the valley of the Illecillewaet to within a mile & a half of the Great Glacier of the Selkirks. Then, following the slopes of Mt. Abbott, & executing a double loop like a letter S, the level of the stream was reached, which was followed as far as its junction with the Columbia River at Revelstoke. This is a divisional point on the railway, & the crews & engines are changed. The pass over the Gold range is not high, & offers very little of special interest, while in crossing the Coast range the railway follows the canyons of the Frazer & Thompson Rivers, thus avoiding a summit. A few sheds are necessary on the western slope of the Gold range, of similar construction to those

fall. The remaining two spans are expected to be replaced early next spring.

The foregoing paper was read before the Engineers' Club of Philadelphia, to whose officers we are indebted for the use of several of the illustrations.

Why Not Borrow a Hand Car?

The following unique advertisement appeared recently in a St. John, N.B., paper:—

Hampton & St. Martin's Ry. Co.

On & after Tuesday, Aug. 28, 1900, train on the above railway will be cancelled until further notice, on account of some repairs being made to engine.

E. G. EVANS,
Superintendent.

The Columbia & Western Railway.

In our last issue we gave the report on the first section of this line, from West Robson to Greenwood, by H. B. Smith, C.E., who inspected it on behalf of the B. C. Government. Following are extracts from his report on the second section, from Grand Forks to Greenwood, up to Nov. 22, 1899, which has only just been made public:—

The Grand Forks-Greenwood division of the C. & W. Ry., is an indirect extension westward of the Rossland-Trail, Trail-West Robson, & West Robson-Grand Forks divisions of the same railway. Beginning at Grand Forks, 1,700 ft. above sea level, at the junction of the North Fork of Kettle River with Kettle River, & distant from West Robson 67 miles, it extends along the west slope of the valley of the North Fork of Kettle River, northerly to Niagara, a small town 2,230 ft. above sea level, & 72.7 miles from West Robson. From Niagara it continues directly north to Brown's Creek, a small tributary of the North Fork of Kettle River, 79 miles from West Robson. At Brown's Creek the railway deflects almost due west, & continues on that course to Eholt, a mining settlement on the summit between the North Fork of Kettle River & Boundary Creek. Eholt is distant from West Robson 80.8 miles, & is 3,080 ft. above sea level. At Eholt a branch railway, 4½ miles long, proceeds to the B. C. mine, & another, 9½ miles long, to Phoenix. From Eholt the course of the railway is south-westerly along the banks of Eholt & Attwood Creeks to Boundary Creek, 2,500 ft. above sea level, & 88.4 miles from West Robson. Here the course deflects almost due south, & continues in that direction to Greenwood, a mining town on the east bank of Boundary Creek, 2,450 ft. above sea level, & 89.7 miles from

West Robson. Greenwood lies north westerly from Grand Forks, & is distant from it in an air line 12¾ miles. By the railway the distance is 22.7 miles. Between Grand Forks, at mile 67 & mile 77, the country passed over is a very irregular rocky side-hill, not precipitous, but broken into scattered elevations & depressions. Between mile 77 & Eholt, at mile 80.7, the railway passes over earth flats & side-hills. Between Eholt & Greenwood, at mile 89.7, the country traversed is fairly level, consisting chiefly of earth flats, bogs, & gravel side-hills. It is proposed to construct a branch, 2½ miles long, from Grand Forks northerly to the Granby Smelting Co.'s smelter, & from Greenwood a branch, 5 miles long, is being constructed westerly to the Deadwood Mining Camp.

Considerable skill has been displayed in the choice of alignment, & the result obtained has proved satisfactory so far as economical construction is concerned. It would appear to be possible, & even necessary, to dispense with many existing curves without adding excessive additional cost. The total amount of curves is 53.5% of the whole alignment, whereas the total amount of tangents is 46.5% of the whole alignment. This is not good railway practice, & a change is desirable. Trestling has been skilfully avoided, & all flats affording suitable grades have been taken advantage of.

On all tangents & curves not exceeding 4°, or 1,433 ft. radius, the gauge is standard, the rails being placed 4 ft. 8½ in. apart from inside to inside of rail head. On curves sharper than 4° an additional width or spread, varying with the degree of curvature, has been allowed, in order to prevent the binding of car wheels in passing over them. The additional spread is as follows:—

4 degrees to 6 degrees, 1/8 of an inch.
6 " " 8 " " 1/4 " "

8 degrees to 10 degrees, 3/8 of an inch.
10 " " 14 " " 1/2 " "

Curves vary from 40° to 14°, or from 8,594 to 410 ft. radius. These curves are light in mountain railway construction, and in this respect the curvature is not excessive. The total amount of curvature, however, as shown by the subjoined table, is unusually large, and does not appear to be warranted by the physical features of the country traversed:

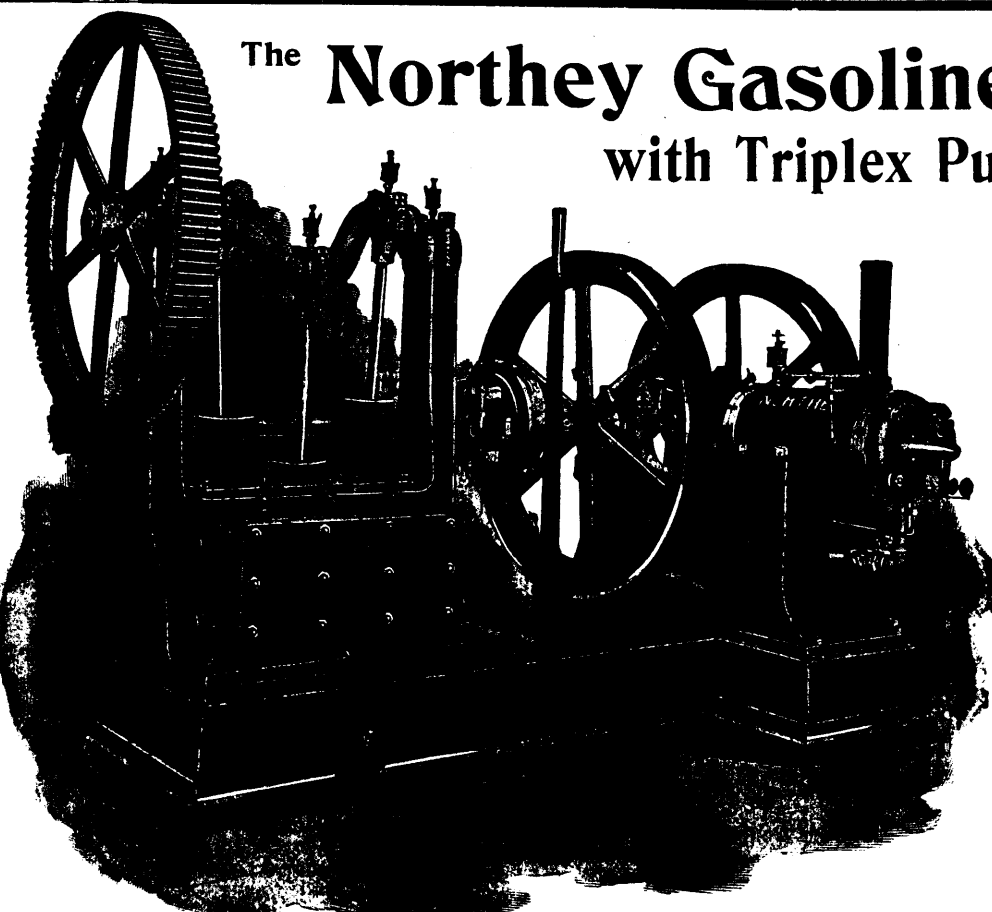
Degree.	Radius in feet.	No.	Length in feet.
to 40 to 1	8,594	to 5,730	1
1	5,730	2,865	2
2	2,865	1,910	7
3	1,910	1,433	13
4	1,433	1,146	12
5	1,146	955.4	11
6	955.4	819	8
7	819	716.3	5
8	716.8	637.3	11
9	637.3	573.7	2
10	573.7	521.7	17
11	521.7	478.3	4
12	478.3	441.7	11
13	441.7	410.3	0
14	410.3		14
Totals.....			118 64,957.1

The total length of the railway from the center of Grand Forks siding to the centre of Greenwood siding is 121,068 ft. The combined length of curves, as shown by the preceding table, is 64,957 ft. The combined length of tangents is, therefore, 56,111 ft. Hence, as before stated, the total curvature is very nearly 53.5% of the whole length of the railway. The curves of most frequent occurrence are from 10 to 11°. The curves of least frequent occurrence are from 40 minutes to 1°. The longest curve is a 3½ degrees, 1,646.2 ft. long; the shortest is a 4 degrees, 100 ft. long. The longest tangent is 5,707.3 ft. in length, and the shortest, 100.9 ft. in length.

From Grand Forks, mile 67, to mile 68, grades are light, varying from level to 0.525

The Northey Gasoline Engine

with Triplex Pump, for



TANK and FIRE DUTIES.

We here illustrate a complete, space saving pumping plant, including the Northey Triplex Power Pump and Gasoline Engine. This arrangement is admirably adapted for prompt service, as the engine is ready for work at a moment's notice, can be run by any one, and will operate for hours without attention.

The Triplex style of pump with cranks placed 120 degrees apart gives a practically constant flow of water. Both machines are strongly built, and have an ample margin of strength for heavy continuous duty. We have recently installed two such plants at Coteau Junction for the Grand Trunk and Canada Atlantic Railways, and are now filling a large order for the Canadian Northern Railway.

Booklet and Catalogues on request.

The Northey Co., Limited,
1032 King St. Subway,
TORONTO, CANADA

per 100. At mile 68, a uniform 2.2 per 100 upward grade, compensated for curvature, begins and continues, without interruption, to Eholt summit, mile 80.8. At Eholt the grade is level for 1200 ft. At mile 81 a uniform 1.8 per 100 downward grade begins and continues to mile 84.9. From mile 85.9 to mile 85 grades fall, varying from .07 to .55 per 100. From mile 85 to mile 85.7 grades fall, varying from 1.10 to 1.20 per 100. From mile 85.7 to mile 88.4 grades fall 1.8 per 100, compensated for curvature. From mile 85.7 to Greenwood, at mile 89.7, grades fall, varying from 1.70 to 1.43 per 100.

All grades exceeding 1.5 per 100 are compensated for curvature at the rate of 3/100 of a foot in each 100 ft, for each degree of curvature, that is to say, that in the case of a 14° curve having a tangential grade of 1.8 per 100, the grade on the curve is reduced 42/100 of a foot, which subtracted from the

structed, having full formation widths and height.

Excavations are 18 ft. wide at formation level, with side slopes of 1 to 1 in earth, sand & gravel, and 1/4 to 1 in solid rock. In certain cases where the nature of the material admitted slopes have been vertical, or nearly so. As in the case of embankments all excavations have originally been thoroughly finished. In rock excavations all work, as a rule, has been well done, the faces of the excavations presenting uniform surfaces.

Rock slope walls occur at two points about midway between Grand Forks and Eholt, each wall being about 59 ft. long and 15 ft. high. They are merely dry stone walls, vertical on the inside face, and battering outwards 1 in 3 on the outside face. They are substantially built, the stones being rectangular blocks, breaking joint and in every way well laid. The top width is not less than 3 ft., and the inside filling is broken rock. In

surfaces approach very closely to the required symmetrical specifications, which are as follows: Width at formation level and at spring of roof, 16 ft.; clear centre height above formation level, 23 ft. 2 1/4 ins, and above rail level, 21 ft. 6 ins., ballast being 9 ins. deep. The rock through which the tunnels pass is solid, and no timbering has been required. The tunnel at mile 74.3 is 402 ft. long from portal to portal. The approaches are rock excavations; that on the north end being 120 ft. long, and that on the south end 100 ft. long. The grade through the tunnel is 1.80 per 100, rising northward, and the alignment is a 10° curve. The tunnel at mile 77.2 is 511 ft. long from portal to portal. The approaches are rock excavations, that on the north end being 110 ft. long, and that on the south end 150 ft. long. The grade through the tunnel is 1.80 per 100, rising north, and the alignment is a 10° curve. In both tunnels the centre lines have been

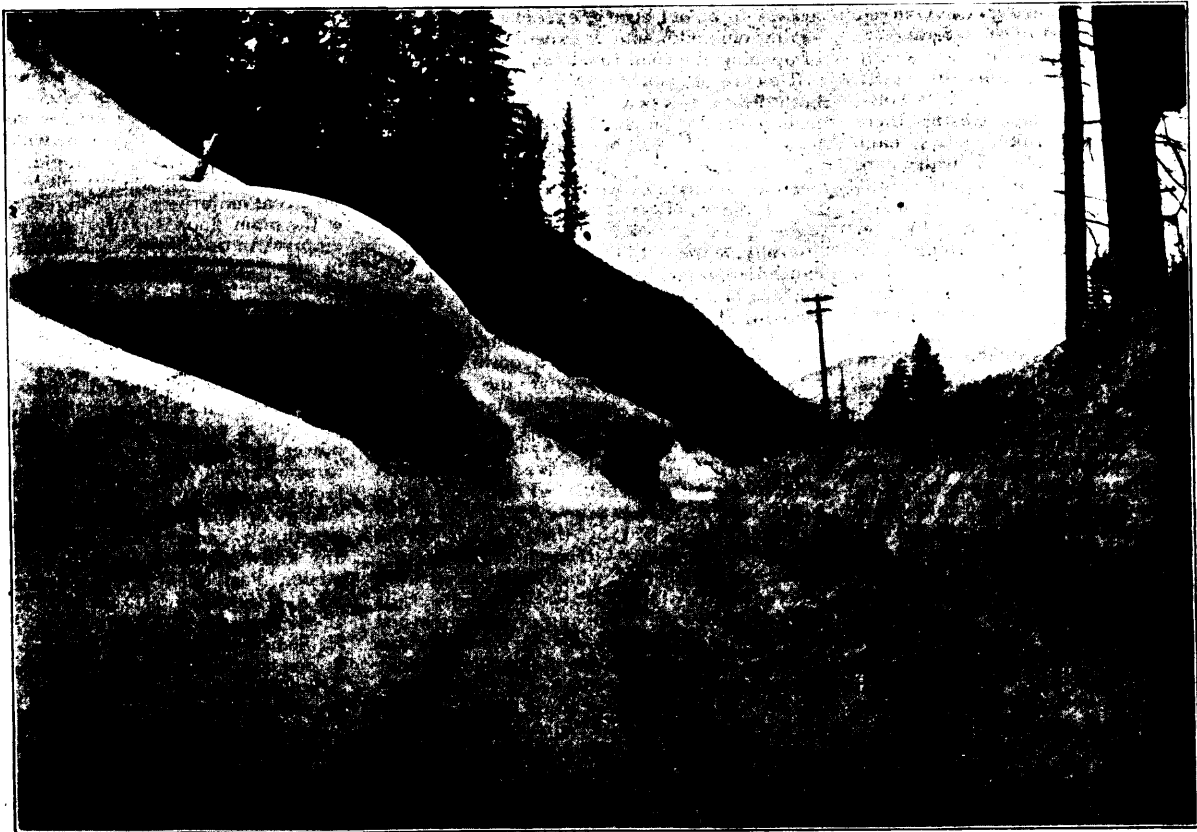


FIGURE 4.—A SNOW-CUT SHOWING DEPTH OF SNOW ON THE C. P. R., IN THE SELKIRK MOUNTAINS, B. C. (SEE PAGE 258.)

original grade of 1.8 per 100, leaves 1.38 per 100 as the compensated grade on the curve. This rule has been adhered to very closely, but in cases where changes of alignment during construction have altered distances, slight deviations have been rendered necessary.

The total ascent from Grand Forks to Eholt summit is 1,380 ft., and the total descent from Eholt summit to Greenwood is 630 ft. The average grade from the middle of Grand Forks siding upwards to Eholt summit is 1.9 per 100, and the average grade from Eholt summit downwards to the middle of Greenwood siding is 1.38 per 100.

Embankments are 14 ft. wide at formation level, having the usual slopes of 1 1/2 to 1 in earth, sand & gravel, and 2 to 1 in loose rock. With the exception of two cases, where dry stone retaining-walls are constructed, the toes of all slopes reach solid ground. No retaining timber crib-work has been used. All embankments have originally been well con-

structed, both cases the foundations are solid rock ledges. The stability of the road-bed does not depend on these walls, there being a sufficient width of rock excavation to sustain the road-bed, even should the walls be removed.

Drainage under the road-bed has been excellently well provided for by means of culverts. Surface drainage, by means of ballast boxes, is still lacking. Side drainage, by means of catch-water drains, is unusually plentiful, and many of these appear to be unnecessary. All culverts are of the usual log pattern, having solid cedar or fir walls and covering, secured by tree-nails and 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 solid rock. The workmanship on these structures is excellent.

Two rock spurs have been pierced by tunnels, one at mile 74.3 and one at mile 77.2. Both tunnels are excellently well constructed, and present uniform clear-cut surfaces. The

placed 7 ins. off the centre line of the road-bed, in order to allow for the inclination of the cars, due to the elevation of the outer rail of the curve.

From Grand Forks to Greenwood there are, including bridge approaches, 6 framed timber trestles, which, combined, cover a distance of 1,610 ft. Following is a list of trestles:

Location.	No. of bents.	Total length.	Centre height.
Mile 68.1	2	45	7'
" 70.2	16	250	30'
" 70.3	16	250	50'
" 73	27	421	102'
" 89.4	34	526	70'
" 89.4	6	106	65'

Trestle at mile 58 is temporary, and, it is stated, will be filled at an early date. Trestle at mile 70.2 is on a tangent, with a grade rising north 2.2 per 100. It is built across a rock ravine, and has solid rock foundations. Trestle at mile 70.3 has two decks, and is on a 7 degree curve, with a grade rising north 1.92 per 100. It is also built across a rock

ravine, and has solid rock foundations. Trestle at mile 73 has three decks, and is on a 10°-curve, with grade rising north 1.80 per 100. It is built across Fisherman Creek, and has solid rock foundations. Both trestles at mile 89.4 are the approaches to a bridge across Boundary Creek. Both have two decks. The first is on a 4°-curve, and the second is on a 10°-curve. Both are on a grade rising westward 1.43 per 100. Both rests on pile foundations. All trestles are excellently designed and well built, strength, rigidity and durability having been obtained.

All trestle foundations, except those of Boundary Creek, being on solid rock ledges, are of the most secure character. If driven according to specification, the pile foundation at Boundary Creek must be of a reliable nature, so long as the upper part of the pile, exposed to atmospheric action, does not decay. The specification for pile-driving required that all piles should be driven with a 2,000 lbs hammer, having a free fall of 20 ft. for the end blow, maximum penetration under the last 5 blows not to exceed 5 ins. One pile is directly under each post of the trestle.

All bents are 15 ft. apart, centre to centre. Caps are 12 ins. by 12 ins. by 14 ft., & are secured to posts by ¾-in. drift bolts, 21 ins. long. In single deck trestles there are 2 vertical posts & 2 raking posts, each 12 by 12 ins. Sway braces & wales are 3 by 10 ins., & are bolted at the ends through posts by ¾ by 18½-in. screw bolts, & spiked to intermediate posts by ½ by 7-in. boat spikes. Longitudinals, 8 by 10 ins., are placed above wales & sills, & are secured at the ends by ¾-in. screw bolts, 21½ ins. long. In 2-deck trestles the same design & scantling of timber are retained. The sill of the upper deck is separated from the cap of the lower deck by 8 longitudinals, 8 by 12 ins. Connecting the lower half of each deck are four longitudinal diagonal braces, 6 by 10 ins. In 3-deck trestles the same design & dimensions are retained. The number of posts is increased as follows:—Upper deck, 2 uprights & 2 raking posts; second deck, 2 uprights & 4 raking posts; third deck, 2 uprights & 4 raking posts. All substructures are fully completed.

The trestle superstructure will be unusually strong. There are 8 stringers of Douglas fir, 8 by 16 ins. by 30 ft., breaking joint, & bolted together by ¾-in. screw bolts, 25½ ins. long. Ties are 8 by 8 ins. by 12 ft., spaced 4 ins. apart, & spiked to stringers by boat spikes, ½ by 12 ins. Guard rails are double, the outside rail is 8 by 8 ins., bolted

to every fourth tie by ¾-in. screw bolts, 18½ ins. long. The inside rail is parallel to the outside rail, except for 20 ft. at the ends, where it flares outwards to a junction with the outside rail. It is secured to the ties at intervals of 3 ft. by means of lag screws, ¾ by 8 ins. On curves, the superstructure is cantled to the required elevation by increasing the length of the outside posts of the superstructure. All washers are of cast iron, ¾ by 3 by 1½ ins.

Between Grand Forks & Greenwood only one bridge span has been found necessary. This is at the crossing of Boundary Creek, 89.4 miles from West Robson. It is a timber Howe truss deck span of 150 ft., supported on framed timber abutments, each of which consists of 24, 12 by 12 ins., vertical & battering posts resting on 12-ins. piles, enclosed in a rock-filled caisson. Rail level is about 75 ft. above river level. The centre alignment is a 4° curve, & the grade 1.43 per 100. The approaches to the bridge have been enumerated & described under the head of trestles. The length of the north approach, 526 ft., does not appear to be necessary, except as a means of saving embankments & expediting the period of opening the road to traffic.

Ties are of cedar, hemlock, tamarac & fir, both hewn & sawn. They are laid 24 ins. from centre to centre. Faces are from 7 to 8 ins. in width, & the thickness uniformly 7 ins.

The alignment of the rail has apparently been at one time as well done as the character of the rails used would admit of. The sagging of embankments, both vertically & laterally, & the settlement of side ballast, have caused irregularities of contour in many places. Surface-men, however, are now at work remedying these defects. All curves have been eased off at both ends, & the outer rails elevated for velocities varying according to the retardation of the curve, & the particular grade on which the curve is situated. Rails break joint, & are double spiked to each tie.

From Grand Forks, mile 67 to mile 68, rails are 56 lbs. steel, which have been used on other parts of the C.P.R. From mile 68 to Eholt, mile 80.8, rails are new 73 lbs. steel, of a pattern designed by the C.P.R. From Eholt, mile 80.8, to Greenwood, mile 89.7, rails are 72 lbs. steel, which have been used on other parts of the C.P.R. The 56 lbs. rails are provided with 4-hole angle plates, pierced for ¾ by 3¾ in. bolts. The 72 lbs. rails are provided with 6-hole angle plates, 42 in. long, pierced for ¾ by 4 in. bolts. The 73 lbs. rails are provided with 4-hole angle plates, pierced for ¾ by 4 in. bolts. All nuts are hexagonal; lock washers are positive & national.

A double-wire telegraph has been constructed from Grand Forks to Greenwood. Poles are 25 ft. long, 8 ins. diameter at the top, & from 150 to 200 ft. apart. This work has been well done.

All timber, for 50 ft. on each side of the railway, has been felled. Side tracks from 1,500 to 4,500 ft. long, & aggregating 13,000 ft., have been built. Y's for reversing engines have been constructed at Grand Forks, Eholt & Greenwood. Permanent water tanks of 10,000 galls capacity each have been erected at four points. Several station & section houses have been built.

The Grand Forks-Greenwood division has been easy of construction as compared with the West Robson-Grand Forks division. The first 9 miles north of Grand Forks cover the whole of the heavy work; beyond this point the works are comparatively light.

A map of the C. & W. R. was given in our last issue, pg. 227.

Altering St. Louis Station.—The main hall of the union passenger station at St. Louis, Mo., one of the finest rooms of the kind in America, is going to be altered, experience having shown that passengers do not use it. The large room beneath it, which is nearer the street level & the train platform level, & which contains the ticket offices, is used by the great majority of passengers of all classes, & the main floor is nearly always practically empty. An opening is to be made in the floor, in the centre of the room, & a handsome balustrade put in; so that the ceiling of the main hall will become the ceiling of the lower hall, & the main floor, what is left of it, will become a gallery.

St. Lawrence Terminal & Steamship Co.—The Dominion Parliament last session incorporated a company under this name, with power to construct & operate vessels, elevators, wharves, warehouses & other terminal facilities, also to construct & operate railway sidings or spur lines not exceeding 6 miles in length, to connect the Co.'s property with any railway line incorporated by the Dominion Parliament. The incorporators are H. A. Hodge & F. D. White, Rutland, Vt.; G. C. Dessaulles, St. Hyacinthe, Que., & G. H. Semple, Montreal. The capital stock is \$1,000,000. We are informed that matters of detail have been perfected, but that actual operation under the charter cannot be begun until certain improvements have been made at the port of Sorel.

F. B. POLSON

J. B. MILLER

The POLSON IRON WORKS

TORONTO, - - CANADA.

STEEL BOILERS

The Best Equipped Boiler and Engine Works

We Manufacture

The Brown Automatic Engine
Single, Compound and Triple Marine Engines
Hoisting and Mining Engines
Steel Steam Vessels of every description
Steam Yachts and Launches

..... Get Our Prices Before Ordering.

Esplanade East, Foot of Sherbourne Street, -:- TORONTO.

The C.P.R. & the I.C.R.

The following correspondence between the President of the C.P.R. & the Minister of Railways has been made public:—

MR. SHAUGHNESSY TO MR. BLAIR, SEP. 3, 1900.

"Within the next month it will be necessary for this Co. to determine the route by which its export & import traffic will be handled during the coming winter. It is the sincere wish of the Co. to see the business of every Canadian port increase & multiply, to the greatest possible extent, & I think it is necessary for me to say that in co-operation to this end we would not be narrow or niggardly.

"For several years past we have made St. John, N.B., our winter port, & have kept it on an equal footing with the other ports, by

port to the extent & in the manner that we would like.

"Therefore, in the hope of holding the traffic to Canadian seaports, I beg to inquire if the Government is prepared, during the season of winter navigation, to accept from us at Jacques Cartier Jct. (Montreal) such export business as we may be able to control, & to deliver to us at the same junction all import business which the Government is free to so direct, on the basis of the existing traffic agreements between the Government & the G.T.R. Co.

"Such an arrangement would practically secure to the I.C.R. for Canadian seaports all the Canadian export & import traffic, excepting that taken to Portland by the G.T.R.

"With the I.C.R. terminus at Halifax & the elevator & other facilities provided by the

your agreement with the G.T.R., the division of the rates to be on the same basis as your G.T.R. agreement, known as the supplementary agreement.

"In making this proposition, & refraining from the use of its shortest available connections with the Atlantic seaboard for this traffic, a use which could be made to afford to this Company a considerable profit east of Montreal, we feel that we are proposing a sacrifice which should not be necessary, but we do not intend to leave in the mind of anybody the least doubt as to how far this Co. is willing to go towards the conservation of the commercial interests of Canada.

"During the past two years we have made every effort to secure a settlement of these traffic questions with the I.C.R., but without success.

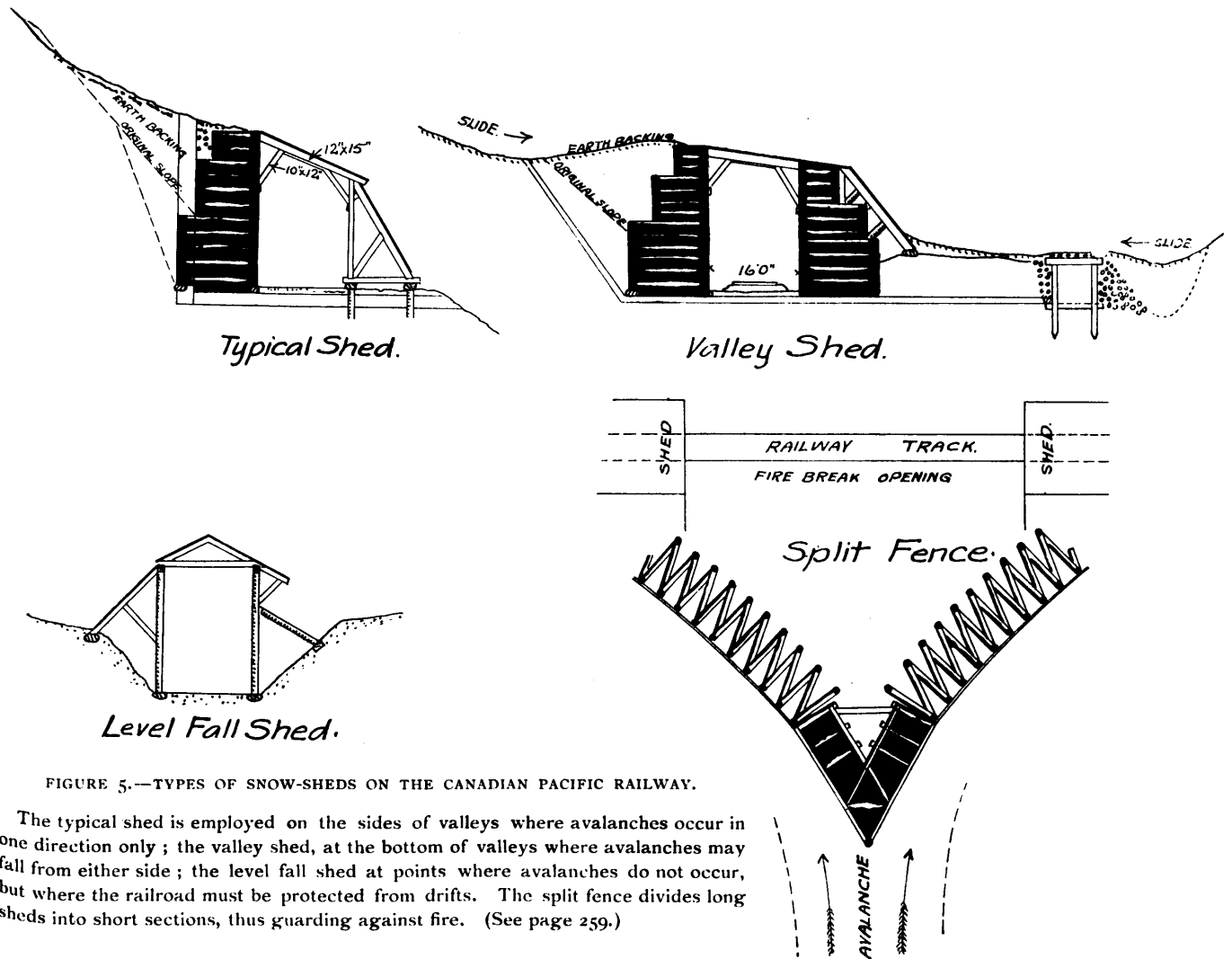


FIGURE 5.—TYPES OF SNOW-SHEDS ON THE CANADIAN PACIFIC RAILWAY.

The typical shed is employed on the sides of valleys where avalanches occur in one direction only; the valley shed, at the bottom of valleys where avalanches may fall from either side; the level fall shed at points where avalanches do not occur, but where the railroad must be protected from drifts. The split fence divides long sheds into short sections, thus guarding against fire. (See page 259.)

meeting the rail rates quoted to Boston & Portland on export traffic, notwithstanding the greater distance, the great preponderance of export over import tonnage & other unfavorable conditions with which we had to contend, & we have been so successful in securing traffic that during last winter we loaded 63 steamships at that port with more than 200,000 tons of export freight, & this amount could have been nearly or quite doubled under more favorable conditions.

"The altered relations between the Government Railway System & this Co., resulting from the refusal of the Government to deliver to us at St. John any business originating on the Government Railway System east of St. John & destined to points on our line & its connections, Montreal & west, make it quite impossible for us to continue to use that

Government at St. John recently, the Government will be in a position to route the export business through either of these ports, or to divide it between them as may appear best. In case the terminal facilities of the I.C.R. at either port be overcrowded, we shall be glad to give the Government the use of our elevator, yards & terminals at West St. John to the extent that may be required for this steamship business, for a nominal consideration.

"If you be willing to enter into such an agreement, we shall solicit & secure traffic & hand it to the Intercolonial at Jacques Cartier Jct. (Montreal) for carriage to either St. John or Halifax. The same rates will be quoted from all points to St. John as those in force at the same time to Portland or Boston on the same classes of business, & the Halifax rates will be 1c. per 100 lbs. higher, as specified in

"As I explained in the early part of my letter, the time is now upon us when an agreement for ocean traffic for the coming winter must be closed, & it is most important, if not necessary, that the subject of this letter be settled one way or the other before the 19th inst. May I not, therefore, hope for an answer during the present week, indicating the disposition of the Government?"

MR. SHAUGHNESSY TO MR. BLAIR, SEP. 18.

"September 3rd I wrote you on the subject of an interchange of import & export traffic between this Co. & the I.C.R., requesting an early reply because of the lateness of the season, but up to this time I have not been favored with an answer. Your silence can hardly be held to indicate a determination on the part of the Government not to open the I.C.R.

as an export route to St. John & Halifax, in view of the vast expenditure made by the Government during the last couple of years in providing steamship terminals for the I.C.R. at St. John.

"It cannot be that the division of rates is an obstacle, unless it be admitted that your agreement with the G.T.R. Co. was unfair to the I.C.R., because the divisions proposed in my letter are precisely the same as those specified in that agreement, as approved by Parliament, & we are convinced that there is no disposition on the part of the Government to discriminate between railway companies or individuals in the charges for the carriage of the same classes of traffic between the same points on the I.C.R.

"Clearly, then, we have the right to expect—in indeed if we were dealing with a private railway corporation, instead of the Government, we would have the right to insist—that in the interchange of traffic we shall be given the same terms as are given to any other company routing traffic over the line between Montreal & St. John or Halifax.

"Taking it for granted, therefore, that the I.C.R. will accept in the division of the rates the proportions specified in the G.T.R. agreement, viz., 375 miles on St. John & 425 miles on Halifax as its compensation in full for the carriage of import & export traffic, between Jacques Cartier Jct. (Montreal) & those points, we shall regulate our winter business accordingly.

"The steamship companies that have heretofore made St. John their winter terminus will, within the next couple of weeks, desire to renew arrangements for the coming season. We shall refer them to the officials of the I.C.R., & I have no doubt that you will give such instructions as will ensure a regular ocean service to Liverpool, London, Glasgow, Belfast, Dublin, & Manchester from the time navigation closes in the St. Lawrence until it opens in the spring.

"In order that the port of St. John may not be prejudiced, & the steamship lines embarrassed, a prompt & satisfactory train service will be required. I am sure that we may rely on the I.C.R. officers to see that the export traffic controlled by this Co., which we intend to hand to the I.C.R. at Jacques Cartier Junction, during the coming season, will be moved to the steamer's side with regularity and despatch. In return, we promise that all import traffic delivered to this company, as mentioned in my letter of Sept. 3rd. will be trans-

ported over our line to the satisfaction of everybody concerned."

MR. BLAIR TO MR. SHAUGHNESSY, SEP. 18.

"I have been unavoidably delayed in acknowledging & replying to your favor of the 3rd inst., with reference to the transfer of your export traffic to the I.C.R. at Montreal, & I have only just now concluded my conferences with my officers & the General Manager. The proposition you make, as I understand it, to deliver to us at Jacques Cartier Jct. the traffic you have been heretofore carrying to St. John for export, is one which with some minor modifications I am bound to say has much to commend it to favorable consideration. The arrangement of details to ensure a satisfactory working agreement & the necessary preparations which the I.C.R. would have to make to enable it handle so large an additional traffic, would require time to adjust & provide for. Your suggestion that I should let you know inside of 12 or 15 days whether the I.C.R. is or is not prepared to enter into a binding agreement with you to take care of this traffic during the approaching winter you must, on consideration from the standpoint of the Intercolonial, see does not afford adequate time in which to complete the negotiations necessary before such a contract could be concluded. The volume of your traffic last year eastbound for export aggregated some 200,000 tons. To add such an enormous business to the normal traffic of the I.C.R. would involve the settlement of many details. Let me enumerate these:

"First, your suggestion is based upon the condition that we should make with your Co. an arrangement on the basis of that existing between the G.T.R. & the I.C.R. for export traffic. This would be satisfactory if you make the conditions identical, or nearly so, & in order that we may be on as good a footing in a financial sense carrying your merchandise as we are with respect to any we may receive from the Grand Trunk, we would require you to deliver to us at Ste. Rosalie, rather than at Jacques Cartier Jct. This is a minor detail, however, which we could, I have no doubt, after discussion, arrange between us.

"Second, our facilities at St. John, which are approaching completion, & which will be ready for winter business, would be quite insufficient to handle anything like the large volume of business you propose to turn over to us. As a consequence, we would

have to discuss with you, & also with the bridge company, the terms upon which we could utilize your works on the west side of the harbor, & the bridge and tracks. Upon the assumption that you are retiring from the export business at St. John this ought to be practicable, but some necessary arrangements would require to be made for taking over, either temporarily or permanently, your west side facilities, with the Carleton bridge & connecting tracks, & in this relation I presume the corporation of St. John would be entitled to have a say as to the property which they have constructed & placed at your disposal, & following the results of our arrangement, parliamentary action would have to be had to enable us to legalize & effectuate such agreement as we might make.

"Third, as a sub-question, & perhaps involved in the above, the terms upon which the use of the bridge could be acquired is a matter of importance. The charges now made for crossing the bridge by the bridge company, & the charges of the miles of track which we would have to use to reach the west side terminals, would involve to the I.C.R. an additional cost, as against east side shipments of over \$1 a ton. This is an expense which your Co. avoids, as you are not under the necessity of crossing the bridge, & \$1 a ton taken off the rate which you propose to us would be a very considerable item, & would necessitate our endeavoring to secure the bridge upon terms entirely different from any which the bridge company has heretofore been willing to concede.

"Fourth, the C.P.R. has reached its present capacity for handling the considerable tonnage which you were able to take care of last winter as the result of years of organized work, & is the growth of time. To cast upon the I.C.R. the responsibility of handling 200,000 tons of additional freight beyond its ordinary business during the approaching winter, & to do which you would bind us to undertake in a manner satisfactory to shippers, is such a large problem that months would be required of vigorous preparation to justify us in assuming it. Our present locomotive & car equipment is really not sufficient to handle the ordinary business which now comes to us, & I have been making strenuous efforts to increase our capacity for the purpose of this normal business. I have had no parliamentary authority to incur expense this year to make up such a burden as you would suggest we might assume. I quite understand

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that in the matter of cars you would no doubt be willing to furnish these on the usual car mileage terms, but we would require a number of additional locomotives, besides securing sufficient & organized staff to handle business.

"Fifth, there would still remain the making & concluding of arrangements with shipping companies for the ocean transport of this traffic, & you would realize as fully as the traffic officers of the I.C.R. do, the impossibility of effecting such arrangement on 12 or 15 days' notice.

"Sixth, I have assumed that you propose to hand us over all the export traffic you can secure. Possibly I may be in error in this, & if I am, there is the more reason for our coming to an explicit understanding upon this question, which can only be arrived at after much thought & discussion. In your letter to me of the 3rd, you speak of your being under the necessity of discontinuing export business from St. John 'in the manner & to the extent you have heretofore carried on that business.'

There is here an implied reservation, if not an express one, that part of the business you would retain. We would naturally have to discuss between us what is the portion of this business you contemplate reserving for your Co. Export business consists of various classes, some of which are better paying than others, & it is only when the general traffic includes both, the less profitable & the more profitable, that average results are obtained which make it possible for the railway to transact the business. You would be the first to acknowledge that an offer to us of the unprofitable business, while you retain the profitable portion, could not be entertained, & would not be in accordance with either the letter or spirit of the suggestion that we should get your export traffic on the same basis as is provided for in our agreement with the G.T.R. All the above considerations, it appears to me, can only point to one conclusion, viz., that your Co. should have decided months ago what you intimate now you have decided, that the relations of the Government railway with your Co. render it necessary for you to withdraw from the export business at St. John. If such is really your present view, the conclusion will have likely forced itself upon you months ago, & when you did so decide it would have been better to have at once made such a proposition to us as is contained in your letter of the 3rd. Had that been done, we could then have debated the whole question with you, doubtless have come to a conclusion upon it, procured the necessary parliamentary authority, have increased our equipment & got into a shape in which we could have undertaken the business.

"Upon the whole, & treating your pro-

posal seriously, I would suggest that you continue the export business this winter as usual, & I will be prepared during the coming season to take your proposition up & make an honest effort to come to an agreement upon fair & reasonable terms."

MR. SHAUGHNESSY TO MR. BLAIR, SEP. 21.

"Your letter of the 16th, from St. Stephen, in reply to mine of Sep. 3, only reached me late Wednesday afternoon, &, therefore, I was unable to reply before leaving for the west yesterday morning. There was nothing equivocal in our proposition; all of our controlled export traffic was distinctly specified, so that there was no ground for your apparent apprehension that the more profitable business might be diverted by us. The junction point mentioned in your agreement with the G.T.R. is Montreal, and not St. Rosalie; hence, in submitting our proposition I named Montreal as the point of interchange in order that we might be in exact conformity with the

the I.C.R. facilities, but it is not easy to see why this should be the case under existing conditions. Although nearly two months will elapse before the winter exports commence to move, it might have been more convenient for all parties if earlier notice could have been given, but in view of our earnest endeavors during the past two years to secure a settlement of the several traffic questions in dispute between the Government railway system & this Co., you will, I am sure, absolve us from any responsibility whatever for the delay."

Mainly About People.

Mrs. C. R. Hosmer & family have returned to Montreal from St. Andrews, N.B.

Mrs. C. M. Hays, of Montreal, has been spending a few weeks at Cushing's Island, Me.

Mrs. Sutherland Taylor has returned to Montreal after a trip to the Lower St. Lawrence.

Mrs. T. G. Shaughnessy has returned to Montreal after spending the summer at St. Andrews, N. B.

Mrs. A. Piers, & the Misses Piers of Montreal spent the summer at the Cascade House, Little Metis, Que.

The family of J. W. Loud, Freight Traffic Manager of the G. T. R., spent the summer on the Maine coast.

W. Apps, Master Car Builder of the C. P. R., & Mrs. Apps, sailed from Montreal, Aug. 15, for a visit to England.

Mrs. C. F. Sise & Miss Sise have returned to Montreal after spending the summer at the Algonquin, St. Andrews, N.B.

Shirley Denison, of the C. P. R. Solicitors' Office,

Toronto, was married at Bowmanville, Ont., Sept. 5, to Miss M. B. Fairbairn.

C. S. Lee, General Passenger Agent of the Lehigh Valley Ry., spent a portion of Aug. in the Muskoka Lakes & the Lake of Bays district.

Mrs. P. A. Peterson & the Misses Peterson have returned to Montreal after spending the summer at the Manoir Richelieu, Murray Bay, Que.

President Shaughnessy left Montreal Sep. 20 on an inspection tour of the C.P.R. main line & branches between Montreal & the Pacific Coast.

J. D. Flower, of New York, who died at Prout's Neck, Me., in Aug., from paralysis, was Vice-President of the Kingston & Pembroke Ry.

G. R. Joughins, Mechanical Superintendent of the I.C.R., who is visiting in Europe, is expected back at Moncton, N.B., about the middle of Oct.

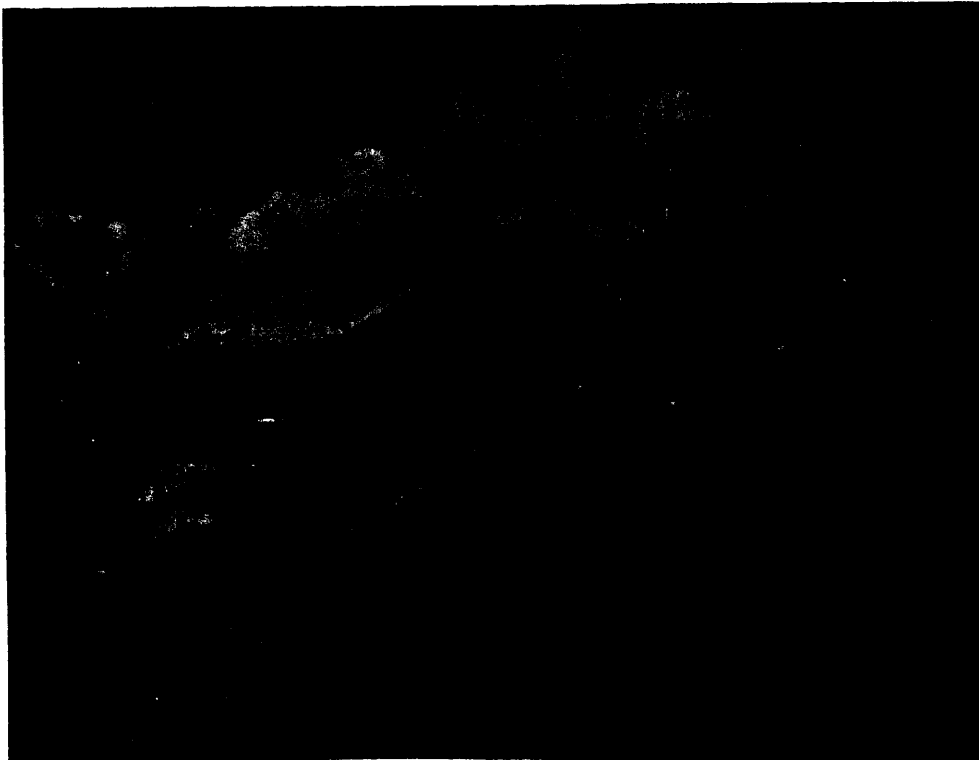


FIGURE 6.—A TYPICAL SNOW-SHED ON THE CANADIAN PACIFIC RAILWAY. (SEE PG. 259.)

The split fences & deflectors are seen on the mountain-side to the right.

G.T.R. agreement. A careful analysis of your agreement with the G.T.R. discloses nothing in the nature of a limit to the amount of export traffic which that Co. is at liberty to hand to the I.C.R. On the contrary, it is clearly their privilege to give the I.C.R. their entire export traffic, or any portion of it, without notice. We are warranted in assuming that the Government would not have entered into a contract of this character with a company whose winter export tonnage is, if anything, greater than our own, without having made the necessary preparations to handle the business. Although the G.T.R. Co. may hold this privilege in reserve, you will probably find upon inquiry that, with its shorter line to Portland & its excellent facilities, it will continue to send its business to that port, & the I.C.R. is offered our business instead on precisely the same terms. I can quite understand that if the G.T.R. were delivering its export business, or any considerable portion of it, to the I.C.R., the additional traffic coming from the C.P.R. might overtax

L. A. Lovett, barrister, of Liverpool, N.S., was married at Kentville, N.S., Aug. 15, to Miss E. B. Gifkins, daughter of the General Manager of the Dominion Atlantic Ry.

W. Phillips is reported to have resigned the managership of the Niagara Falls Park & River Ry. His name is mentioned in connection with the management of the Winnipeg Electric St. Ry.

J. W. Hickson, eldest son of the late Sir Jos. Hickson, formerly General Manager of the G.T.R., who has been studying in Germany the last year, has taken the degree of Ph.D. with honors.

H. T. Smith, Advertising & Claims Agent of the London St. Ry. Co., recently received the medal granted him for his participation in repelling the Fenian Raid in 1866. He served in the St. John, N.B., volunteers.

A. C. Curry, New Brunswick agent of the Dominion Atlantic Ry., who resigned recently to go into life assurance business, was, on leaving, presented with a gold-headed cane by the office staff in St. John, N.B.

H. Ledyard, of Detroit, eldest son of President Ledyard, of the Michigan Central Ry., was married at Hamilton, Ont., Sep. 5, to Miss M. A. M. Hendrie, fifth daughter of W. Hendrie, G.T.R. cartage contractor.

D. W. Beatty, Chief Clerk of the Freight Claims Department of the G.T.R., was recently presented by the members of the staff with a dressing case & a gold-mounted walking stick, on ending his service with the Co.

G. B. Reeve, ex-General Traffic Manager of the G.T.R., writes the RAILWAY & SHIPPING WORLD from La Pomelo Rancho, La Mirada, Cal.:—"Allow me to compliment you on the advancement & growing importance of your publication."

E. A. Cunningham, who recently resigned the chief clerkship of the C.P.R. Stores Department, Montreal, was, on leaving, presented with a gold watch by fellow-employees of the department, & with an address & locket from the formen of the locomotive shop.

R. J. Smith, heretofore District Freight & Passenger Agent of the Great Northern Ry., (U.S.A.) at Winnipeg, has been appointed District Passenger Agent at Pittsburg, Pa. G. C. Jones has been appointed Acting District Freight & Passenger Agent at Winnipeg.

R. H. Ingram, Treasurer of the Central Vermont Ry., fell off the str. Bohemian just after it passed under the C.P.R. bridge at

Lachine, Que., on Sep. 3, having leaned too far over the railing. He was rescued by three Indians who put off from Caughnawaga in a canoe.

Sir Wm. Van Horne, in an interview in Montreal early in Sept., said there was no truth in the rumor that he intended to entirely sever his connection with the Company. "It is the old rumor," said Sir William with a laugh, "and it is hardly worth contradicting. I think I will be connected with the C.P.R. for some time longer."

Geo. Irving, who died at Montreal Aug. 28, aged 78, of pneumonia, came to Montreal some 40 years ago from Scotland, & was 33 years in the service of the G.T.R., retiring in 1897. After he came to Canada he inaugurated & practically owned the Adirondack & St. Lawrence Ry., which was afterwards sold to the G.T.R. He was then appointed Paymaster of the G.T.R.

Members of the Brotherhood of Railway Trainmen of America on the C.P.R. have been notified that M. Fitzgerald has resigned the chairmanship of the joint protective board & that T. G. McManamon, of Ruby Creek, B.C., the Secretary of the Committee, will perform the duties of Chairman until arrangements can be made for the members of the joint protective board to meet & elect a permanent Chairman & a Secretary.

E. B. Osler, of the C.P.R. directorate, has been on a visit to Great Britain, chiefly with the object of sitting for his portrait to Sir Geo. Reid, the President of the Royal Scottish Academy. Sir George was commissioned by the North of Scotland Canadian Mortgage Co., of Aberdeen to paint a full-length portrait of Mr. Osler, for presentation to Mrs. Osler, with a view of commemorating a connection with Mr. Osler's firm for 20 years which has permitted the payment of dividends of 10%, while at the same time a reserve fund of £90,000 has been accumulated against a paid-up capital of £150,000. The portrait is regarded as ranking with the best of Sir Geo. Reid's works.

Capt. P. J. Larkin died at St. Catharines, Ont., Aug. 31, aged 71, of cancer of the throat, after 8 months' illness. He was a native of Galway, Ireland, & came to Canada with his parents in 1837. For 14 years he lived in Toronto, & then went to St. Catharines. He sailed the lakes for many years, & was known in every port. When he retired from that sphere he was possessed of a handsome

competency. In 1875 he undertook a large contract on section 1 of the Welland Canal, which he carried out successfully. The firm formed, & the work of constructing the graving dock & harbor works at Quebec was secured. The graving dock at Esquimalt, built in 1886, was another contract which fell to this firm. Capt. Larkin also built portions of the Ontario & Quebec division of the C.P.R. & the Esquimalt & Nanaimo & Shuswap & Okanagan railways in B. C. For the past three years the firm of Larkin & Sangster has been engaged on a large contract on the St. Lawrence canals at Iroquois, Ont.

C. P. Huntington, President of the Southern Pacific Ry., died in the Adirondacks, N.Y., Aug. 14. His railway career may be said to have begun in 1861 with the inception of the plans to build the Central Pacific R.R., & 40 years after, at the time of his death, he was the executive head of railway lines involving over 8,000 miles of road & of steamship interests connecting the continents of Asia & America, & leading the coastwise traffic of the American Continent. He was also the originator & chief adviser in many other transportation interests. The story of the construction of the Central Pacific by Mr. Huntington & his associates—Hopkins, Sanford & Crocker—and the difficulties which they overcame, are a familiar part of American history. After the completion of the trans-continental railway the development of the Pacific Coast states was undertaken, & the Southern Pacific line was extended northward to Portland & south to Los Angeles, through New Mexico & Texas to New Orleans & Galveston & into Mexico. Connecting steamship lines on the Atlantic & Pacific as auxiliaries to the railway system were created. In all these developments the prevailing motive force was the genius for construction & combination of Mr. Huntington. In 1869, he acquired control of the Chesapeake & Ohio R.R., which was extended & its terminal at Newport News enlarged & equipped. The great shipyard at the latter point is also a product of his foresight & energy. Every wheel & stroke of commerce throughout the great Southern Pacific system of railways & steamship lines was stopped for seven minutes during his funeral in New York. At the exact moment when the clock struck 11 in New York every hammer in all the shops ceased clanging, engines paused upon the rails, & steamships floated lifelessly upon the water.

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RAILWAY APPOINTMENTS, Etc.

Algoma Central.—Press items state that T. Williams, lately of the Bank of Toronto, London, has been appointed Paymaster of this line, & that H. Dreany, for several years a passenger conductor on the Sault Ste. Marie branch of the C.P.R., has been appointed General Agent of the A.C.R. at Michipicoton.

Boston & Maine.—W. J. Hobbs has been appointed Comptroller & General Auditor, with immediate charge of the treasury & accounting departments. J. W. Richards has been appointed Assistant General Auditor. M. T. Donovan has been appointed Freight-Traffic Manager, & A. S. Crane has been appointed Export Freight Traffic Manager, both reporting directly to the Second Vice-President. All with offices in the Union Station, Boston. F. O. Melcher has been appointed Superintendent of the Fitchburg Division, with office at Boston. M. P. Snyder has been appointed Assistant Superintendent, with office at Mechanicville, N. Y., & E. A. Smith Assistant Superintendent, with office at Boston. C. C. Rinehart has been appointed Assistant Superintendent of the White Mountains Division, with headquarters at Woodsville, N. H. The B. & M.R. having leased the Fitchburg R.R., & A. H. Harris, former general Canadian traffic agent of the Fitchburg at Montreal, having resigned, hereafter all business in connection with that office will be handled by A. Lalonde, Canadian passenger & freight agent of the B. & M. R., with office at 138 St. James Street, Montreal.

Canadian Pacific.

—The newly appointed Land Commissioner, F. T. Griffin, has appointed J. L. Doupe Assistant Land Commissioner, as foreshadowed in our last issue. Mr. Doupe has been Chief Surveyor of the Land Department for a number of years.

J. Hennesy has been appointed Roadmaster Quebec Section, with headquarters at Three Rivers, Que.

N. Delaire has been appointed acting Roadmaster Montreal Terminals, with headquarters at Montreal.

P. Houston has been appointed Roadmaster M. & O. Section, with headquarters at Ottawa.

R. Clarke has been appointed acting Roadmaster North Bay Section, with headquarters at Mattawa, Ont.

Central Vermont.—J. E. Toohey having resigned, J. A. Sheedy has been appointed Superintendent of Bridges & Buildings. Office at St. Albans, Vt.

Grand Trunk.—G. C. Jones, heretofore Superintendent of the Middle Division at Toronto, has been appointed Superintendent of the Eastern Division at Montreal, succeeding J. M. Herbert, who resigned to enter the service of the Missouri Pacific Ry.

F. W. Egan, heretofore Assistant Superintendent of the middle division at London, has been appointed Superintendent of the middle division, succeeding G. C. Jones, transferred.

ter of the 4th & 5th districts, at Point St. Charles, Montreal, succeeding G. Beckingham, resigned.

Intercolonial.—N. L. Rand has been appointed acting foreman of engines from Campbellton East. J. Murphy has been appointed to a similar position from Campbellton West.

Kootenay Railway & Navigation Co.—A. M. Thomas has been appointed Auditor of the Co.'s line between Bonner's Ferry, Idaho, & Kuskonook, B.C.

Michigan Central.—S. H. Palmer has been appointed Canadian Passenger Agent at St. Thomas, Ont.

Northern Pacific.—W. G. Pearce, Assistant General Superintendent of the N. P. & Assistant General Manager of the Seattle & International, has been appointed Assistant to the President of the N.P., at Tacoma, Wash.

Quebec Southern.

—President H. A. Hodge issued the following circular at Rutland, Vt., Sep. 1: "Effective this date, the Quebec Southern Ry. Co. assumes the control & management of the East Richelieu Valley R. R. & the United Counties Ry. of Canada, with operating headquarters at St. Hyacinth, Que. Officers, agents & all other employes of the United Counties Ry. will perform the duties of their respective positions in the service of the Quebec Southern Ry. Co., from the above date. F. D. White, Vice-President, will perform the duties of General Manager."

Rutland.—A. H. Harris, formerly of the G.T.R., later in the I.C.R. service, & latterly with the Fitchburg Ry., has been appointed Canadian Traffic Agent of the Rutland, at 141 St. James St., Montreal. He has been placed in immediate charge of matters in Canada & agents in Canada are to report to him.

Rutland-Ogdensburg & Lake Champlain.

—C. L. Pierce, General Superintendent of these Companies, died at Rutland, Vt., Aug. 6, 1900. C. B. Hibbard will perform the duties of General Superintendent pro tempore, & correspondence relating to matters of that department should be addressed to him. Mr. Hibbard continues in the position of General Passenger Agent.

Grabbenheimer (injured in a railway wreck)—Oh, toctor, toctor! Vill I recover? Surgeon Oh, yes! Grabbenheimer (greatly relieved)—About how mooch, do you t'ink?



FIGURE 7.—STONY CREEK BRIDGE, ROGERS' PASS, CANADIAN PACIFIC RAILWAY. (SEE PG. 259.)

Height, 300 feet; span, 336 feet.

A. S. Begg, heretofore Superintendent of the St. Clair Tunnel & terminals, has been appointed Assistant Superintendent of the middle division at London, succeeding F. W. Egan.

C. S. Cunningham, heretofore Trainmaster at Battle Creek, Mich., has been appointed Superintendent of St. Clair tunnel & terminals, embracing Port Huron tunnel & city, & Fort Gratiot yards, in Michigan; also Sarnia tunnel & city, & Point Edward yards in Ontario; & has assumed the duties of Agent at Port Huron tunnel, vice A. S. Begg, transferred. Office at Port Huron Tunnel.

J. McKeown has been appointed roadmas-

CURRENT TOPICS.

The Newfoundland Railway.

The general elections which will be held in Newfoundland on Nov. 8, will have especial interest from the fact that the railway contract with R. G. Reid will be the principal issue. The present Bond Government favors the repeal or radical amendment of the contract, & refuses to allow Mr. Reid to transfer his interests thereunder to a limited liability company, while the opposition endorses the contract in its entirety. A very complete statement of the whole affair was published in our July issue, page 204.

Similar Names for Railway Companies.

The Dominion Parliament last session incorporated the South Shore Line Ry. Co. to acquire the property of the Shore Line Ry. Co. in New Brunswick & to extend it. This is likely to lead to confusion as the South Shore Ry. Co., running from Sorel to St. Lambert, Que., was already in existence. There is altogether too close a similarity between the names of these two companies, & the officials who have charge of the railway legislation at Ottawa should point out cases of this sort to the railway committees of Parliament with a view to securing a change of name where such may be necessary to prevent confusion.

Railway Operating Rules.

As will be seen by reference to the Act to amend the Railway Act, which was given in full in our last issue, the measure as passed by Parliament differs very materially from the original form in which it was introduced by the Minister of Railways, & has been changed to meet the objections urged in our April issue. We then particularly drew attention to the clause which proposed to empower the Railways Committee of the Privy Council to make rules for the operating of the railways which should supersede the rules of the railway companies where they differed therefrom. This proposed clause was entirely struck out, as we suggested, & an amendment made to section 217 of the act, which merely extends the power of the Governor-in-Council in regard to the sanctioning of the operating rules.

Sunday Cars at St. John, N.B.

The efforts of the Sad Sunday Society at St. John, N.B., to stop the running of electric cars on Sundays have not met with success. The St. John Railway Co. operates an elec-

tric lighting plant as well as the railway, & gave it to be clearly understood that if its railway employees were stopped from operating the cars on Sundays, the employees in the electric lighting department would also have to stop work, which would have practically put the city in darkness after midnight on Saturday & until midnight on Sunday nights. However, this perfectly defensible measure did not become necessary, as the cases instituted by the Society before the Police Magistrate were dismissed. Counsel for the Co. contended that it was exempt under section 6 of the Sabbath Observance Act, which provides that the Act shall not apply to persons conveying travellers, & also contended that persons doing "a Sabbath day's journey," or 2,000 paces, about a quarter of a mile, were travellers.

The C.P.R. Land Department.

Mr. Hamilton, who has just retired from the C.P.R. service, after being in it for 19 years, first as Surveyor & Engineer in the Land Department, then as Assistant Land Commissioner, & for the past 12 years as Land Commissioner, has been a most valuable officer of the Co. Nearly all the Co.'s townsites from Fort William to the Pacific coast were surveyed by him. He had charge of the Co.'s land office at Vancouver when that city was founded, & for several years he took an active part in its civic affairs, & later he successfully administered the enormous business of the Land Department, with a domain larger than many principalities. In promoting Mr. Griffin to succeed him the management has recognized faithful & efficient service, Mr. Griffin having been connected with the Land Department for 17 years, for the past 9 of which he has been Assistant Commissioner. He is eminently qualified for the position, & his appointment will be exceedingly popular throughout the West, where his duties will lie.

C.P.R. Finances.

The Railway Times, of London, Eng., in referring to the change at the end of the C. P.R.'s fiscal year, from Dec. 31 to June 30, says there is really no reason why this Co. should not make up its accounts every half-year as the G. T.R. & most other railway companies do. The Times, no doubt, refers to the English practice, but it must be aware that yearly accounts, & not half-yearly ones, are usual on this continent. We do not see that the making up of accounts half-yearly would be of any benefit to the shareholders, while it would entail more expense on the company. Yearly

accounts & yearly meetings are quite enough, & accounts made up for a full year are much more easy of comparison than half-yearly ones.

The Times refers to what it calls the "vagaries" of C.P.R. finance, & thinks there are visions of more stock to be issued shortly. Should such an issue be made, it will undoubtedly be based on sufficient reasons. An expanding property such as the C.P.R., which is constantly opening up new territory, & which has enormous districts to develop west of Lake Superior, cannot be expected to keep its capital account stationary. If it did other roads would soon pass it. Judging by the Co.'s past expenditures, any additional capital laid out in this way will yield good returns, & will not in any way impair the original security.

The Greatest Railway Mileage.

In our July issue we pointed out that the C. P.R. then had 10,018 miles of line, which has since been increased to 10,035 miles. In a recent article on the leading railway systems of America, the Scientific American conceded the 10,018 miles, but placed two other lines ahead of it, claiming that the largest aggregation controlled by any one company is that of the New York Central, which totals 10,410, & that the Pennsylvania system comes next with 10,392 miles. These figures are certainly erroneous. The August issue of the Official Guide shows that the New York Central has but 2,924 miles, which includes the West Shore 495 & the Wallkill Valley 33 miles, also trackage over 79 miles. On the same authority the Pennsylvania system comprises 4,233 miles, which includes 38 miles of the N.Y. & Long Branch, & the Pennsylvania Lines west of Pittsburg comprise 2,865, including 90 miles of track operated jointly, a total of 7,098 miles. In the article referred to in our July issue we only credited the Pennsylvania with 4,233 miles, having omitted the lines west of Pittsburg. We should like to know how the Scientific American arrived at the mileage it accords the New York Central & the Pennsylvania. The figures we have quoted from the Official Guide are furnished by officials of the two companies mentioned & are no doubt reliable. Again, the Scientific American credits the Southern Pacific with over 9,000 miles, but it only has 7,313, & it gives the Union Pacific as 5,584, while the actual mileage is 3,031, including 75 miles operated jointly. It credits the Northern Pacific with 5,449, but the actual mileage is 4,993, including 39 miles operated jointly, & 5 miles of trackage rights.

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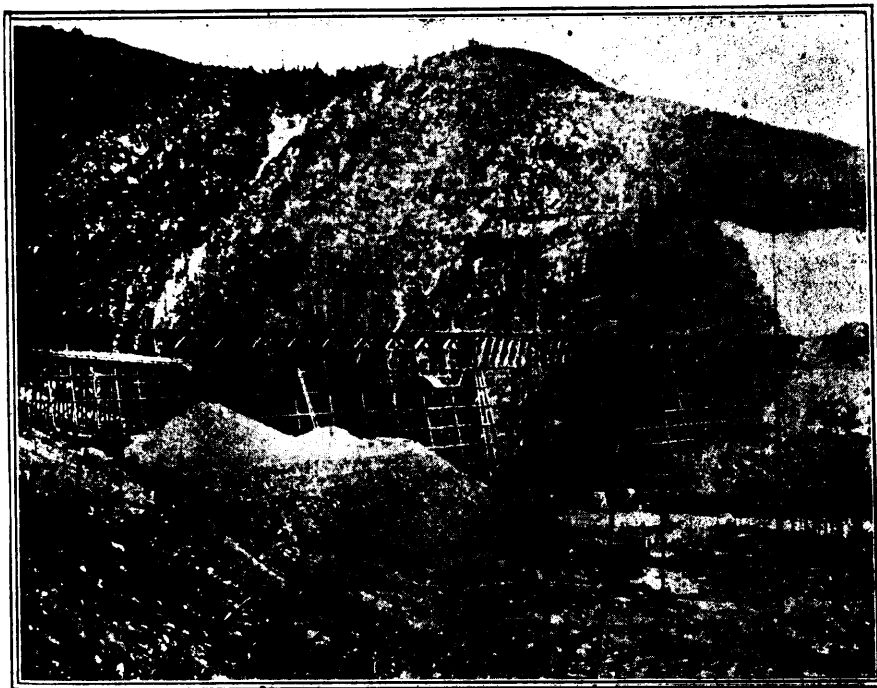


FIGURE 8.—HYDRAULIC FILLING ON THE C.P.R. AT MOUNTAIN CREEK, B.C. (SEE PAGE 261.)

We cannot understand this series of mistakes in a publication so well informed as the *Scientific American* usually is. However, the fact remains that the C.P.R. has the greatest mileage, & that it is the only railway which has passed the 10,000 mark.

Canvassing for Passengers & Baggage.

The case of the *Queen vs. the Verral Transfer Co.*, recently decided in Toronto, is of considerable importance to transportation companies. A by-law of the Police Commissioners of the City of Toronto, amongst other things, provides that, "No person licensed or authorized under this by-law shall employ or allow any runner or other person to assist or act in concert with him in obtaining any passenger or baggage at any of the stands, railway stations, steamboat landings or elsewhere in the said City." Some of the private cabmen complained to the Commissioners that the *Verral Co.* was violating the provisions of this by-law by canvassing for cab business, at what is known as the "Exit" at the Union Station. As the result of this complaint a prosecution was instituted by the police against G. W. Verral, the Manager of the Co., for employing a runner to assist him in obtaining passengers at the station. The defendant contended that the Union Station was private property, & did not come within the terms of the by-law. The Magistrate, however, decided that the exit from the station was within the terms of the by-law, & as the canvassing was admitted he imposed a fine of \$5 & costs. This conviction was appealed against, & came on for hearing in the *Queen's Bench* division of the High Court of Justice, before Judges Falconbridge & Street, who dismissed the appeal without going into the merits of the case, apparently holding that it was a question of fact for the magistrate to decide whether the exit was or was not a place within the meaning of the by-law, & they would not review his decision. The result is that the conviction stands, & the *Verral Co.*, or rather its successor, The *Canadian Transfer Co., Ltd.*, cannot lawfully canvass passengers at the Union Station. This decision does not, of course, interfere with the right of the Co. to canvass on the trains, which remains the same as before. As this decision practically deprives transportation companies of the control of their own pro-

perty, & is a serious interference with private rights, it is safe to assume that it will not be readily tolerated. If necessary an attempt should be made to secure an amendment to the Municipal Act to remedy the wrong.

Chicago & G.T. Finances.

A Chicago despatch of Sept. 18 says:—Judge Swan, of the U.S. Court, has granted a decree of foreclosure & sale of the C. & G.T.R., a part of the G.T.R. system, under the 1st mortgage covering the property of the Co. The complainants in the action are the *Mercantile Trust Co.*, of New York. The 1st mortgage was given April 10, 1880, to secure an issue of \$6,000,000 of bonds bearing 6% interest. John Bell, of Belleville, Ont., Solicitor for the G.T.R. Co. of Canada, & E. W. Meddaugh, of Detroit, were the trustees, but they resigned, & were succeeded by the *Mercantile Trust Co.*, complainants in the present suit. On Jan. 18, 1882, a 2nd mortgage was given to secure a further issue of \$6,000,000 bonds bearing interest at 5%, & on April 13, 1893, a 3rd mortgage was given to secure the same amount of bonds at the same interest. The decree was granted by consent of all parties to the suit. It is found that the C. & G.T.R. Co. is

indebted in large sums over & above the three mortgages, & that the property, franchises & rights of the Co. should be sold without delay. The amount due on the 1st mortgage, with interest, is now nearly \$6,000,000. The amount due is ordered to be paid within 10 days, or in default all the property of the C. & G.T.R. Co. in Michigan, Indiana, & Illinois, is to be sold at Port Huron by public auction. By request of all parties to the suit, W. S. Harsha, clerk of the U. S. Circuit court, is appointed special master Commissioner to conduct the sale.

AN EX-PRESIDENT HEARD FROM.

The *Financial News*, London, Eng., says:—"We have received a copy of the correspondence which has passed between Sir Henry Tyler & Sir Rivers Wilson, with regard to the reorganization of the mortgage bonds of the C. & G.T.R. Sir Henry, in a letter to the Secretary of the G.T.R., refers to the 'discreditable character of the whole business.' To this Sir Charles replied: 'I cannot allow such an imputation on the Board of Directors of the G.T.R., & on myself, as their President, to pass without notice & protest.' Sir Henry rejoins that he is unable to withdraw the words, 'discreditable character,' with regard to the recent dealings with the mortgage bonds of the C. & G.T.R. Co.; explains his reasons at great length, & concludes by stating, 'You would, I apprehend, have no difficulty whatever in dealing fairly on the basis of an exchange of 4% debenture stock with the Amsterdam & English Committee whom you have apparently forced into an unhappy compromise. You might thus restore the good feeling, now so ruthlessly disturbed, which would be so valuable to you in the future, & would enable you to obtain on easier terms all further capital required for the G.T.R. system, including its connection—to the value of which you have testified at public meetings—the C. & G.T.R.' To this, Sir Rivers, in response, declined to enter upon a discussion of the various points which had been raised by Sir Henry. The reply of Sir Henry to this communication, states: 'As you add that the scheme I condemn is "framed in the interest alike of the C. & G.T.R., & of the G.T.R.," I am compelled to reply that no scheme which is founded on distinct repudiation can be to the interest of any company. The distinct repudiation of an obligation solemnly entered into & printed on every 2nd mortgage C. & G.T.R. bond—acted upon



FIGURE 9.—GRAVEL BED AND MONITOR, MOUNTAIN CREEK, B.C. (SEE PAGE 261.)

for 18 years, & due to be fulfilled for 22 years more—by means of what I may call a mere trick of foreclosure, fully justifies me in applying the term discreditable—or, to use your own synonym, dishonorable—to the President & the board so unnecessarily engaged in carrying it into effect."

C.P.R. Earnings & Expenses.

Gross earnings, working expenses, net profits and increases or decreases over 1899, from Jan. 1, 1900 :

	Earnings.	Expenses.	Net Profits.	Increase or Decrease.
Jan.	\$2,152,071.32	\$1,460,501.71	\$691,569.61	\$74,035.75+
Feb.	1,954,087.59	1,331,355.34	622,732.25	2,409,774+
Mar.	2,294,786.97	1,495,685.73	799,101.24	29,794.33+
Apr.	2,401,194.47	1,464,126.85	1,027,067.62	106,794.13+
May.	2,662,897.81	1,583,227.32	1,079,670.49	46,911.88+
June.	2,612,759.73	1,554,954.11	1,057,805.62	34,745.42+
July.	2,471,160.64	1,586,795.74	884,373.90	88,587.73+
	\$16,638,067.53	\$10,476,046.80	\$6,162,320.73	\$167,105.89

Approximate earnings for Aug. \$2,569,000, against \$2,429,000, in Aug. 1899. Increase \$140,000.

HALF-YEARLY DIVIDEND.

The directors have declared dividends of

2% on the preference stock, & 2½% on the common stock, for the ½ year ended June 30, payable, Oct. 1.

SUBSIDIARY LINES.

DULUTH, SOUTH SHORE & ATLANTIC.—Approximate earnings for Aug., \$254,440; increase over Aug., 1899, \$8,581.

Net earnings for 5 months to May 31, \$387,381, against \$282,905 for corresponding periods.

MINERAL RANGE, HANCOCK & CALUMET.—Approximate earnings for Aug., \$61,841; increase over Aug., 1899, \$9,523.

MINNEAPOLIS, ST. PAUL & SAULT STE. MARIE.—Approximate earnings for Aug., \$326,831; decrease from Aug., 1899, \$51,621.

Net earnings for 5 months to May 31, \$949,669, against \$559,031 for corresponding period.

It is said the C.P.R. has contracted to haul over its line from St. John, N.B., to Montreal, 80,000 tons of Springhill coal during the coming winter. This will be in the nature of an experiment.

Canadian Pacific Railway Land Sales.

	Acres.		Amount.	
	1900	1899	1900	1899
Jan.	31,486	14,718	\$100,857.85	\$46,411.35
Feb.	23,613	13,747	75,771.19	43,371.60
Mar.	31,183	24,045	97,777.79	75,460.70
April.	58,457	36,626	181,775.78	116,835.84
May.	66,957	26,584	214,851.09	88,928.98
June.	57,831	54,225	188,779.64	169,192.74
July.	49,715	47,401	129,481.42	149,546.48
Aug.	32,178	35,214	103,480.78	110,705.50
	341,520	252,560	\$1,092,775.54	\$800,453.34

Grand Trunk Earnings, Expenses, &c.

The secretary has issued from the London office the results, subject to audit, of the accounts for the ½ year ended June 30, against which we have placed for purposes of comparison the figures for the corresponding ½ of 1899 :

	1899.	1900.
Gross receipts.....	£1,983,200	£2,130,000
Working expenses.....	1,298,200	1,442,000
Net receipts.....	£685,000	£697,000
Net revenue charges, less credits.....	489,800	491,300
Balance of net revenue.....	£195,200	£205,700

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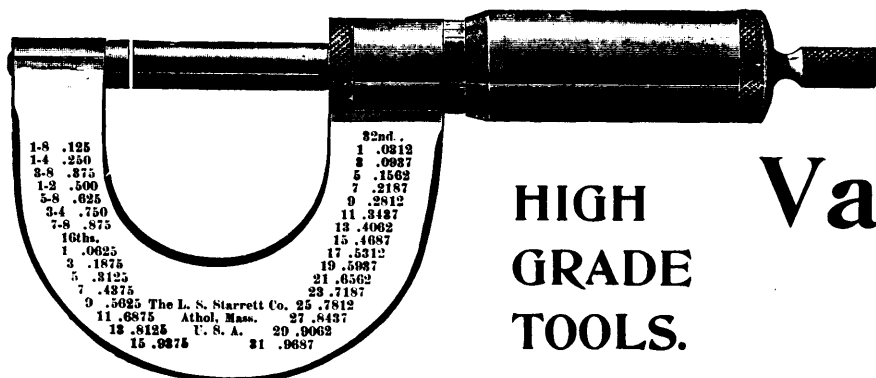
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- Montreal, Que. Chatham, Ont. Peterboro, Ont. Vancouver, B.C. Moncton, N.B. Stratford, Ont.
- Kingston, Ont. Windsor, Ont.

THE FAIRBANKS COMPANY.



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Valves, Pipe Fittings.

HIGH GRADE TOOLS.

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The Fairbanks Co., 749 Craig St., Montreal, Que.

Deduct—Amounts payable by the Co. under traffic & other agreements, Chicago & G. T. Co.	£36,400	£30,800
Detroit, G. H. & M. Co.	22,400	22,900
Total deductions	£58,800	£53,700
Surplus for the ½ year	£136,400	£154,000
Add—Balance brought from previous ½ year	4,200	3,900
Balance available for dividend	£140,600	£155,900

The above balance admits of the payment of the full dividend for the ½ year on the 4% guaranteed stock, & a dividend of 1½% on the 1st preference stock, leaving about £2,000 to be carried forward.

The following statement of earnings, supplied from the Montreal office, includes the G.T. of Canada, & the Detroit, Grand Haven

TRAFFIC RECEIPTS OF THE SYSTEM.

Traffic receipts, July. 1 to Aug. 31 :	1900.	1899.	In-crease.	De-crease.
Grand Trunk	£769,523	£752,645	£16,878	.....
D., G. H. & M.	38,660	41,372	.....	2,712
Total	£808,183	£794,017	£14,166	.....

G. B. Reeve's California Ranch.

The many friends of George B. Reeve, ex-General Traffic Manager of the G.T.R., will be pleased to see the views of his home, La Pomelo Rancho, La Mirada, Cal., which are given on page 275. The first view shows the ranch buildings. On the right of the view is the farm hands' house, next to it the long low building is the engine house, then the driving shed, horse corral, barn, packing house &

lines, & we have already very good connections by the existing lines."

Compound Decapod for M., St. P. & S. Ste. M. Ry.

The Baldwin Locomotive Works has recently delivered to the C.P.R.'s subsidiary line, the Minneapolis, St. Paul & Sault Ste. Marie Ry., for service between Minneapolis & Pennington, Wis., 165 miles, a compound decapod locomotive, illustrations of which are given on page 275. The ruling grade on that division is 42 ft. to the mile, one such grade being 10 miles long. The maximum grade is 63 ft. per mile, but it is not expected to haul the full tonnage over that grade without doubling. The decapod is expected to haul, when working compound, a train weighing 2,000



FIGURE 10. — SNOW-SHEDS ON THE C. P. R. IN THE SELKIRK MOUNTAINS, B. C. THE WINTER TRACK UNDER COVER ; THE OUTER TRACK FOR SUMMER USE. (SEE PAGE 258.)

& Milwaukee Rys., the earnings of the Chicago & G.T., which is in the hands of receivers, being omitted :

	1900.	1899.	Increase.	Decrease.
July	\$1,844,458	\$1,799,945	\$44,513	.....
Aug.	2,088,602	2,064,269	24,333	.....
	\$3,933,060	\$3,864,214	\$68,846	.....

The following figures are issued from the London, England office :

GRAND TRUNK RAILWAY.

Revenue statement for July :

	1900.	1899.	Increase.	Decrease.
Gross receipts	£360,400	£350,147	£10,253	.....
Working expenses	242,600	235,115	7,485	.....
Net profit	£117,800	£115,032	£2,768	.....

DETROIT, GRAND HAVEN & MILWAUKEE RY.

Revenue statement for July :

	1900.	1899.	Increase.	Decrease.
Gross receipts	£18,500	£79,704	.....	£1,204
Working expenses	13,300	12,811	489	.....
Net profit	£5,200	£6,893	.....	£1,693

chicken corral, winding up at the left with the water-tower, which contains two tanks of 30,000 gals. each.

The second view shows Mr. Reeve's residence, part of the reservoir, with Mrs. Reeve & the Superintendent of the ranch, S. H. Druce, sitting on its edge, & Mr. Reeve returning from shooting, not empty handed. The reservoir is of solid cement, & holds 333,000 gallons. The principal products of the ranch are lemons, oranges, grape fruit & walnuts, while in what is termed the home garden, there are figs, almonds, apples, pears, plums, quinces, sapodillas, peaches, apricots, & berries of all kinds.

In answer to a question as to whether the G.T.R. intended establishing an Atlantic steamship line, General Manager Hays recently said :—"It is not advisable, as a rule, for railway companies to operate steamship

tons, exclusive of the tender & caboose, on a 42-ft. grade.

The total weight in working order is 207,210 lbs. & 184,360 lbs. are on 5 pairs of drivers. The main driving journals are 9½ in. in diameter by 12 in. long, & the others are 8½ x 12 in. The driving wheel base is 19 ft. 4 in., the engine wheel base is 28 ft., & the length of the engine & tender over all is 68 ft. 10 in. The tender loaded weighs 120,000 lbs. & has a capacity for 7,000 gals. of water & 9 tons of coal, & the Westinghouse friction buffer will be used at the rear of the tender.

The cylinders are 17 & 28 in. x 32 in., the driving wheels are 55 in. in diameter & the working steam pressure is 215 lbs. The boiler is of the radial stay wagon top type, 68 in. in diameter at the front, & the firebox is 11 ft. long by 3 ft. 5¼ in. wide ; the depth of the firebox at the front is 77¾ in., & 75¾ in. deep

at the back. There are 344 tubes, 2 in. in outside diameter & 15 ft. 7 in. long. The firebox heating surface is 201 sq. ft., the tube heating surface is 2,799 sq. ft., making a total of 3,000 sq. ft.; the grate area is 37.5 sq. ft. Piston valves are used having a travel of 5 1/4 in. The special equipment includes American-Westinghouse driver brakes & Westinghouse tender brakes. General dimensions other than those mentioned above are as follows:—

Gauge	4 ft. 8 1/2 in.
Fuel	Soft coal
Wheel base, total (engine and tender)	57 ft. 4 in.
Length over all, engine	45 ft. 6 in.
Height, centre of boiler above rails	12 ft. 11 in.
Height of stack, above rails	14 ft. 7 in.
Drivers, material of centres	Cast steel
Truck wheels, diameter	30 in.
Journals, truck axle, size	6 x 10 in.
Main crank pin, size	6 1/2 x 7 in.
Piston rod, diameter	4 1/2 in.
Main rod, length center to center	9 ft. 5 1/2 in.
Steam ports, circular length	20 in.
Steam ports, width	1 1/2 in.
Exhaust ports, length	20 in.
Exhaust ports, width	4 1/2 in.
Bridge, width	3 & 2 1/2 in.
Valves	Balance piston
Valves, greatest travel	5 1/4 in.
Valves, outside lap	H. P. 3/4 in.—L. P. 1/2 in.
Valves, inside lap	H. P. 3/4 in. negative—L. P. 1/2 in.
Valves, lead in full gear	H. P. 0—L. P. 1/4 in.
Boiler, material in barrel	Steel
Boiler, thickness of material in barrel	11-16 in. & 3/4 in.

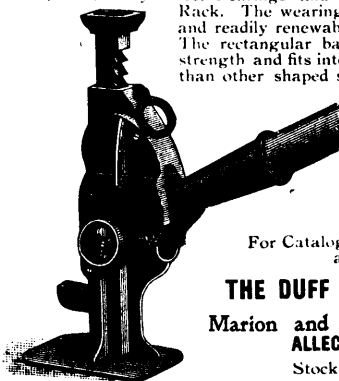
Seams, horizontal	Butt jointed with double cover strips
Seams, circumferential	Double riveted
Thickness of tube sheets	1/2 in.
Thickness of crown sheet	3/8 in.
Crown sheet stayed with	Radial stays
Dome, diameter	32 1/2 in.
Firebox, material	Steel
Firebox, thickness of sheets	5-16 in.
Firebox, with brick arch	
Firebox, water space, width	
Grate	Front, 4 in.; Sides, 3 1/2 in.; Back, 3 1/2 in.
Smokebox, diameter	69 in.
Smokebox, length	6 1/2 in.
Exhaust nozzle	Double
Exhaust nozzle	Permanent
Stack	Straight
Stack, least diameter	16 in.
Stack, height above smokebox	2 ft. 7 in.
Type	Swivel truck
Material in tank	Steel
Thickness of tank sheets	1/4 & 3-16 in.
Type of under-frame	Steel channels
Type of truck	1-beam bolster, arch bar
Truck with rigid bolster	
Type of truck spring	Triple elliptic
Diameter of truck wheels	33 in.
Diameter & length of axle journals	5 1/2 x 10 in.
Distance between centers of journals	77 in.
Type of truck bolster	1 beam
Type of truck transom	Channel
Length of tender frame over bumpers	28 ft. 3 1/2 in.
Width of tank	24 ft. 7 in.
Height of tank, not including collar	10 ft.
Height of tank over collar	4 ft. 6 in.
Type of back drawhead	5 ft. 4 in.
	Westinghouse friction draft gear.

Railway Equipment Notes.


The Great Northern of Canada is receiving considerable new equipment. The Lake Erie & Detroit River Ry. recently purchased 3 locomotives in the U.S. The Newfoundland Ry. recently received 4 locomotives from the Baldwin Locomotive Works. The Algoma Central recently placed an order in the U.S. for 100 flat cars of 40 tons capacity. The Richmond Locomotive & Machine Works will soon be operated throughout by electricity. The Ottawa & New York is about to purchase 2 freight locomotives, but not any passenger locomotives, as erroneously stated in some papers. Orders issued a short time since by the Northern Pacific for freight cars, the cost of which in the aggregate would have been \$250,000, have been countermanded, owing to the partial failure of the wheat crop in the Northwest. Mackenzie, Mann & Co., recently purchased an official car in Chicago, which has been lettered Canadian Northern & named the Atikokan. The car Dauphin, which they previously used, has been transferred to Sup-

THE BARRETT TRACK JACK.

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Road Masters' Association of America.



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These Jacks are made with Malleable Iron Frames, Steel Pawls, Machinery Steel Bearings and Pivots, forged Steel Rack. The wearing parts are removable and readily renewable at slight expense. The rectangular base gives great lifting strength and fits into close quarters better than other shaped stands. Adaptable to either high or low set loads. The Barrett Jack is the safest, best and strongest known to the railroad world to-day. Lifting capacity 10 to 15 tons.

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THE PAGE WIRE FENCE CO., LTD., WALKERVILLE, CANADA.



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promptness secures business
immediate information is required:
an answer is wanted, and wanted quick:
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BUILDINGS ON G. B. REEVE'S RANCH, LA MIRADA, CALIFORNIA.

erintendent Hanna, of the Canadian Northern.

The Ottawa & Gatineau & the Pontiac & Pacific Junction Rys. are in the market for some passenger & freight equipment, as mentioned in our June issue, pg. 167. Master Mechanic Kay recently visited Cincinnati to inspect some 1st class coaches there, but at latest advice no order had been placed by either Co.

The Richmond Locomotive Works has recently received, by cable, from the Finland State Railways an order for twelve 16 x 24 inch 10-wheeled passenger locomotives. The contract price of this order aggregates upward of \$160,000. This is the third order for engines received by the Richmond Works from the Finland State Railways, & is an illustration of the increasing demand for American locomotives abroad.

At the Master Mechanics' Association Convention in June it was reported to have been stated that the first steel cab built on a locomotive was in 1891, on the Southern Pacific System. F. R. F. Brown, of Montreal, wrote to a contemporary stating that this was not the case, & that he believed that the first steel cab put on a locomotive was built by him when he was Mechanical Superintendent of the C. P. R. in 1889. L. B. Paxson, of the Philadelphia & Reading, followed this up with a letter

stating that the first iron cabs for locomotives were built on that road in 1859.

A Chicago despatch says two boats left South Chicago Sep. 25 with more than two complete railway trains for cargoes. The boats are car ferry barges nos. 1 & 2 of the Lake Michigan Car Ferry Transportation Co. They carried two complete locomotives, set up & ready for running, 40 flat cars & 2 passenger coaches. They are bound for the harbor at Michipicoton & will be used on the Algoma Central Ry. Michipicoton harbor is without any rail connection with the outside world, & so all supplies are shipped in by boat. The car ferry barges, being designed for this work, with tracks on their decks, were chartered, & loaded the outfit at Calumet.

The Prince Edward Island Ry. is getting two narrow gauge locomotives, with 4 coupled wheels & 4-wheeled truck, of which the following are the general dimensions.

Gauge	3 ft. 6 in.
Driving wheels, diameter inside of tire.....	42 in.
Cylinders, diameter.....	15 in.
Stroke.....	20 in.
Rigid wheel base.....	7 ft. 9 in.
Engine wheel base.....	19 ft. 8 in.
Truck.....	4-wheeled
Total wheel base of engine & tender.....	38 ft. 6 in.
Weight on drivers.....	43,000 lbs.
Weight on truck.....	22,000 lbs.
Total weight of engine about, but not less than.....	60,000 lbs.
Fuel.....	Soft coal

Tender.....	4-wheeled trucks
Capacity of tank.....	2,200 Imp. gals.

At the Prince Edward Island Ry. shops at Charlottetown there have been built this year two 1st class cars for winter service 42 ft. long, 1 baggage car 42 ft. long, 18 box cars 28 ft. long of about 12 tons capacity & 20 platform cars. A 1st class 50 ft. long is now being built and another will be built this year, also one second class car. Vacuum brakes & Miller couplers are used on all passenger equipment. Very few of the freight cars are equipped with air brakes. An order has recently been placed for steel tire wheels for all passenger cars. The Dominion estimates for the current year provide \$10,000 for rolling stock for this line & \$3,500 for machinery. With the latter amount there will be purchased a planer, a mortiser, a boring machine, a bolt cutter & 2 lathes for the machine shop.

What is said to be the largest locomotive in the world was recently built for the Pittsburgh, Bessemer & Lake Erie Ry. With others to be constructed it will be used in hauling exceptionally long, heavy trains of ore & iron at moderate speeds. The net hauling capacity on a level & nearly straight track is 7,847 tons. When the engine is working up to its full power, the drawbar pull is 56,300 lbs. The total weight of the engine alone is 125 tons, & of the tender 70 tons. The boiler is 88 ins.



G. B. REEVE'S RESIDENCE, LA POMELO RANCHO, LA MIRADA, CALIFORNIA.

in diameter at the throat-sheet. There are 406 2¼-inch tubes in the boiler, each measuring 15 ft. over the sheets, & the total heating surface in the tubes is 3,564 sq. ft. The heating surface in the firebox is 241 sq. ft. & the grate area 26.8 sq. ft. The total heating surface is 3,805 sq. ft. The driving journals, on the front intermediate, & back axles measure 9 by 13 ins.; the main driving journals measure 10 by 13 ins., the main crank pin is 7½ ins. in diameter by 8 ins. in length. The cylinders are 24 ins. in diameter by 32 ins. in length, piston rods have a diameter of 4½ ins. The tender has a tank capacity of 7,500 gals., & carries 14 tons of coal.

On the Great Northern Ry. of England the problem of automatic couplings has been ingeniously solved. As a foundation the automatic coupler of the M.C.B. Association of the U.S. has been taken, & this had been modified so that it is incorporated with the ordinary English hook & chain. When the coaches are to be coupled automatically, the couplings are so arranged as to be held rigidly in a horizontal position when they engage, in the usual way common in the U.S. If, however, the carriage is so fitted as to be incorporated with an ordinary train, the automatic coupler is allowed to hang vertically & the hook common to English carriages is exposed, & can be used with a shackle exactly in the usual manner. The side buffers are arranged so that they can be run back out of the way when not required, but if the hook & shackle are used they are brought forward & held extended by a half sleeve on the shanks; the usual play on the buffer springs being, of course, retained. Other English railways, the Northeastern, the North-British & the Great Central, are also fitting their rolling stock with automatic couplers of the same description.

After repeated delays, the law which the U.S. Congress enacted in Mar. 1893, requiring all railway companies engaged in interstate commerce to equip their cars with power or train brakes & automatic couplers, went into effect on Aug. 1. It is expected that full compliance with the law will tend to greatly lessen the number of accidental injuries & deaths among railway trainmen. As a matter of fact, statistics show that the number of accidents has been growing less since the roads began to equip their cars with the power brakes & automatic couplers. When the law was passed 7 years ago, only 23% of the freight cars in use were supplied with air brakes, & but a slightly larger proportion had automatic couplers. Four years later 33% had air brakes & 50% were fitted with couplers. The number of railway employes killed during the twelve months ended with June 30, 1893, was 2,727, & for the year ended June 30, 1897, the number was 1,693. Since Jan. 1 the companies have been making tremendous efforts to equip all of their rolling stock with air brakes and automatic couplers, & a majority of the big railways are now in a position to fully comply with the law.

The Algoma Central is obtaining 4 consolidation locomotives from the Baldwin Locomotive Works. Following are the general dimensions:—

Cylinders, diameter	21 in.
" stroke	30 in.
" valve	Balanced piston
Boiler, diameter	68 in.
" thickness of sheets	¼ in. & ½ in.
" working pressure	200 lbs.
Fuel	Soft coal
Firebox, material	Steel
" length	120 in.
" width	42 in.
" depth	F. 72½ in., B. 60 in.
" thickness of sheets, sides	¼ in.
" " back	¾ in.
" " crown	¾ in.
" " tube	¾ in.

Tubes, number	406
" diameter	2¼ in.
" length	15 ft. 6 in.
Heating Surface, firebox	241 sq. ft.
" tubes	2,455 sq. ft.
" total	2,455 sq. ft.
" grate area	26.8 sq. ft.
Driving Wheels, diameter outside	56 in.
" diameter of centre	50 in.
" journals	8½ x 11 in.
Engine Truck Wheels, diameter	30 in.
" journals	6 in. x 10 in.
Wheel Base, driving	15 ft. 1 in.
" total engine	23 ft. 9 in.
" total engine & tender	52 ft. 6 in.
Weight, on drivers	158,800
" on truck	16,000
" total engine	174,800
" total engine & tender about	265,000
Tender, diameter of wheels	33 in.
" journals	5 in. x 9 in.
" tank capacity	4,500 gals.
Service	Freight

Intercolonial Railway Equipment.

The Dominion Parliament last session voted the following amounts:

CHARGEABLE TO CAPITAL.

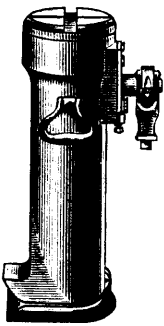
Rolling stock	\$190,000
Machinery at various points	11,200
To change air brakes on passenger cars etc.	13 0 0
To apply air brakes to freight cars	40,000
To change couplers on passenger cars	26,000
To equip passenger cars with vestibules	10,000
Machinery at shops	5,000
To change drawbars on freight cars	20,000
Additional rolling stock	950,000
To purchase tools & machinery	66,000
To equip passenger cars with gas apparatus	4,800

In addition to the order mentioned in our last issue as having been placed with the Richmond Locomotive & Machine Works for 10 consolidated locomotives, another order has been placed in the United States for eight 10 wheel locomotives, designed for fast passenger service, with cylinders 20x26 ins. & 72 ins. drivers, delivery to be made as soon as

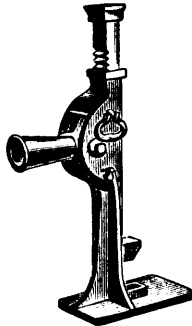
Norton's Ball Bearing Jacks.

Standard Wherever Jacks are Used.

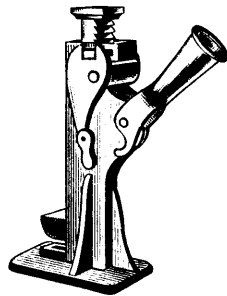
50 STYLES. 8 TO 70 TONS CAPACITY.



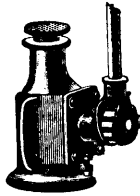
40 Ton Jack.



10 Ton Automatic Lowering Jack.



15 Ton Track Jack.



8 Ton Jack.

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"PHENIX" Loco. Spring Steel is the accepted Standard in Canada.

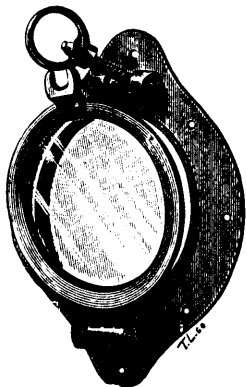
SOLE AGENTS:

James Hutton & Co., Montreal.

NEW BOOKLETS.

The Chicago, Milwaukee & St. Paul Railway is issuing a series of booklets regarding points of interest along its lines, and if you are interested in the western country, or contemplating a trip, write GEO. H. HEAFORD, General Passenger Agent, Chicago, Ill., for the special publication desired, enclosing four cents in stamps for postage for each one.

- No. 1. The Pioneer Limited.
- No. 2. The Land of Bread and Butter.
- No. 3. The Fox Lake Country.
- No. 4. Fishing in the Great North Woods.
- No. 5. The Lake Superior Country.
- No. 6. Cape Nome Gold Diggings.
- No. 8. Summer Days in the Lake Country.
- No. 9. Summer Homes, 1900.
- No. 11. The Game of Skat.
- No. 12. Milwaukee—The Convention City.
- No. 13. A Farm in the Timber Country.
- No. 14. Stock Raising in the Sunshine State.
- No. 15. Hunting and Fishing.



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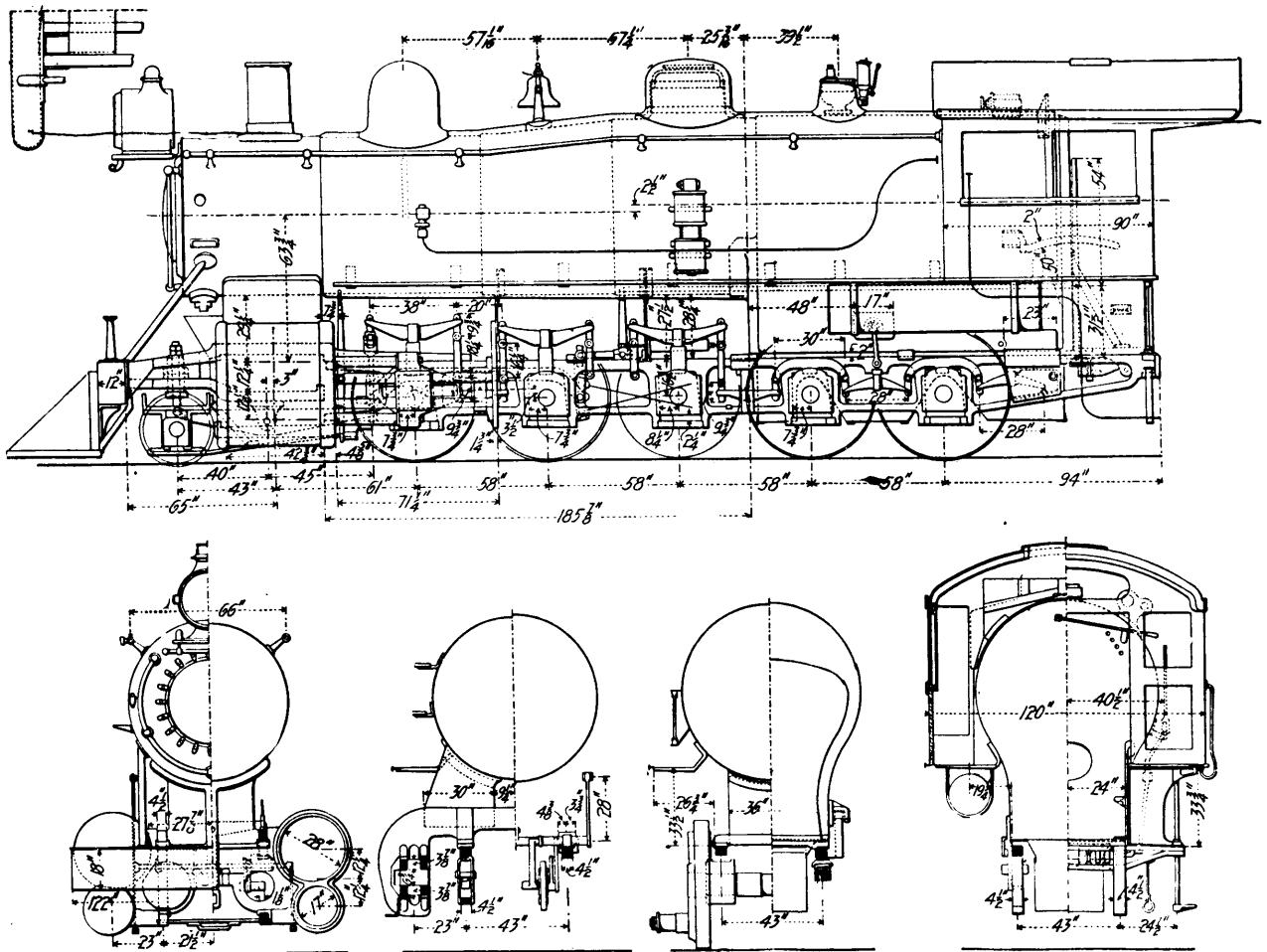
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STOVEL'S
RAILWAY and STEAMSHIP TIMETABLES, MAPS, Etc.
At Bookstores. On Trains. 5c.
POCKET DIRECTORY.



BALDWIN COMPOUND DECAPOD LOCOMOTIVE FOR MINNEAPOLIS, ST. PAUL AND SAULT STE. MARIE RAILWAY.

possible. It is expected that a further order for 10 will be placed shortly.

The following cars are expected to be added this year on capital account:—4 sleepers, 6 first class, 3 diners, 6 second class, 3 postal & express, 3 baggage, 4 postal, 39 refrigerator & live stock, 1,500 box of 60,000 lbs capacity.

Grand Trunk Railway Equipment.

Press reports say the Co. has placed orders in the U.S. for a number of mogul locomotives.

An order is said to have been placed in the Co.'s Montreal shops for 1,000 box cars of 60,000 lbs capacity.

Twenty-five passenger & freight locomotives, whose usefulness had gone, were recently broken up at the Montreal shops.

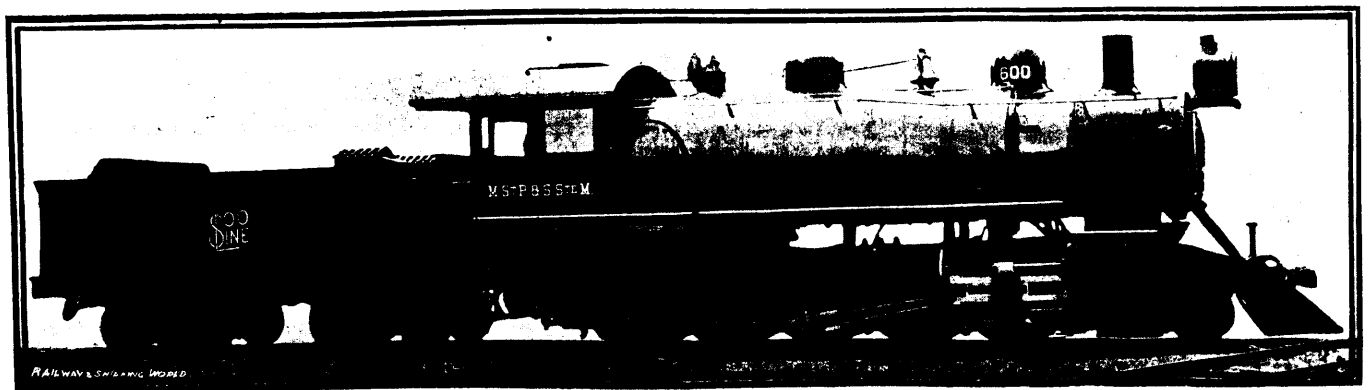
Fifty new cinder dump cars have been put into service at terminal points between Montreal & Port Huron. They were built at the Montreal shops.

Five more 1st-class coaches of the 800 series have recently been completed at the Co.'s Montreal shops. They are 68 ft. long, with a seating capacity for 68 passengers, the body of the car holding 54 & the smoking-room 14. They have wide vestibules & are up to date in every respect.

The Co.'s Montreal shops have recently completed 2 heavy freight locomotives of the 900 class. They form part of an order of 24 of similar character which will be completed within the next few months. The weight of these engines is 175,000 lbs, & the tender 90,000 lbs, making a total weight of 250,000 lbs. The locomotives will be able to handle between 45 and 50 loaded cars on an ordinary grade.

The Co. recently placed an order in the U. S. for 300 coal cars of 80,000 lbs. capacity. The general dimensions are 37 ft. 11 1/2 ins. long over end sills, 4 ft. 3 in. high from top of floor to top of box, 9 ins. wide over side sills. The cars are to be equipped with M.C.B. draft gear, automatic couplers, Westinghouse air brakes, twin hoppers, standard M.C.B. 5x9 iron axles, 650 lb. cast iron wheels, cast iron journal boxes, metallic brake beams, longitudinal sills 6x12, end sills 9x12 & malleable iron stake pockets.

The management having decided to renumber every piece of rolling stock in its possession, with the exception of locomotives, the work is now proceeding. It will probably occupy more than a year, & will involve a large expenditure. M. C. Sturtevant, Superintendent of Car Service, is in charge of the work; the renumbering will be according to



BALDWIN COMPOUND DECAPOD LOCOMOTIVE FOR MINNEAPOLIS, ST. PAUL AND SAULT STE. MARIE RAILWAY.

class, length & capacity. The subjoined table is explanatory :

Passenger equipment.....	1 to 2,999
Box cars.....	3,000 to 29,999
Furniture.....	30,000 to 39,999
Refrigerators.....	40,000 to 49,999
Stock cars.....	50,000 to 59,999
Flat cars.....	60,000 to 69,999
Coal cars.....	70,000 to 79,999
Tank cars.....	80,000 to 89,999
Caboose & miscellaneous cars.....	90,000 to 99,999

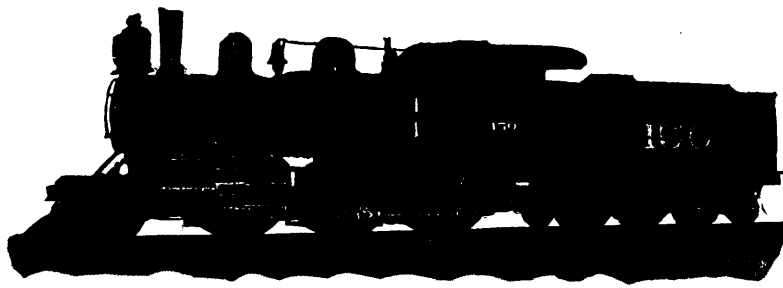
Cars of the present standard of dimensions in each class are assigned the lower numbers in the particular series selected. There are sufficient spare numbers to provide for such cars as may be constructed or acquired by the Co. within 7 or 8 years. Then come cars of smaller lengths & capacity. The plan contemplates that by the time the intervening numbers are utilized, the older cars will have become demolished, & equipment added can be numbered in sequence to the completion of the allotment. Before this is accomplished the earlier numbers will have become vacant, & it will be practicable to revert to the numbers first employed, & repeat the operation throughout all the series.

Two new dining-cars have recently been put on between Suspension Bridge & Chicago. They are 74 feet over all, & are equipped with standard wide vestibules, steel platforms and 6-wheel trucks, with 33-ins. steel tired wheels. Air signals are attached, an anti-telescoping device affixed, & all modern appliances added.

The general exterior appearance of the cars is similar to the new standard day coaches which are run on the G.T.R. system. The windows are glazed with heavy plate glass, are all double, being dust proof when shut. The dining-room is 31 ft. 8 ins. long, & will seat 30 comfortably. The general style of the interior design is colonial, in quartered oak. The chairs are of oak, upholstered in leather. The windows are decorated with costly draperies, and the openings into the dining-room are provided with ornamental portieres. The floors are carpeted with handsomely designed Wilton throughout the whole length of the car, & the vestibuled floors are covered with rubber tiling. The kitchen & pantry are equipped with refrigerators, range, steam table, lockers & all modern conveniences, the tables being covered with polished brass. A handsome sideboard is placed at one end of the dining-room just in front of the pantry & opposite to the sideboard a wine locker is provided. China & linen closets, wardrobes & white metal washstands are in evidence in accordance with modern practice. The cars are heated with hot water coils in connection with steam from the engine, & lighted by acme lamps, & the trimmings throughout are of solid bronze most beautifully designed. The car, which is running between Suspension Bridge & Port Huron, is elaborately decorated in a general green & gold effect, while the one operated

between Port Huron & Chicago is decorated in gold, maroon being the predominating color, giving the car a most comfortable appearance.

Two buffet & parlor cars built in the Co.'s Montreal shops have recently been placed on the International Limited, running between Montreal & Toronto. It is a common belief, but altogether erroneous, that all the Pullman cars used to be built at the Pullman works in Illinois. At the G.T.R. Montreal workshops 35 Pullmans have been constructed, & it was a favorite saying of the late G. M. Pullman that next to those built in his own workshops, he liked those constructed by W. McWood, & certain it is that the experience gained by the G.T.R. Master Car Builder in the manufacture of Pullmans has been turned to splendid account in the two handsome specimens of railway rolling stock now referred to. The cars are striking in the first place by reason of their size, measuring 71 ft. from sill to sill, & if the vestibule be included an additional 10 ft. The vestibules are of the Pullman standard type with steel platforms. The cars are built on 6 wheel trucks with steel tires. The framework of the exterior of the cars is white wood, painted with the G.T.R. standard body color, bottle green, tastefully & exquisitely finished. The furnishing of the interior is of Canadian quartered oak, finished with English oak lining. The head lining is engaged to harmonize with the olive-colored & gold-



Richmond Locomotive and Machine Works,

RICHMOND, VIRGINIA, U.S.A.

BUILDERS OF

Simple and Compound

LOCOMOTIVES.

Adapted to every variety of service.

MANITOBA

The Government Crop Bulletin issued Dec. 12th, 1899, gives the following statistics for the year:

CROPS.

ACRES.	AVERAGE YIELD.	TOTAL.
Wheat.....1,629,995	17.13 bus.	27,922,230 bus.
Oats.....575,136	38.80 "	22,318,378 "
Barley.....182,912	29.4 "	5,379,156 "
Potatoes...19,151	168.5 "	3,226,395 "

STOCK.

Beef Cattle exported during the year	12,000
Stockers exported.....	35,000
Total value dairy products.....	\$470,559 09

10,500 FARM LABORERS

Came from Eastern Canada to assist in the harvest fields of Manitoba in 1899—and the demand was not fully satisfied.

MANITOBA FARMERS ARE PROSPEROUS.

Farmers erected, last year, farm buildings valued at one and one-half million dollars.

MANITOBA LANDS—For sale by the Provincial Government. Over 1,600,000 acres of choice land in all parts of the Province are now offered at from \$2.00 to \$5.00 per acre. Payments extend over eight years. **Special Attention** is directed to 500,000 acres along the line of the Manitoba and Northwestern Railway at \$3.00 and \$3.50 per acre.

FREE HOMESTEADS are still available in many parts of the Province.

For full information, maps, etc., FREE, address J. A. DAVIDSON, Minister of Agriculture and Immigration, Winnipeg, Manitoba. Or C. H. JEFFERYS, Manitoba Emigration Agt., Union Station, Toronto, Ont.

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To **New York** and
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Route of the "Black Diamond Express," handsomest train in the world.

Leaving **Toronto** daily (except Sunday) at 9 a.m., Hamilton 9.55 a.m., arrive New York 10.08 p.m.

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Pullman Sleepers from Toronto, Hamilton and London to New York and Buffalo to Philadelphia.

Call on Grand Trunk Ticket Agents for tickets and further information, or address

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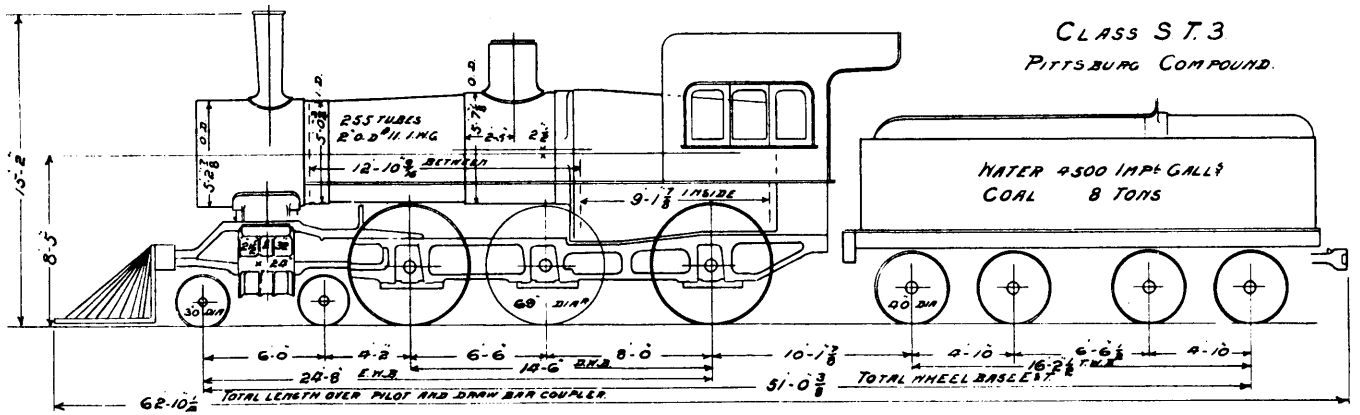
sell through tickets to the Old Country, cheaper than if passengers bought railway tickets to New York or Montreal, and then re-booked.

They also sell prepaid tickets to passengers coming from the old country, cheaper than the rate obtainable in Europe, and on favorable terms.

Apply to any agent Port Arthur and west, or to

W. P. F. CUMMINGS,

C.P.R. Offices, WINNIPEG.



CANADIAN PACIFIC RAILWAY COMPOUND PASSENGER LOCOMOTIVES NOS. 224 TO 227.

tinted ceiling. The roofs are of the elevated type, which are known in the U.S. as the monitor roof. Each car is so designed that the dining-room or cafe is at one end & the parlor at the other, with the kitchen & the waiters' room in the centre. The dining-room is capable of accommodating 24 people at the tables. The tables are not quite so large as the ordinary double table nor so small as the single table, but each is commodious enough for 4 persons. The leather-bottomed chairs with their polished oak frames look very pretty. The windows are large & provided with curtain hangings & roller blinds, & the floor coverings are Wilton pile. The transoms of embossed glass & other decorations, while in no way fantastic, are very artistic & in good taste. The parlor is furnished with 12 large revolving chairs upholstered in green figured plush, with a sofa to match, capable of affording seating accommodation for 3 persons, or of being used by an invalid when required for that purpose. Between each 2 chairs a small movable table can be placed for the convenience of those who desire to have light refreshments served there in preference to going in the dining room or who wish to engage in games for recreation. Two features in the interior of the cars are noticeable. One is the idea of perfect harmony which the designer has deftly carried out, & the other is the ingenuity displayed in utilizing every inch of space to the best advantage. Even the corners, which under ordinary circumstances are unoccupied, have been utilized as cupboards, with ornamental facings, semi-circular in shape, & in no way suggestive of cupboards until opened by the attendants. The lavatories & ladies' & children's toilet arrangements are in a manner unique & equipped with the latest modern devices for comfort, & here, too, it is observable that no space has been wasted. The kitchen with its coal range & large refrigerators through which the cold air circulates from top to bottom & from side to side through numerous small channels is de-

serving of notice. There are double sets of hot & cold water taps, the water being drawn from large cisterns above the kitchen range, but separated from it by galvanized iron canopy which keeps down the heat. The ice boxes, the requisites for cooking & washing, the arrangements for the hanging of food, & preparations of food, the pantries & cupboards are all as perfect as can be devised. No essential has been overlooked, not even the patent swill which carries off the waste water & prevents it dripping down on the kitchen floor. Away from the kitchen & the not less complete waiters' room adjoining is the cupboard for liquid refreshments, which is also fitted with ice boxes & receptacles for the bottles.

Canadian Pacific Railway Equipment.

A handsome official car, the Manitoba, was recently built at the Co.'s Hochelaga shops for President Shaughnessy.

No new locomotive work has been done in the Montreal shops since June. An order was placed for 10 consolidation locomotives, but it has not been proceeded with on account of the boiler maker's strike.

The 3 Atlantic type locomotives on the Montreal-Ottawa short run are doing the passenger service very easily, making the 111.4 miles in 2 hours & 20 minutes. They can easily do it in 2 hours, & probably in 1 hour & 50 minutes if required.

No passenger cars are being built by the Co. at present. At Perth work is being done on replacements of freight cars, & about 150 box & stock cars are being built. In the meantime further orders have been hung up owing to labor troubles.

A recent press despatch from Montreal stated that a dining car 70 ft. long, & one half of which was used as a parlor car, had been placed on the Imperial Limited. We are informed that this is incorrect, & that the Co. does not own a dining car divided in this way.

The Richmond Locomotive Works has com-

pleted delivery of the 12 compound consolidation locomotives ordered by the Co. Dimensions & an elevation of them were given in our last issue, pg. 202. Twelve other consolidation engines have also been received during the year from another works.

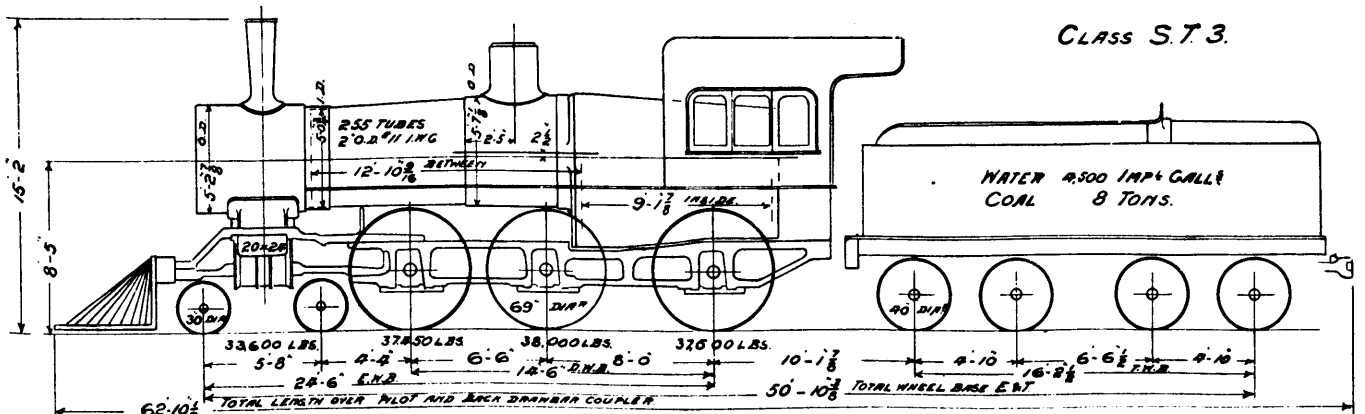
Between Nov. 1, 1899, & June 30, 1900, the Co.'s Montreal shops turned out 28 new locomotives, 19 for passenger service, 6 heavy shunting & 3 very heavy shunting. Of the passenger locomotives 15, or nos. 209 to 223, are simple, & 4, or nos. 224 to 227, are compound on the Pittsburg system. Of the number mentioned 19 were turned out during the first six months of this year. Elevations of the simple & compound passenger engines are given on this page. In addition to the dimensions, &c., shown on the diagram, the following apply to the simple locomotives :

Heating surface, tubes	1,717 sq. ft.
fire box	155 "
" " total	1,872 "
Grate area	32.25 "
Working pressure	200 lbs.
Steam ports	1 ft. 6 in. x 1 1/2 in.
Exhaust ports	1 ft. 6 in. x 3 in.
Balanced slide valve	
Travel of	5 1/2 in.
Crank pins, main	5 1/2 in. x 6 in. & 6 in. x 4 1/2 in.
" leading	4 in. x 3 1/2 in.
" trailing	4 in. x 3 1/2 in.
Driving journals	8 1/2 in. x 10 in.
Engine truck journals	5 in. x 8 in.
Tender " "	5 in. x 9 in.
Engine truck swing bolster	
Tender frame, steel	
Total weight engine	146,650 lbs.
" engine and tender	261,150 lbs.

These locomotives are giving very satisfactory service.

Canadian Electrical Association.

The annual convention of this Association was to have been held in Ottawa in June, but owing to the disastrous fire which occurred there in April it was impossible to carry out the proposed arrangements, & the convention was therefore held at Kingston on Aug. 29, 30 & 31. The membership of the Association showed a gain of three in the past year.



CANADIAN PACIFIC RAILWAY SIMPLE PASSENGER LOCOMOTIVES NOS 209 TO 223.

The President, A. A. Dion, in his annual address, made the following references, among others, to the developments of the past year:—

Some steam railways have been converted into trolley lines. Electric railways have been extended far out of cities, equipped with heavier rails, better rolling stock, larger generators, & more powerful motors, & higher speeds have prevailed. In the telegraph & telephone fields the past year has witnessed important extensions & improvements to existing systems. Among the many important works of the year the following may be mentioned:—

Extensions of the Metropolitan Ry., of Toronto, to Newmarket, 30 miles distant.

Extensions of the Ottawa Electric Ry. to Britannia on the Bay, & to the Dominion rifle ranges.

The conversion of the steam railway from Quebec to St. Anne de Beaupre, some 30 miles.

The adoption by the Montreal St. Ry. of electric power from Chambly, Que.

The extension of the Government telegraph system to the Yukon district, 600 miles, & along the north shore of the lower St. Lawrence for 300 miles down to Labrador.

The substitution of storage batteries & dynamos for chemical batteries in the plants of the G.N.W. & C.P.R. telegraph companies at several places.

The complete renewal of the Bell Telephone Co.'s plant at Ottawa, introducing the "central energy" system. The complete reconstruction of its lines there & into the

places, & the extension of its long distance system in all directions.

The following officers were elected: President, A. A. Dion, Ottawa; 1st Vice-President, E. E. Cary, St. Catharines; 2nd Vice-President, P. G. Gossler, Montreal; Secretary-Treasurer, C. H. Mortimer, Toronto; Executive Committee, J. J. Wright, Toronto; O. Higman, Ottawa; A. B. Smith, Toronto; D. R. Street, Ottawa; B. F. Reesor, Lindsay; W. H. Browne, Montreal; J. Yule, Guelph; F. W. Simmons, Kingston; W. J. Camp, Montreal; E. Slade, Quebec.

The convention for 1901 will be held in Ottawa, probably in July.

Condition of Operation of Street Cars in the City of Quebec.

By D. E. Blair, B.Sc., Chief Electrician
Q. R. L. & P. Co.

The following paper was read at the recent Convention of the Canadian Electrical Association:

Of all financial undertakings, none, perhaps, depends more upon the nature of local conditions than does the successful development of a city street railway system, and for this reason it may be of interest to the members of this Association to have before them a more or less general description of the difficulties encountered & overcome by those responsible for the development of the Quebec Street Railway.

Quebec, as a city, has many distinctive features that are not to be found in any other city in America, & the stranger within its fortified walls is very soon struck with the unique fashions, methods & temperament of the quiet people who make up what may be called the native population, numbering about 75,000, & of which about 65,000 are French-speaking.

When the construction of the road was first contemplated by those responsible for the promotion & fulfilment of the scheme, there existed certain unpromising conditions which tended to arouse the doubts of many as to the feasibility & possible financial success of the enterprise. Of these I might mention a few at random. Business, in general, is carried on in a very quiet & matter-of-fact way, & an observant critic does not notice the hustle & bustle so common in most modern cities of this continent. The salary of the clerk & the wages of the laborer are moderate, & the average individual very seldom seems inclined to do any more than he is paid for. The natural result of this state of affairs is that the electric street car was not likely to be looked upon as a valuable & indispensable time saver, as well as a welcome convenience, but rather as a luxury to be enjoyed by those who could afford it.

The manufacturing interests of the city are limited, & further development along this line is hindered by the somewhat strict conservatism of capital. Further, the average laborer or even expert workman is the proud possessor of a large family, several of whom are perhaps engaged in the same work as him-

WIRE ROPES, MARION STEAM SHOVELS, BALLAST UNLOADERS.



Columbus Pressed Bowl Wheel and Drag Scrapers.

.....Wheelbarrows, Picks, Shovels, Mattocks, Etc.

Contractors Rails and Dumping Cars.

Saddle Tank Locomotives.

JAMES COOPER, 299 ST. JAMES ST., MONTREAL.

Baldwin Locomotive Works

Burnham, Williams & Co.,

PHILADELPHIA, U. S. A.

GRAND PRIX,

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EXECUTIVE OFFICES

NOB. 346 and 348 BROADWAY, N.Y. CITY, U.S.A.

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self, & he finds it convenient & economical to live near his work, as rent in the manufacturing districts is very reasonable. The city is very compact & densely populated, being furthermore divided into certain sections which are practically self-contained municipalities. Public entertainments & social functions were very little appreciated or patronized, & the principal streets seemed almost deserted after 9 p.m. Although these conditions may have no direct bearing on the practical expenses of construction & operation, they were certainly not in favor of the credit side of the prospective railway company's cash book.

The more formidable objections, however, were of a practical nature. Five years ago, & even less, it was considered impossible that anything that looked like a street car could ever climb the steep, narrow & winding thoroughfares that lead from the water's edge to the highest points of the solid mass of rock upon which the city is built. Besides this, the heavy snowfalls, coupled with the narrowness of the streets, were likely to be a great hindrance to the service, but in spite of everything, the completion of the road was finally rushed through, & it has now been proved that the limiting conditions of the street railway operation were not overstepped in the bold undertaking which has given the people of Quebec a reliable & efficient means of transportation. The city has improved wonderfully since the inauguration of the road, & promises to become, before long, as wide-awake & progressive a centre as any in the country. Even theatrical entertainments have become more or less popular & everything seems to be moving at a faster pace than heretofore. On Nov. 1, 1896, was commenced the laying of the rails through the main streets of the city, & on July 1, 1897, the road was open to traffic.

SPECIFICATIONS OF TRACK were as follows:—72 lb. 6" steel T rails in 30 ft. lengths. Standard gauge laying on 7" ties at 28' centres. Each joint to be double rounded by two-00 solid copper wires in Eclipse copper bonding caps, these to be tinned, & ends of wires riveted on outside of rail. Double cross bands to be placed at every 5th joint—150 ft.

OVERHEAD CONSTRUCTION.—Tubular poles 28 ft. long, weighing 700 lbs., & spaced 90 ft. apart, are used throughout. Insulation is of Dirigo type, & trolley wire no. 00 hard-drawn. Span wires of standard galvanized steel wires 3/8" in diameter. Lightning arresters of non-arc type. All construction is elegant & of a substantial nature. Altogether there are 10 miles of span wire construction & 2 1/2 miles bracket.

CAR SHEDS.—Of these there are two, one in Upper Town, 210x120 ft., having 14 tracks & 7 doors, where all cars in service are laid up at night. The other is in Lower Town, & is used for storage purposes only. The capacity of the working car shed is 52 cars, & here all repairs are done. There are 7 floored pits communicating with the machine & blacksmith shops underneath. It has been found cheaper to manufacture most of the repair parts than to purchase them from supply dealers.

PAVING.—At this time all streets, without exception, were covered with a generous laying of macadam. Within the last two years, however, a great improvement has been made in this respect on nearly all the streets through which the lines run. All macadam was removed to a depth of about 12", leaving the ties completely exposed, & these were then filled in with concrete to within about 4" of the top of the rail. The facing of the new pavement throughout the city now consists of Scoria blocks between & 8" beyond the rails, while the remaining strip of roadway is filled either with asphalt, asphalt brick, or Scoria blocks, according to the grade of the street.

In Upper Town, the residential district of the better class of people, the streets were nearly all wide enough to permit of a double track, but even here it was found necessary to run through certain sections on single track. Lower Town, the business section of the city, is a semi-circular strip of varying width, & of a practically level ground which is surrounded on the outer edge by water, & lying beneath the cliffs which mark the boundary of Upper Town. Here the lines are all single track with the exception of one section, where two parallel streets converge into one wide street 1/4 mile in length. The main street, which runs through the entire length of this section, is about 2 1/2 miles long, & is so extremely narrow in places that there is hardly room for an ordinary vehicle to squeeze past on either side of a car, on the single track in the centre of the street.

The return line is run through a maze of narrow & unsymmetrical side streets, which seem to run in almost any direction until they form a junction at an oblique angle with one of the largest arteries, thereby losing their identity. On one section of the line, one mile in length, there are no less than 11 curves of from 35 to 40 ft. radius at intersections of about 90°, one of which requires a reverse curve of 40 ft. radius. On all these streets the inner rail is placed within 2 ft. of one sidewalk in order to leave room for single vehicles to pass a car on the other side.

The Upper and Lower town lines are connected by two cross town lines which ascend obliquely along the face of the cliff. One of these, the Green Line, runs through the public thoroughfare which, though very steep, is yet feasible. The actual length of this line is 3,440 ft., & the difference of level between junctions is 172 ft., which is equivalent to an average grade of 5%. The total length is made up of sections of 200 ft., 12 1/2%, 100 ft. of 10%, & 600 ft. of 9.5% grades, the rest of the line being nearly level. All these grades have sharp curves in their lengths, but the most difficult to operate is the first. This one begins to rise at a gradient of 11 1/2%, & terminates at 14.15%, there being a 40 ft. rad. curve at the top, of which half is on the heaviest part of the grade.

The second cross-town line runs for a certain distance down Palace Hill at an average grade of 11% & then turns off the public street at an angle of 80° on to a steel trestle which runs parallel with the face of the cliff at a gradient of 7.5% for 800 ft. The total length of this line is 1,300 ft., with average gradient of 6.85% & a maximum of 12%, difference of level being 89 ft. One disadvantage in the operation of this line is, that when a car leaves the trestle to take the 11% grade, it is running at half speed, & must be accelerated on grade. This means a very heavy drag on the motors for the first 50 ft. of the climb.

CAR SERVICE.—The Upper Town service consists of a double belt line, 3 1/2 miles in circumference, with from 4 to 7 cars running in each direction on a 4 minute headway in summer, & 5 minutes during the winter. Schedule speed on all lines is approximately 8 miles per hour, except for a few short stretches of level; the total length of this belt is laid on streets having a gradient of from 4% to 8%.

In Lower Town there is but a single belt line, both branches of which are intersected by the cross-town lines. Cars running west are for most of their run within one block of those running east. Here, also, cars are run on a 4 minute headway, & the service requires from 8 to 10 cars. Free transfers are issued from one belt to the other over the cross-town lines. These are run separately in winter, but two sides of a double rectangular belt line in summer. Both tracks are single, & crossings are made at turnouts.

Strict regulations govern the operation of cars on grades & sharp curves. On some of the grades stop-boards are placed top & bot-

tom, & the motorman cannot proceed until signalled by the conductor. Speed down grade must not exceed 4 miles per hour. As a result of these precautions, runaway cars are very rare, & have never been attended by any serious consequences. The average number of cars in regular service during the summer months is about 35, & in winter about 30.

BRAKES.—In every city of grades, such as Quebec, the system of braking should be of special interest, yet hand-brakes are used throughout, the effective leverage being 100 to 1. The brake shoes in use are of very soft cast iron, & it has been found that the retarding force due to the application of this shoe is much more evenly supplied, & that the coefficient of friction is higher under all conditions than it is when hard cast iron is used. This is especially the case in frosty or snowy weather. New shoes weigh 19 1/2 lbs. & wear down to 4 1/2 lbs. Average life is 6,150 miles, or 410 miles to the lb. of wear.

WHEELS.—All wheels used are of ordinary chilled cast iron 33" diam., weighing 425 lbs. each, & mounted on 4" steel axle. Of these removed from cars during the first three years of operation there is not a great proportion of "flats," as will be noticed from the accompanying table:—

Wheels removed.....	125 pairs	
Of these Worn out.....	94 "	75.2%
"Flats".....	23 "	18.4%
Broken Flanges.....	8 "	6.4%

Average life, 24,800 car miles.
Maximum life, 49,000 car miles (reached by 10 pairs).

CAR EQUIPMENT.—The car equipment consists of: Thirty-five 28 ft. double vestibule closed cars, weight fully equipped, 14,500 lbs., seating capacity, 30; 24 double & open cars, weight 16,500 lbs., seating capacity, 50; 6 double ended snow sweepers; 2 double ended wing plows; 1 street sprinkler; 1 converted horse car.

ELECTRICAL EQUIPMENT.—The electrical equipment is standard throughout on all rolling stock. It consists of 124 no. 12 A-30 horse-power motors; 124 no. 28 A controllers; 62 sets controlling resistance. All closed cars are fully equipped & in service during 12 months of the year, & the extra equipment required for sweepers & snow plows during the winter is borrowed from the open cars. The sweeper & plow equipments are necessarily very much over-loaded at times, & it will be of interest to some here present to know how they have stood the hard usage.

OVERLOADS ON MOTORS.—An overload of 100% for several minutes at a time has often been carried by these during heavy snow storms, & a sweeper will sometimes burn 5 or 6 no. 13 B. & S. copper wire fuses, or in other words draw from 200 to 250 amp. at 520 volts before it can get past a difficult spot. This extremely hard usage does not seem to have any very bad effects beyond a temporary softening of the armature insulation, & sometimes the loss of a certain amount of solder from the commutator connections, & the management are proud to say that they have not had a single armature burned out since the road has been in operation, in fact the only trouble they have ever had with an armature is that in two cases the insulation was scraped off the wire by rubbing against the pole pieces in consequence of a defective bearing. This is not a bad record considering that there were 124 of them in use. There has never yet been a commutator lost, or even has it been necessary to repair one, apart from resoldering a few melted connections, & the heaviest wear on any diameter up to date is 3/8 in., & the average wear taken from the first 28 closed cars in operation is 22 ins. on the diameter after having made an average run of 71,800 miles. There has not been a commutator "flashed" or "bucked" in the past 18 months, & this, perhaps, is largely due to the excellent quality of brush used, as well as to the constant care that they receive.

CARE OF MOTORS.—It has always been the practice to send an armature to the lathe at the first sign of a "buck," & it has been found that this is absolutely the only way to prevent a re-occurrence of the trouble. A sharp eye is kept on the brushes to see that they do not wear down too far or become gripped in their holders, & commutators are cleaned & sandpapered about once a week with no. 0 sandpaper, although it is quite common for a commutator to keep a nice chocolate glaze for over a month without being touched. The commutator is the most delicate & troublesome part of any electric equipment, & there are two or three more points which ought to be strongly recommended in its care:

1st—To send it to the lathe before it has worn down too far. Just as soon as a slight shoulder is formed at each side of the wearing surface, the brush is lifted by the end play of the armature & unnecessary & expensive sparking is the result. Further, the copper segments are rarely of a uniform boldness throughout, & the least inequality of wear soon develops into a low spot on the commutator.

2nd—It is very important that the brush springs be set at the proper tension, & it is easy to make a rough comparative test of this statement with no other tools than a pair of calipers or steel tape line & an angler's spring balance. It will be found that too light is just as serious a defect as too heavy a tension, if not more so. In one case excessive wear is due to sparking & probable "flashing," & in the other to actual friction.

3rd—See that brush-holders are accurately aligned so as to divide the current equally between the two circuits of the armature. If the brushes are but the thickness of one segment

out of place, one is liable to be notified of the fact at the first heavy overload on the motor. Of course a great deal depends upon the quality of brush used, & cost price of this article should not be considered.

The brush used here averages a life of 12,600 car miles & costs 15c. a piece, which is more than most brushes of this size on the market, but let any one just make a simple calculation to see how many times the difference in the price of the brush goes into the saving effect by prolonging the life of a commutator several years. The cost of renewing one commutator would keep a 50 car equipment in brushes for two years.

I have now to apologize for having perhaps tired you with detail, but I feel that a great deal more could be said on this subject if time & courtesy permitted.

Some trouble has been experienced during the snow storms of winter by the grounding of field coils, but means have been found to effectively prevent this in future. I might here mention that during 12 hours of a cold dry snow storm, when light particles of snow are flying about, 2 or 3 gallons of water are sometimes collected in the bottom of the motor casings. Water & slush in the spring time have given no trouble.

A word about controllers. Aside from the burning out of a couple of magnetic blow-out coils, there have never been any repairs made on any of the 124 controllers in service beyond the renewing of the sparking tips of the drum, which is done about once in two years, at cost of about 50c. a controller. Here again are the results attained by vigorous inspection & careful cleaning each night. Apart from the nightly inspection it is the practice of the road to thoroughly overhaul every car

once in every six weeks. This work is done in day time. Bearings & armatures are examined, brush springs set, brake rigging adjusted, & journal boxes examined & renewed if necessary. As a result of this routine work, which costs but little, it is seldom that the service has to suffer the annoyance & blockade of traffic caused by a disabled car on the road. It can be safely said that there are not more than 2 or 3 cars ever pulled out of service for any reason whatever from early spring to late in the fall. In winter the number is somewhat greater.

CURRENT CONSUMPTION OF CARS ON GRADES.—The current required to get a loaded car up the steepest grades on a good summer rail, is practically constant & well within the overload capacity of the car motors. The maximum amount usually drawn from the line at 520 to 540 volts under such conditions is rarely above 125 amperes, & that for a short time only. The average current is from 60 to 80 amperes per car.

Just as soon as the appearance of snow or ice on the rail has to be considered, the ascent becomes a more serious question. Wheels begin to skid & the car loses momentum, then sand is applied, & the sudden overload on the motors as the wheels take a grip is often beyond the capacity of the heaviest fuse wire it is safe to use on the car equipments, viz., 14 B & S. This wire will carry 180 amperes for several minutes in winter time, & 200 amp. for about 10 seconds, & this will give a rough idea of the power required. The rated capacity of the motors is 50 amp., so that when running on the parallel connection the rated load per car would be 100 amp.

In other words, every equipment on the road has frequently to stand each day an

C. P. R. LANDS.

The Canadian Pacific Railway lands consist of the odd-numbered sections along the Main Line and Branches, and in Northern Alberta and the Lake Dauphin District. The Railway Lands are for sale at the various agencies of the company in Manitoba and the North-West Territories at the following prices:

Lands in the Province of Manitoba average \$3 to \$6 an acre.

Lands in Assiniboia, east of the 3rd meridian, average \$3 to \$4 an acre.

Lands west of the 3rd meridian, including the Calgary District, generally \$3 per acre.

Lands in Northern Alberta and the Lake Dauphin District, \$3 per acre.

TERMS OF PAYMENT.

The aggregate amount of purchase money and interest is divided into ten instalments, as shown in the table below; the first to be paid at the time of purchase, the second two years from the date of purchase, the third in three years, and so on.

Interest on the outstanding purchase money is payable in one year, except in case of an actual settler who breaks up at least one-sixteenth of the land within that time. No rebate of interest is allowed on hay or grazing lands.

The following table shows the amount of the annual instalments on a quarter section of 160 acres at different prices under the new conditions:

160 acres at \$3.00 per acre, 1st instalment \$71.90, and nine equal instalments of \$60.

160 acres at \$3.50 per acre, 1st instalment \$83.90, and nine equal instalments of \$70.

160 acres at \$4.00 per acre, 1st instalment \$95.85, and nine equal instalments of \$80.

160 acres at \$4.50 per acre, 1st instalment \$107.85, and nine equal instalments of \$90.

160 acres at \$5.00 per acre, 1st instalment \$119.85, and nine equal instalments of \$100.

160 acres at \$5.50 per acre, 1st instalment \$131.80, and nine equal instalments of \$110.

160 acres at \$6.00 per acre, 1st instalment \$143.80, and nine equal instalments of \$120.

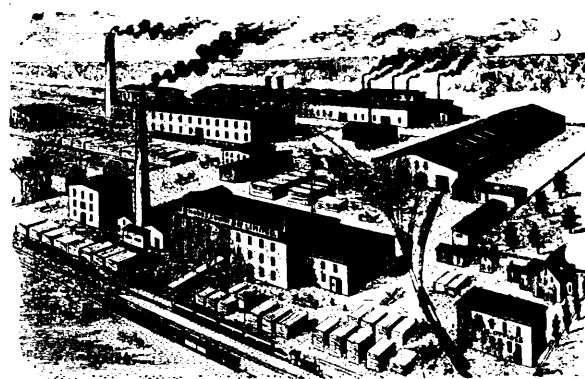
DISCOUNT FOR CASH. If land is paid for in full at time of purchase, a reduction from price will be allowed equal to ten per cent. of the amount paid in excess of the usual cash instalment.

Purchasers paying any instalment, or more, one full year before the date of maturity, will be allowed a discount on the amount of the instalment or instalments so paid at the rate of six per cent. per annum.

Interest at six per cent. will be charged on overdue instalments.

Write for maps and full particulars.

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Burlington Elevator, St. Louis, Mo.	Capacity	1,300,000 Bushels
Grand Trunk Elevator, Portland, Me.	"	1,000,000 "
Export Elevator, Buffalo, N.Y.	"	1,000,000 "
J. R. Booth Elevator, Depot Harbor, Ontario	"	1,000,000 "
Cleveland Elevator Company's Elevator, Cleveland, O.	"	500,000 "
Erie R. R. Transfer & Clipping House, Chicago, Ill.	"	100 cars in 10 hrs.
Manchester Ship Canal Co.'s Elevator, Manchester, Eng.	"	1,500,000 "
Burlington Elevator Co., Peoria, Ill.	"	500,000 "
Canada Atlantic Railway Elevator, Coteau Landing, Que.	"	500,000 "
Northern Grain Co., Manitowoc, Wis.	"	1,350,000 "
Union Elevator, East St. Louis, Ill.	"	1,100,000 "
Montreal Warehousing Co.'s Belt Conveyor System		

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overload of from 50 to 120%. These figures, however, are yet too low for the current consumed at times by the driving motors on the sweepers. On these there has been frequently measured an overload lasting an appreciable time of 180% to 200%. Apart from these sudden maxima, the average load distributed between the two motors sometimes averages 150 amp. for hours at a time, including several short periods of comparative rest. Some, I know, will say that it is extremely bad practice to strain an equipment to such an extent, but, without denying the charge, it may be said that these sweepers have cleaned over 6,000 miles of track every year for the last three years, & the only mishap which occurred to any one of them during the third year of their operation was the grounding of one field coil, this too in spite of the fact that they were on one occasion running for 106 hours continuously, each one wearing out 3 or 4 sets of brooms during that time. On several occasions they were running continuously for two or three days, except for an occasional stop of an hour to renew the brooms.

Curve no. 2 shows the average power required by each car in service during each month of the year. These curves are calculated from the readings of an integrating wattmeter in the central station.

The total cost of maintenance of electric equipment per car mile per year is 17c.

EFFICIENCY OF MOTORMEN.—The car service calls for a working staff of 70 conductors & as many motormen. All motormen before being accepted on the road must go through a period of training averaging from three weeks to a month. Part of this time is spent on the road in the company of a good regular motorman, & at least a week is spent in the car sheds, where the novice acts as helper at nominal wages. He is then examined as to his knowledge of the road, car equipment & regulations. Very little technical knowledge is required beyond a thorough understanding of the different parts of the equipment. As a result of this discrimination against the block-head & the fool, it is a marked fact that on every car in service, "the man behind the gun" knows his business & uses his brains to the advantage of the company.

SNOW AND ICE.—The greatest difficulty encountered by the Railway Co. in its efforts to provide a regular & efficient car service during the winter months, is the clearing away of the snow from the tracks. It is not so much that the snowfall is somewhat heavier than in Montreal & Ottawa districts, as that the extremely narrow strips of roadway either one side of the track or the other, soon become piled up with snow to such an extent that all snow removed by a passing sweeper immediately slides back on to the rails & blocks the passage of the following car.

Another serious disadvantage is that all cars in the city have to run over some sections of single track. This fact requires, of course, that cars shall make regular crossings at certain points, & if one car should be late for—or worse still, not reach—its crossing point, several of the following pairs of cars which cross at the same point will be stalled there until the tangle is straightened out. A delay of this sort is disastrous in many ways, because the leading car, when it gets away, has sometimes to plow its way through a heavy accumulation of snow until it is, possibly, extricated from its sorry plight by a passing sweeper, which has to be signalled & shunted past the waiting cars before it can be of any service. Matters are soon straightened out, but then that sweeper should have been somewhere else & there is more trouble ahead. Just as long as all cars make their proper crossings, no matter if they be a few minutes behind scheduled time, everything works smoothly, and after that, complications seem to increase in geometrical progression.

It is the practice to send out the "wing plows" as soon as a certain amount of snow has fallen, & these follow the sweepers around the whole length of the track, at regular intervals, pushing the snow piles back as far as 6 ft. from the rail where it is possible, although there are miles of track to be kept open where there is less than that distance between the rail & the actual buildings, to say nothing of the sundry poles & sidewalks that necessarily intervene. As the day wears on & the snow still continues to fall, the swing of the plows is limited to 2 ft. & possibly to 1 ft., after which it is a hard struggle to keep everything moving through the rectangular channel four to five feet deep which has been formed by the wing plows in their endeavors to clear the right of way. There are several bad spots at which it is absolutely necessary to keep gangs of snow shovellers at work as soon as the storm reaches any more than even moderate proportions. It has further been necessary on two or three occasions to pull all cars out of service in order to give the tireless sweepers a chance to keep the road open, but only once in 1898 & once in 1899 has the service been entirely blocked, & that for one day only.

Nearly all cars in service now carry side-brooms or flangers about 3 ft. in length, which are set obliquely across the rails about 1 ft. ahead of the front wheels. These consist of cast frame, into which are fastened a number of cuttings from the sweeper brooms about 10 ins. in length. They cost very little & have proved of invaluable service in keeping the rails clear of snow during the hourly or half-hourly intervals between passing sweepers; in fact, the car service very often depends entirely upon these to get through a light snowstorm, a couple of sweepers being sent out, after it is all over, in order to clean up. These long brooms have another great advantage over a narrow steel wire brush in that they keep the snow & ice at each side of the rails at an easy slope toward the bottom, instead of cutting a deep rectangular trough which remains filled with snow after the sweeper brooms have gone over the track. Since adopting these brooms on the road, a marked decrease in the power consumed by the rolling stock during storms is noticed, & a great saving has been effected in the quantity of rattan used by the sweepers for each mile of sweeping. This results from the fact that when the transverse section of the winter road-bed is properly graded the sweeper brooms need not be let down so far in order to clear all snow from the rail, thus saving a great deal of breakage.

The average snowfall in Quebec for the last three years has been as follows: 1897-98, 104.6 inches; 1898-99, 120.6 inches; 1899-00, 100.3 inches.

Curve no. 1 shows the proportion of last year's total fall during each month, also the number of miles covered by the sweepers during each month of the same year. Further data relative to cost of removal will be found beneath. These include all cost of sweeping, shovelling & carting away of snow, as well as the interest, depreciation & maintenance of the necessary equipment.

With reference to the removal of snow, the city by-laws enact "that proprietors or occupants shall remove the snow & ice from their roofs and from the streets, from the street line to the centre of the street, & keep the same within two inches of the pavement."

The by-law granting a franchise to the Quebec Railway, Light & Power Co. enacts "that the Co. shall remove the snow from their tracks & two feet on either side thereof." As the Co. could not see its way to carry out this regulation without having trouble with the proprietors or tenants, it every year makes an arrangement with the tenants on that side of the street on which the Co. throws its snow, to remove the same, paying them at the rate

of 10c. per lineal foot of their frontage, except in places where the snow is known to accumulate, where it pays at the rate of 15c. per lineal foot. Consequently, all the Co. has to do is to throw the snow off its tracks, leaving the proprietors to remove the same along with their own. With this arrangement the proprietors seem very well satisfied.

One can better appreciate the relative magnitude of the snow expenses when told that \$1.54 has to be deducted from the daily gross earnings of every car in service during the year in order to make up the amount.

HEATERS.—All closed cars in service are heated electrically during 6 months of the year, the heaters being divided into 4 sections, 2 on each side of car, each pair being separately controlled. The current consumed by each pair is 4.9 amp., & it therefore requires 9.8 amp. at 520 volts, 5.1 k.w., to heat a car during 4 months of the year when both sides are in use, but during Nov. & April one side is quite sufficient to maintain a comfortable temperature within the thin shell which composes the car body.

Taking the average time of service of car at 18 hours per day, & the actual cost of the extra current required at 65c. per k.w. hr., the cost of heating one car is as follows:—

$$5.1 \times .65 = 3.21 \text{ cts. per hour}$$

$$150 \times 58 = 87.00 \text{ cts. per day}$$

This is equivalent to .204 cents per car mile, & the maxim taught is, "don't use electric heaters in a cold climate unless you have the advantages of an unlimited water-power & station capacity." The interest on first cost, depreciation & maintenance of the heating equipment would not add more than 2 or 3% to the figures.

The electric railway, as well as nearly all lights & motors in Quebec, are operated through a substation within the city, from a power house situated at the Falls of Montmorency. The power house is 150 x 50 ft., & contains the following equipment: 3-600 k.w. 2 phase 66 eye 5,500 volt S.K.C. alternators; 1-750 k.w. 2 phase 66 eye 5,500 volt S.K.C. alternators; 1-600 k.w. double current 273,500 volt generator; 2-30 k.w. bipolar exciters. All the larger machines are direct connected to 52 in. water wheels of 1,000 h.p. capacity each, & operating at a speed of 286 revolutions per minute.

The power is transmitted to the city over 16 wires, carried on 2 separate pole lines. Each machine is fed into a separate circuit at Montmorency, but may be connected in parallel at the substation in the city, the substation consists of a substantial stone building containing the following machines: 2-600 k.w. 2 phase S.K.C. synchronous motors, taking current at 5,000 volts direct connected to 2 500 k.w. 550 volt railway generators, 2-200 k.w. 2 phase 5,000 volt synchronous motors direct connected to 4 125 light multi-circuit arc machines. Besides these are the direct connected starting motors required for the motor-generators, 2 exciters driven by induction motors, & all necessary transformers & switchboards for distributing the current to its various uses.

RAILWAY SWITCHBOARDS.—The railway switchboard contains—besides switches, circuit-breakers, volt & ampere meters & field resistance—1 intergrading wattmeter, 2 recording ammeters, & 1 recording volt-meter.

From the daily reading of the first has been prepared curve no. 2, which shows the current consumed by the railway cars during each month of the year. It will be noticed how much more power is required during the winter than in summer, in spite of the fact that fewer cars are in service, & the car miles run by each are fewer than in the summer. It will also be seen that, during Feb. each car consumes an average of 24 h.p. during a whole day's run.

The maximum overload capacity which the

station is ever called upon to furnish the railway, is about 900 k.w., and a yearly average is about 350 k.w.

The peak of the summer load very rarely reaches 550 k.w., & is easily handled by one generator, although a 10 or 15% increase

over this load would be very liable to pull the synchronous driving motor out of steep if of long duration.

Time has unfortunately not permitted the preparation of any accurate curves to tell the story of the station's output, but one may

form an idea of the average fluctuations by an examination of the recording ammeter charts on exhibition.

Before closing this very hurriedly prepared

The Grand Trunk Railway Company of Canada.

NOTICE is hereby given that the Ordinary General Half-Yearly Meeting of the Grand Trunk Railway Company of Canada will be held at the City Terminus Hotel, Cannon Street, London, E.C., on Tuesday the 9th day of October, 1900, at Two o'clock p.m. precisely, for the purpose of receiving a Report from the Directors and for the transaction of other business of the Company.

A Resolution will also be submitted for the approval by the proprietors, of the arrangements to be made for the reorganization of the Chicago and Grand Trunk Railway Company, including particularly a guarantee, by the Company, of the interest on the Bonds proposed to be issued by the new Company.

Notice is also given, that the Transfer Books of the Company will be closed from Saturday the 15th day of September, to the day of meeting, both days inclusive.

By order,
C. RIVERS-WILSON, President.
WALTER LINDLEY, Secretary.

Dashwood House,
9 New Broad Street, London, E.C.
7th September, 1900.

THE CANADIAN PACIFIC RAILWAY CO.

DIVIDENDS for the half-year ended thirtieth June, 1900, have been declared as follows:

On the Preference Stock two per cent.
On the Common Stock two and one half per cent.
Warrants for the Common Stock dividend will be mailed on or about first October to Shareholders of record at the closing of the books in New York and London respectively.

The Preference Stock dividend will be paid on Monday, October first, to Shareholders of record at the closing of the books at the Company's London Office, 1 Queen Victoria Street, London, E.C.

The Common Stock transfer books will close in London at 3 p.m. on Friday, 24th August, and in Montreal and New York on Friday, 7th September. The Preference Stock books will close at 3 p.m. on Friday, 31st August.

All books will be re-opened on Tuesday, 2nd October.
By Order of the Board,
CHARLES DRINKWATER,
Montreal, 13th August, 1900. Secretary.

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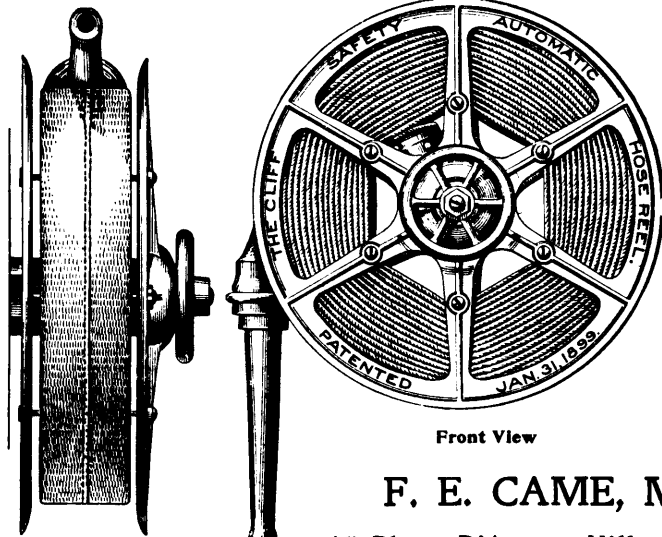
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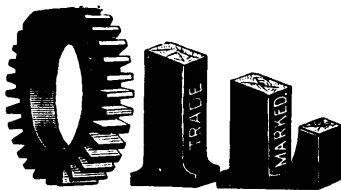
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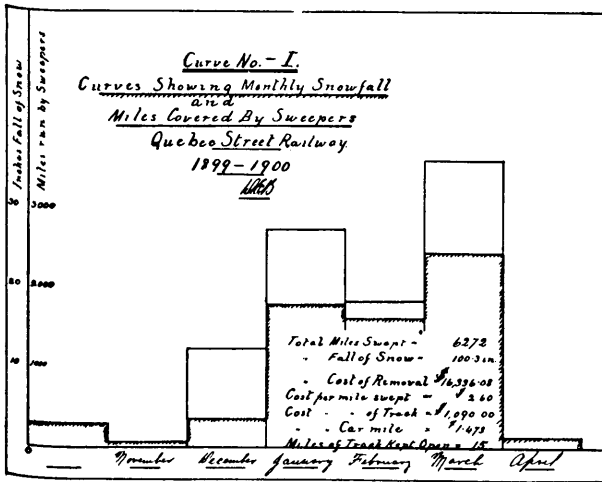
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Anybody who knows Quebec will know the point I refer to, Chateau Frontenac.

The foot passengers have to come in along the car tracks.

The Co. pays the tenants 15¢ per lineal foot once a year for the removal of snow.

The Co.'s day is 18 hours long.

The power supply is water power.

The rotary converter is used for the railway at St. Anne de Beaupre, where 500 volts are fed into the wire. There are 18 stops made in 21 miles. We have as many trains on now as we can put on in that section. In all probability another line will be laid in the near future.

The pressure on each brush depends on what car it is.

paper, it may, perhaps, be in order to make a few remarks relative to the conversion of the old Q. M. & C. Ry. to an electric suburban line. This excellent roadbed now serves to carry a fast service of electric cars, interspersed with steam trains, which handle the heavy traffic between Quebec and the shrine of St. Anne de Beaupre.

A trolley wire is suspended at a height of 22 ft. above the rail by stranded steel span wires hung from wooden poles, & the rails have been connected with single bonds of no. 00 wire for 26 miles. A copper cable of 300,000 C.M. area runs parallel with trolley wire for most of its length & is connected to the trolley every quarter mile.

This cable is fed at a pressure of 560 volts at 3 points: at Quebec, at Montmorency, 7 miles away, & at St. Annes, 21 miles away from the city, all power of course being generated at Montmorency & transmitted for ends of line at a high alternating tension.

Cars used are 50 ft. over all, & each equipped with four 38 B motors geared to a speed of 45 miles an hour.

On account of the many stops to be made in the length of the line (18), a schedule time of 21 miles in 60 minutes has been adopted. This is quite satisfactory & fast enough, because the line is a very busy one in two ways. The number of passengers carried is beyond the highest hopes of the management, & it would be impossible to run any more trains over a single track & on train orders than are operated at present. There is every prospect of a second track being laid in the near future. The idea of running steam & electric cars is a novel one in this country, but is highly successful in every respect.

In the discussion which followed the reading of the paper, Mr. Blair gave the following further information:—

The road has been operated three years.

The heaviest wire on any commutator is 3/8 of an inch.

The heaviest grades carry the heaviest traffic in town.

There has not been a commutator flash or buck on the road for 18 months.

The water & slush in the spring-time have never given us any trouble, it is the hard snow in the winter. \$16,300 is the total cost chargeable to snow.

The Co. has no depreciation account, everything goes in to maintenance account. Depreciation & cost of repairs go in together, & the road is kept up to the standard for railways.

In some cases we have to actually cart the snow away to some convenient place for the time being, & then the next day take it away permanently. In almost every case we have to cart it twice. In some cases, without exaggeration, there are 4 ft. of snow above the top of the car; that, of course, has to be shovelled out. A car will run into these drifts.

We keep the hill cars & level running cars separate. We run the same car over the hill as on the level, but draw more current than on the level.

We keep records of everything. We keep them by numbers of the car & so forth. The men who do the work keep the records during the month, & I take the whole of them & enter them in my own book once a month.

The Use of the Dynamo and Storage Battery in Telegraph Offices.

By W. J. Camp, Superintendent C.P.R. Co.'s Telegraphs.

Previous to 1870, acid batteries of various kinds were used for main telegraph circuits, & the Daniel form of blue-stone battery for the locals, or sounder circuits. Between 1870 & 1874, what is known as the "gravity battery" was brought into general use. This battery is a modification of the Daniel cell, but the sulphate of zinc & sulphate of copper solutions are kept separate by the difference in their specific gravity instead of by means of a porous cup. This form of battery is very constant & requires but little attention as compared with the acid. To obtain the best results not more than 2 or 3 wires should be worked from each bank, although frequently 10 or more are thrown on one bank of battery. When this is the case the results are unsatisfactory, particularly during wet weather, & when wires of different lengths are combined together. A separate bank is required for each duplex or quadruplex set, & also a local battery for each sounder circuit. It is true that, as each cell gives out about one volt E.M.F., the exact power required for each multiple circuit or local can be very accurately adjusted by adding to or taking off from the number of cells; & on this account a great many chief operators raised objections to dynamo currents. However, even this advantage has been compensated for.

While the change from acid to gravity batteries effected a great economy in maintenance, and improvement in the working of the telegraph wires, a much greater stride has been made by the introduction of the dynamo & storage battery in telegraphic work. I will deal first with main lines, & then with local, or sounder & transmitter circuits.

About 1880 dynamos were introduced by the Western Union Telegraph Co. at New

York for supplying current to the single working wires. The means for doing this are comparatively simple. Two dynamos are used, each of a voltage high enough for the longest wires; the positive pole of one & the negative pole of the other dynamo are earthed, & the opposite poles connected to two buss wires. The various single working wires are connected to these buss wires, according to the polarity required, through an artificial resistance for each wire. The Western Union in the U.S. & both companies in Canada use incandescent electric lamps for these resistances. The Postal Co. in the U.S. uses German silver wire wound on tin tubes, so designed that, should any heating take place, it is counteracted by a current of cold air which passes through the tube. Additional resistances were inserted on the shorter wires to make all lines approximately of the same electrical length. These resistances were usually of fine German silver wire wound on the handle of a wedge which was inserted with the instrument wedge in the spring-jack of the switch. It has been found much more satisfactory, however, to have several dynamos giving different voltages, & the use of the resistance wedges abandoned.

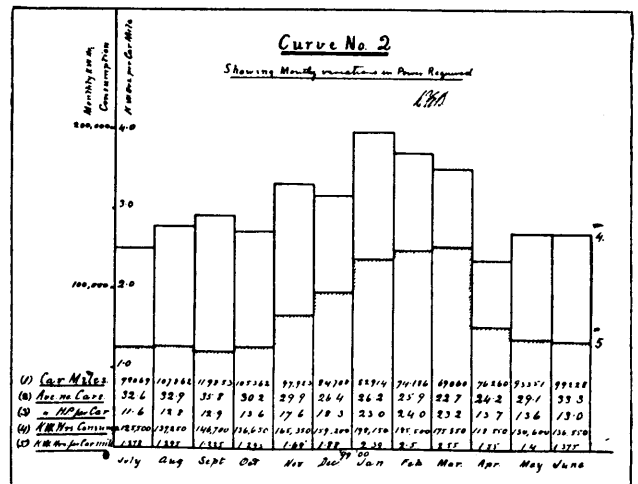
The next step was to apply dynamo power to duplex wires. For many years back the polar duplex has been used all over America. When using the gravity battery the transmitter (pole-changer) was arranged to reverse the poles of a bank of battery from earth to line & vice-versa. This pole-changer required very accurate adjustment in order to reduce the time of reversals to a minimum, the least break in the circuit, or short-circuiting of the battery, being liable to affect the signals at either or both terminals of the line.

For dynamo power the earth connection is omitted in the pole-changer; the armature is connected to the line circuit, the front contact to the negative buss wire, the back contact to the positive, & resistances of 600 or more ohms inserted ahead of each buss wire to prevent arcing at the contacts of the pole-changer.

Then came the application of the system to quadruplex circuits. Great difficulties had to be overcome to effect this. Two entirely different systems are in general use, one by the Western Union & G.N.W. Telegraph Companies & the other by the Postal Telegraph Co. The C.P.R. Co. uses the systems at Toronto & Montreal, & the Postal system at other W.U. points.

A few general remarks with reference to the duplex & quadruplex as worked with gravity batteries may be of interest at this point to those who have not read up the subject.

Duplex is a system by which two operators can transmit simultaneously in opposite directions. This is attained by winding the receiving relays with two coils of wire in opposite directions, one winding being connected to



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- 9.—**A Funeral Benefit** of \$50 at death of a member enrolled in Sick and Funeral Benefit Department.
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1888	11,800	89,018 16	117,821 96	9 98	6.43
1889	17,349	116,787 82	188,130 36	10 84	5.85
1890	24,604	181,846 79	283,967 20	11 54	5.18
1891	32,303	261,436 21	408,798 20	12 65	6.40
1892	43,024	344,748 82	580,597 85	13 49	6.25
1893	54,484	392,185 93	858,857 89	15 76	5.47
1894	70,055	511,162 30	1,187,225 11	16 94	5.47
1895	86,521	685,000 18	1,560,783 46	18 03	5.67
1896	102,838	820,941 91	2,015,484 38	19 60	5.50
1897	124,685	992,225 60	2,558,832 78	20 52	5.56
1898	144,000	1,176,125 14	3,186,370 36	22 12	5.67
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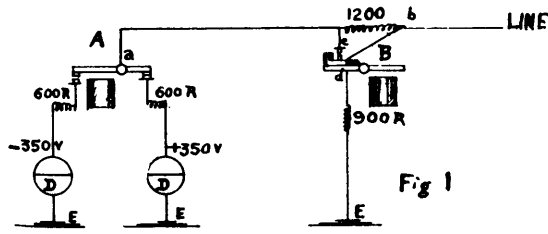


Fig. 1

the line, & the other to a set of resistance coils & condensers which are so adjusted that the electrical length & static capacity are the same as the real line. The home power divides equally, half passing around the core in one direction to the real line, & half in the opposite direction to the artificial line, the result being that the core is not magnetized by it, & is not susceptible to any change in the home power. As the power coming over the line from the distant station only passes through one of the coils, & there is none coming in from the artificial line to counteract it, the core is affected by any change in power at the distant station. The receiver is a polarized relay whose armature closes the sounder when moved in one direction, & opens it when moved in the other. The transmitter is an instrument worked by an ordinary telegraph key & local circuit. It is so arranged that when the key is depressed the negative pole is connected to the line & positive when the key is opened.

Quadruplex is a system by which two operators can transmit one way simultaneously with two operators transmitting in the opposite direction, i.e., four messages can be sent simultaneously on one wire, two in each direction. The arrangement by which two operators transmit in the same direction may be briefly described thus :

A transmits by reversing the polarity to line the same as in duplex, & C receives by means of a polarized relay. B transmits by increasing & decreasing the same power which A is reversing ; D receives from him by means of a neutral relay which responds to power of any direction if it is strong enough. The retractile spring of the armature is adjusted so that the weaker power does not move the armature, but when the full power is on the spring is overcome. By double winding both receivers at each end, as explained for the duplex, we obtain "two circuits in the opposite direction."

In order to obtain satisfactory work all resistances must be maintained at their relative length. When using gravity battery transmitter "B" simply adds more cells to "A's" battery, or takes them off when closing or opening his key. A resistance coil to compensate for the internal resistance of the extra battery is automatically cut out, or inserted, thus maintaining the total electrical length of the line from earth to earth.

The W.U. system of transmission is shown in fig. 1. The resistance from A to earth through the dynamo circuits is 600 ohms, no matter which position transmitter A is in. When transmitter B is closed the resistance from B to earth is 600 ohms because the 1200 ohm coil is shunted out by contacts c & the leak of 900 ohms is disconnected at d. The full power of either the negative or positive dynamo goes to line through one of the internal resistances of 600 ohms. When the transmitter B is opened the 1200 ohm coil is inserted between b & c, making the total resistance between b & earth via the dynamo of 1800 ohms. There is also another route to earth, through the leak of 900 ohms. The joint resistance of these two routes is 600 ohms, as found by the formula $\frac{A \times B}{A + B}$ or $\frac{(1200 + 600) \times 900}{(1200 + 600) + 900} = 600$, thus maintaining the same resistance between b & earth for all changes.

The amount of power passing b to line is, however, reduced to $\frac{1}{4}$ when transmitter B is

open, first on account of the added resistance of 1200 ohms, & second, on account of the leak of 900 ohms. In other words, when transmitter B is closed, the power passing to line is three times as much as when B is open.

By changing the added resistance to 1800 & the leak to 800 ohms the difference is then as 4 to 1 & the internal resistance still maintained at 600 ohms.

The principle of the Postal system of quadruplex transmission is shown in fig. 2. For the purpose of explanation, transmitter A is shown as two separate instruments worked simultaneously by one key. The one on the left gives 350 volts to the line & the one on the right 100 volts. Opening of the key connects either m or p to line according to the position of transmitter B ; closing of key connects either n or o ; or opening A gives positive pole & closing gives negative. Closing connects line through b, c, a, to dynamos m or n (350 volts) according to the position of transmitter A ; opening transmitter B connects line through b, d, e, with dynamos o or p (100 volts). Thus B transmits by increasing or decreasing the power sent out by A. As the resistances in each of the four leads to the

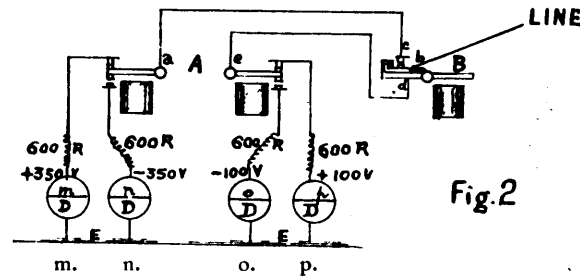


Fig. 2

dynamos are the same (600 to 1000 ohms) the internal resistance from b to earth is constant.

It is hardly within the scope of this paper to compare one system with the other. It is sufficient to state that either system has certain advantages & both give excellent results. The receiving instruments are the same as for gravity battery.

The dynamos are made of sufficient voltage for the longest quadruplex circuit from the office. When the same machines are used on comparatively short circuits a resistance coil of 1000, or more, ohms is inserted between b & the receivers.

We now come to the locals. For ordinary sounder circuits a very simple plan is to use a dynamo of 6 volts & connect all sounders in multiple. The sounders are wound to 20 ohms resistance ; but in nearly every office where dynamos are used there are also quadruplex or duplex sets, & it is often necessary to connect these as repeaters. There are a number of systems, but I will only describe the one in use by the C.P.R. This is, I think, the most simple yet designed. It is shown in fig. 3. Each half quadruplex or half repeater is treated as a duplex set. All sounders & transmitters are wound to 20 ohms &, by resistance coils, each local circuit is brought up to 100 ohms. The dynamo gives from 20 to 25 volts. The former is found to be sufficient. The figure shows the instruments in a normal position, except that the transmitter wedge should be inserted in the spring jack. Starting from the dynamo the receiving circuit passes through the relay contacts, 20 ohm sounder, 80 ohm coil, earth to dynamo, the leg through jack being open at c. The sending circuit is from dynamo through switch b, key, 20 ohm transmitter, switch a, d, wedge, back contact of jack, 80 ohm coil, earth to dynamo.

To work as repeaters the wedges of the two sets are exchanged, that of no. 1 set being inserted in no. 2 jack & no. 2 wedge in no. 1 jack ; the table switches a & b on each set are reversed.

The circuit then is, earth, dynamo, relay contacts, 20 ohm sounder, 80 ohm coil, earth ; also from relay contact to top of jack, front of wedge of no. 2 set, c, a, transmitter, key, b, d, back of wedge, coil & earth. The circuits from no. 2 set are the same. Any break in contacts of relay opens its sounder & also the transmitter of the other set. Thus signals received from the line on no. 1 set are automatically retransmitted over the line connected to no. 2 set, & vice versa.

To extend the locals of a duplex to a branch office, the loop wedge is inserted in the spring jack on top of the transmitter wedge ; switch a is turned up ; switch b down. Circuits are then as follows : Receiving side, dynamo, relay, sounder, coil, earth ; with leg from relay contacts to top of jack, front of wedge, coil, line, branch receiver & earth. The resistance coil is adjusted so as to make the circuit from wedge to branch earth total 100 ohms including branch sounder.

Sending side, dynamo, b, key, transmitter, a, c, front of transmitter wedge, back of loop wedge, coil, line, branch sounder, key & earth. The resistance from wedge to distant earth is 80 ohms, including sounder. On this circuit the resistance of the transmitter is added, making a total of 100 ohms.

Sometimes the dynamos are operated from a common shaft driven by an electric motor or other power, but the plan most generally adopted is to use motor generators, each machine working independently. In order to

be reasonably certain of a continuous supply of power, spare leads are run to different power stations, & spare machines are also kept in readiness, so that not more than a minute or so is lost at any time.

In cities where continuous power cannot be obtained from at least two different stations, storage batteries are now largely used. Generally speaking, the wiring of a telegraph office, from the discharge leads of a storage battery to the instruments, etc., is the same as for dynamos, but extra switches have to be used for connecting the various banks of battery with the charging or discharging circuits. Various devices are used, but as I consider the C.P.R. system the most flexible, I will describe it only.

At Vancouver & Winnipeg street railway power is transformed by two motor generators ; one reducing the power to seven volts of twenty amperes capacity for charging local batteries ; & the other to 130 volts, 5 amperes, for main batteries. In Ottawa a 250 volt power is reduced to seven volts for the locals, & the mains are charged direct without reduction. In St. John the 114 volt lighting circuit is used. The locals are in two banks, of two cells each, of chloride accumu-

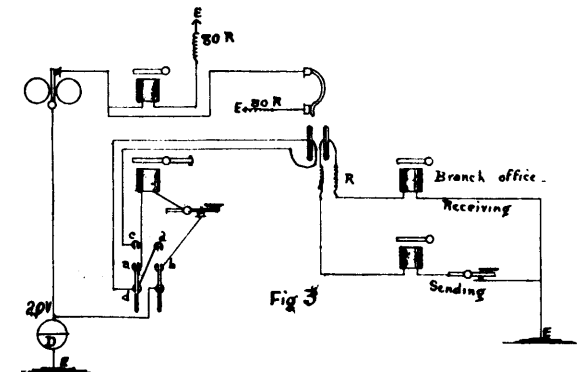


Fig. 3

lator, type E 9, one bank being charged while the other is discharging. There is no dead resistance inserted in the local circuits, as is the case where dynamos are used, extra cells providing the necessary power when quadruplexes or duplexes are extended to branch offices.

The switch for the main batteries consists of a series of spring-jacks and wedges, so designed that the jack is open, & a wedge cannot be inserted when reversed. The cells (which are C 3 type of accumulator) are arranged in banks of 40 or more as needed to meet the requirements of the office, & of a voltage sufficiently below the charging circuit. The negative pole is connected to the top of a wedge & positive to bottom. The wedges are all interchangeable. As many banks as required can be charged simultaneously.

In Canada, the C.P.R. has storage battery plants at Vancouver, Winnipeg, Ottawa & St.

John, & dynamos at Toronto. The new Telegraph building in Montreal will also be equipped with dynamos. At present power in the latter place is obtained from the dynamo plant of the G.N.W. Tel. Co. I understand that the W.U. & G.N.W. Co.'s have storage plants at St. John, Quebec, London & Ottawa, & dynamos at Toronto & Montreal.

The adoption of either dynamos or storage

battery for power or telegraph lines has very materially improved the working of the lines, & at the same time effects a great economy. One or the other will gradually replace gravity batteries for all main lines, & the time may come when even the locals at way-side stations will be worked by storage battery cells, which will be charged at some central point & sent out by train.

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Size 18 x 3½ inches. Oblong, square ends, white ground, blue letters, lined & tipped.

Furnished Apartments. Stick no Bills.
Please Shut the Door.

PUSH PULL

Oval, size 2 x 3 inches, white ground, blue letters, tipped, hollowed, lettered **Push, Pull**, as above.

Oblong, square ends, size 3 x 1½ inches, white ground, blue letters, tipped, lettered **Push, Pull**, as above.

Perpendicular, square ends, size 12 x 3 inches, white ground, blue letters, lined & tipped, lettered perpendicularly, **Push, Pull**.

Oblong, square ends, size 12 x 3 inches, white ground, blue letters, lined and tipped, lettered horizontally, **Push, Pull**.

Oblong, fancy ends, size 3 x 1¾ inches, white ground, blue letters, lined and tipped, lettered **Push, Pull**.

NO ADMITTANCE

Size 10 x 2½ inches. Oblong, oval ends, white ground, blue letters, lined & tipped, hollowed:

Bar Room.	Men.
Luggage Room.	Private.
Office.	No Admittance.
Refreshments.	No Road.
Exit.	Boarding House.
Fire Escape.	Private Board.
Lavatory.	Dressmaking.
Ladies.	Fresh to Day.
Women.	Teas Provided.
Gentlemen.	Please Shut the Gate.

Size 14 x 3 inches. Oblong, oval ends, white ground, blue letters, lined and tipped.

No Admittance.

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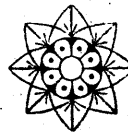
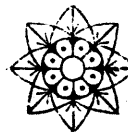
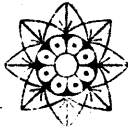
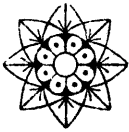
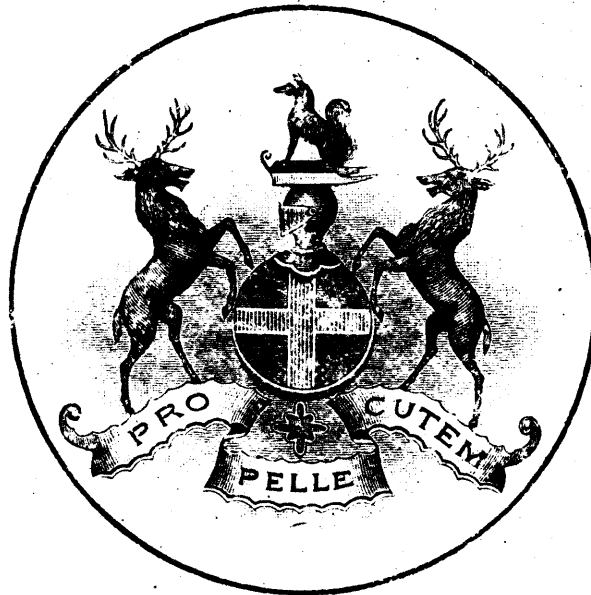
The Purchasing Agents' Guide

To the Manufacturers of & Dealers in Steam & Electric Railway, Steamship, Express, Telegraph & Telephone supplies, &c.

Accident Insurance Travelers' Insurance Co. Montreal.	Half Tones Acton Burrows Co. Toronto.	Shipbuilders' Tools & Supplies Rice Lewis & Son. Toronto.
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Air Brakes & Fittings Westinghouse Mfg. Co. Hamilton, Ont.	The Fairbanks Co. Montreal.	Shovels James Cooper. Montreal.
Ales E. L. Drewry. Winnipeg.	Hardware Rice Lewis & Son. Toronto.	The Fairbanks Co. Montreal.
Anchors Rice Lewis & Son. Toronto.	The Hudson's Bay Company. Toronto.	The Hudson's Bay Company. Toronto.
Axles James Hutton & Co. Montreal.	Headlights Noah L. Piper & Sons. Toronto.	Rice Lewis & Son. Toronto.
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Babbit Rice Lewis & Son. Toronto.	Illustrations Acton Burrows Co. Toronto.	Signals Noah L. Piper & Sons. Toronto.
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Bolts Rice Lewis & Son. Toronto.	Rice Lewis & Son. Toronto.	Steamboat Signs Acton Burrows Co. Toronto.
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Cuts Acton Burrows Co. Toronto.	Mohair The Hudson's Bay Company. Toronto.	The Haliburton Lumber Company. Toronto.
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