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TORONTO, CANADA, MARCH, 1901.
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TORONTO, CANADA, MARCH, 1901.

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A New Method of Rating and Loading Engines in Freight Service.

By Thos. Tait, Manager C.P.R. Eastern Lines.

The C.P.R. put in effect on Oct. 1 last a new method of rating & loading engines in freight train service. This Co. was one of the first to adopt the tonnage basis for rating & loading its engines—using actual tons, except in the case of empty freight cars, to the weight of which an arbitrary addition was made—but experience of this, what may be called "actual" tonnage system, especially in connection with the larger capacity car & the resulting greater variation in the weight of "contents," & consequently in the proportion of "tare" of cars, demonstrated:

1.—That the haulage capacity of engines should be based on a uniform proportion of tare weight to gross weight behind the tender.

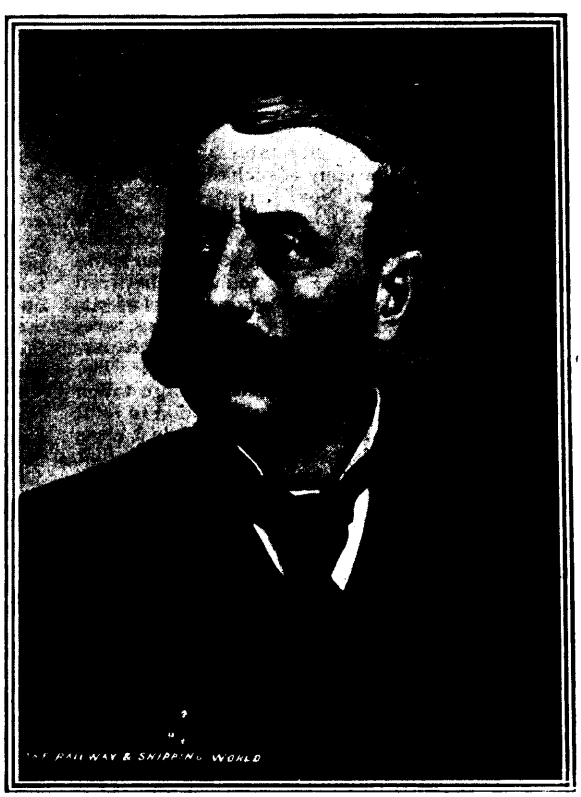
2.—That in loading engines the resistance of every train, as compared with that of a train having this uniform proportion of tare, should be determined.

After investigation it was decided to adopt one-third (two tons of "contents" to one ton of "tare" weight), as the uniform proportion of "tare" weight to "gross" weight behind the tender to be used in the new schedules of haulage capacity of engines in freight train service. These schedules of haulage capacity of locomotives in freight train service show the number of tons which each class of engine can take from station to station in each direction in a train, the tare weight of which is one-third the gross weight behind the tender. Table 1 on page 67 gives the figures for the Havelock section.

The engines are classified according to their haulage capacity—(see tables 2 & 3 on pages 67 & 69)—each class being designated by its percentage of haulage capacity—the standard 10-wheel freight engines being termed "100%" engines; more powerful engines "140%," "150%," etc.; lighter engines "60%," "65%," etc. Five per cent. of haulage capacity represents approximately a draw-bar pull of 1,000 lbs. at 7 miles an hour, which is the speed over grade summits on which the haulage capacity of engines has been based. The draw-bar pull which any engine can exert is thus easily ascertained if its percentage of haulage capacity is known or vice versa. In these schedules the ruling grade on each section is clearly indicated, as is also the increased tonnage (passing load), if any, which can be taken if the train does not stop at a station (see figures in italics, table 1 on page 67).

A dynamometer car was used to determine the relative haulage capacity of the different classes of engines, & the grade & curve resistance from station to station in each direction; the tonnage in the schedule being the results in many cases not of one or two, but of many tests with this car.

These schedules are accompanied by a "chart," reproduced opposite page 80 (suggested by a graphic chart prepared by Mr. McHenry, of the Northern Pacific), to be used by those whose duty it is to make up trains, for the purpose of calculating the resistance of each train (having regard to the proportion of "tare"), so that the proper load for the engine may be determined. This chart has been compiled on the basis that empty cars require 30% more power to haul them than the same tonnage in loaded cars, the "contents" of which weigh twice as much as the "tare." It takes the form of a pyramid—the "tare" tons or scale being shown along the base, & the "contents" tons or scale up the side, & the operation of finding by it the resistance of any given number of cars, loaded or empty, or both (having regard to the proportion of "tare"), is quite simple; the figures where the "contents" & "tare" tonnage lines meet on the chart being the resistance or equivalent tonnage of the train. For instance, if it is desired to make up a train for an engine scheduled to haul 900 tons over the ruling grade on the section, the "tare" & "contents" of sufficient cars to equal together about 900 tons are ascertained. It is found that the "tare" is 400 tons & the "contents" 500 tons; opposite 400 on the scale of "tare" tonnage at the base of the pyramid, & opposite 500 on the scale of "contents" tonnage on the side is found 945—45 tons too much load for the engine, due to the large proportion of "tare." If, however, the "tare" had been found to be 300 tons & the "contents" 600 tons, or the "tare" 410 & the "contents" 430 tons, in the same way, the figures where the "tare" & "contents" tonnage meet are found in both cases to be 900—exactly the right load for the engine—the actual tonnage in the latter case being 60 tons less than in the former case owing to the larger proportion of "tare."



G. A. SHARP,

Superintendent, Prince Edward Island Railway.

The resistance, in tons, of a train, as shown by this chart, is termed the "equivalent tonnage," & the actual weight of the train behind the tender the "actual tonnage." By this method of rating & loading engines every engine is given its approximately correct load—having regard to the proportion of "tare" weight to gross weight behind the tender, & by the use of the "equivalent" ton mileage more fair comparisons of fuel & other performance of engines & men can be made than with the "actual" ton mileage.

The main benefit, however, derived from this system of rating & loading engines is that advantage is taken of every opportunity arising out of the use of larger capacity cars, fully or well loaded (small proportion of "tare"), to increase the tonnage of freight trains. As the conditions change, owing to the continued increase in the average capacity of cars, it may become advisable to use a different basis in the compilation of these schedules of haulage capacity of engines & of the chart for calculating the resistance of trains.

The full loading of engines in the direction of the balance of tonnage is closely supervised. Superintendents are debited with the equivalent tonnage their engines should take over the ruling grade on each section, & are credited with what they do take. They are only charged 90% ("B" rating) of full schedule load on fast freight trains, such as provision, stock & competitive merchandise trains; 93% ("C" rating) on ordinary freight & 88% ("D" rating) on fast freight trains if rail is bad or temperature between 10° above to 20° below zero, & 88% ("F" rating), & 85% ("G" rating) respectively, if temperature colder than 20 below zero—& a special rating is fixed by the master mechanic in case of an engine in bad condition—just out of the shop, etc., or by the superintendent during snow or

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NEXT ANNUAL MEETING at Hamilton, Oct. 16, 1901.

wind storms, etc. (See table 4 on page 69). A statement (see copy of such report covering Havelock section, Nov. 1, 1900, in table 5 on page 71) for the 24 hours ended midnight is made up & sent the general superintendent by first mail showing each freight train run in the direction of balance of tonnage—between what stations, number of engine, class of rating, schedule load at that class of rating, tare, contents, actual & equivalent tonnage & particulars of any doubling or assisting. The percentage of total equivalent tonnage taken over the ruling grade on each section to total of loads which, according to schedule & class of rating, should have been taken over that ruling grade by the power on that day is calculated, & the percentage performance on the different sections tabulated for comparison. If an engine doubles or is assisted over the ruling grade the superintendent is debited with what the engine can take over the next heaviest grade.

The foregoing paper was read by Mr. Tait before a recent meeting of the New York Railroad Club, at which 1st Vice-President W. W. Wheatly presided. The reading of the paper was followed by a very important discussion.

The CHAIRMAN said:—There is probably no subject in connection with freight transportation on our railways which in recent years has excited more discussion & interest than the matter of rating freight engines according to tonnage. This is a matter which interests not only the transportation officer, but also the head of the locomotive department. I think we should have a discussion this evening without it being necessary for me to call upon members by name. As no one has been selected to open the discussion, the field is free for any one who chooses to speak first.

A. E. MITCHELL—I notice that the author has mentioned the old method without stating what it was. I would be glad if he would tell us what his old method was when he adopted the new.

The CHAIRMAN—I have no doubt that there will be a great many questions asked Mr. Tait to-night, & I suggest that he make a note of them as they are propounded, & he will be given an opportunity later to reply to them all. Will some one open the discussion? We would be glad to hear from Mr. Daly, of the Lackawanna road.

J. M. DALY—I came here more to learn about tonnage than to talk about it. But there are one or two points I would like more information on as regards this chart. It strikes me that the chart provides for a reduction on the ratio of 13 to 10 of loads against empties regardless of the number of empties you have on the train. In other words, if you are pulling up a grade 90 ft. to the mile, it is more easy to handle the full rating of empties than it would be if you are undertaking to pull them up a grade of 45 ft., by reason of the length of train & gradient resistance. So that it struck me that the longer the train or the greater the tonnage assigned a train, the greater should be reduction for empties hauled. Another question that I wished to ask is what provision is made for busy tracks? For instance, on a portion of our line we have 20 first-class trains in each direction each 24 hours, & from 5 to 7 fast freights, with a grade of about 45 ft. to the mile for 24 miles. Now, if we confined the movement of trains to 7 miles an hour it is going to utilize that track with freight trains the greater portion of the time. Another feature that struck me was in the testing arrangements. If on a favorable day, with an engine that the master mechanic knew was good, & a choice engineer, good fuel, favorable conditions, he hauled 1,000 tons, what reduction from that was arbitrarily made in rating the engines to insure the general run of engines hauling tonnage up the same grade during the busy season, when the power is more or less overtaxed & run down, & when new enginemen & firemen are pressed into service that are not as competent as the average run of enginemen & firemen that are utilized in testing? It appears to me there is as much danger in undertaking to rate your engines too high & as much money lost in overtime as in underestimating them a little, especially on busy pieces of track where you have a heavy passenger service & a heavy high-class freight service.

F. F. GAINES—As I understand the matter, this sliding scale is made on a basis of either light & loaded cars or partially loaded cars. Now, there is another case that may come up, & I would like to know what provision would be made for it. For instance, I have here a record of two different trains, both handled by the same engine; one was made up of 100,000 lbs. capacity cars, the other was of old-style 60,000 lbs. capacity cars. The tare in the 100,000 lbs. car train was 676 tons; the net tonnage was 1,824 & the gross tonnage 2,500. With the 60,000 lbs. cars the tare was 619, the net 1,381, & the gross tonnage 2,000. By comparing those figures, the net tonnage of the 100,000 lbs. cars is 24.2% greater than the 60,000 lbs. cars. The gross tonnage is 20% greater in those 100,000 lbs. cars than in the 60,000 lbs. What kind of provision would be made for cases of that kind? We all have more classes of cars than one on our roads. It takes more power to haul one class of cars than it does another, & I wish to know if this scale provides for any feature of this kind.

The CHAIRMAN—I think it would perhaps facilitate the discussion if Mr. Tait were permitted now to reply to the questions that have been asked & the points that have been raised & also to elaborate slightly upon the paper.

Mr. TAIT—This paper is, as you will have seen, only a brief description of a method of rating & loading engines which we have had in effect since Oct. 1. Prior to that date we had about the same system of rating engines for the different weather & other conditions as we have now, but we were loading them then on what I have called the "actual" tonnage basis; that is, the actual weight only

was counted, whether a car was loaded with only one ton or to its full capacity. The only exception was in the case of an entirely empty car, to the weight of which an arbitrary addition was made. When we said that under the old system an engine was capable of taking 900 tons over a grade, that meant 900 tons in loaded cars, whether loaded light or to their full capacity. This, I think, answers Mr. Mitchell's inquiry.

The comparison between our old & our new system might be summed up in a question. When you say that an engine will take 900 tons over a certain grade, what kind of tons do you mean? Do you mean 2 to 1 tons; that is, 2 tons of contents to 1 of tare? Or do you mean 3 to 1 or 1 to 1? It makes a great difference. For example, let us take a train of dressed beef. We will say that the load for the engine is 900 tons. The cars will average, say, 15 tons, & the beef & ice, say 15 tons, or 1 to 1. Each car with contents will weigh 30 tons, & 30 cars will make the 900 tons. Now convert the beef into grain, in cars of 30 tons capacity. We still have the car weighing, say, 15 tons, but we have 30 tons of a load in each car, or 2 to 1. Each car with contents will weigh 45 tons, & we will get our 900 tons in 20 cars instead of in 30 cars. Which will pull the easier? The beef or the grain, each weighing 900 tons? There can be no question about that. Any engineman will tell you he would prefer to pull the grain (the 2 to 1 train). What does this mean? It means that if the engine can take 900 tons in the beef train (1 to 1), it can by reason of the smaller percentage of tare take a greater tonnage in the grain train (2 to 1). Our method is devised to take care of this; to profit by the large capacity car fully or well loaded (small percentage of tare), & on the other hand, in the case of a train having a high percentage of tare, to prevent the overloading of engines.

The first proposition I advance is this, that the haulage capacity of engines should be based on a uniform proportion of tare weight to gross weight behind the tender. In order that the relative haulage capacity of the different classes of engines may be determined on any given grade the test should be made with the same kind of a train. If not the identical cars, the percentage of tare should be the same. Otherwise the comparison is

TABLE 1.—HAVELOCK SECTION.

HAULAGE CAPACITY (IN TONS) OF LOCOMOTIVES ON FREIGHT TRAINS THE TARE WEIGHT OF WHICH IS 33⅓% OF THE GROSS WEIGHT BEHIND THE TENDER.

EAST BOUND.

FROM	153	145	140	120	115	110	105	100	95	90	85	80	70	65	60	55	50	% ENG. CAP.
Havelock	1968	1865	1800	1543	1479	1415	1350	1286	1221	1157	1092	1028	900	836	772	707	643	
Central Ontario Jct	1241	1176	1135	973	932	892	851	811	770	730	689	649	568	527	487	446	406	
Tweed	**1063**	**1008**	**973**	**834**	**799**	**765**	**730**	**696**	**660**	**625**	**591**	**556**	**486**	**452**	**417**	**383**	**348**	**Controlling Grade.**
Kaladar	1143	1083	1046	896	859	822	784	747	710	672	635	598	523	486	448	411	374	
Mountain Grove	1175	1114	1075	922	883	845	806	768	730	691	653	614	538	499	461	422	384	
Sharbot Lake	**1063**	**1008**	**973**	**834**	**799**	**765**	**730**	**695**	**660**	**625**	**591**	**556**	**486**	**452**	**417**	**383**	**348**	**Controlling Grade.**
Maberley	1273	1206	1165	998	957	915	874	832	790	749	707	666	582	541	499	458	416	
Perth	1405	1331	1285	1102	1056	1010	964	918	872	826	780	734	643	597	551	505	459	

WEST BOUND.

Smith's Falls	1633	1547	1494	1280	1227	1174	1120	1067	1014	960	907	854	747	694	640	587	534	
Perth	1121	1063	1026	880	843	806	770	733	696	659	623	586	513	476	440	403	367	
Bathurst	1134	1074	1037	889	852	815	778	741	704	667	630	593	519	482	445	408	371	
Sharbot Lake	1189	1127	1088	932	894	855	816	777	738	699	661	622	544	505	466	427	389	
Mountain Grove	2006	1901	1835	1573	1508	1442	1377	1311	1245	1180	1114	1049	918	852	787	721	656	
Ardendale	1121	1063	1026	880	843	806	770	733	696	659	623	586	513	476	440	403	367	
Kaladar	1640	1554	1501	1286	1233	1179	1125	1072	1019	965	912	858	750	697	643	590	536	
Hungerford	1461	1385	1337	1146	1098	1051	1003	955	907	860	812	764	669	621	573	525	478	
Tweed	**995**	**943**	**910**	**780**	**748**	**715**	**683**	**650**	**617**	**585**	**553**	**520**	**455**	**422**	**390**	**358**	**325**	**Controlling Grade.**
"	*1120*	*1061*	*1025*	*878*	*842*	*805*	*769*	*732*	*695*	*659*	*622*	*586*	*512*	*476*	*439*	*402*	*366*	
Ivanhoe	1031	977	944	809	775	741	708	674	640	607	573	539	472	438	404	371	337	
"	*1163*	*1102*	*1064*	*912*	*874*	*836*	*798*	*760*	*722*	*684*	*646*	*608*	*532*	*494*	*456*	*418*	*380*	
Central Ontario Jct	1224	1160	1120	960	920	880	840	800	760	720	680	640	560	520	480	440	400	

TABLE 2.—INDEX TO HAULAGE CAPACITY AND DESCRIPTION OF LOCOMOTIVES.

Per Cent. Capacity.	TYPE OF LOCOMOTIVE AND INDIVIDUAL NUMBERS.								TOTAL.	
	EIGHT WHEEL COUPLED		SIX WHEEL COUPLED			FOUR WHEEL COUPLED		SWITCHERS		
	CONSOLIDATION		TEN WHEELERS		MOGUL	ATLANTIC	EIGHT WHEELERS	SIX WHEEL	Road	Switch
	Simple	Compound	Simple	Compound	Simple	Compound	Simple	Simple		
153	732 738								7	
145	739 740	669 731, 741 786,							111	
140	316 320							342/344	5	3
120	312 315		200/202	194/199				336/341, 580/584, 614	13	12
115	497/498	499/504						321/335	8	15
110			203 208, 212/223	224/227					22	
105			532	480/492, 533						
				641/668					43	
100	401 406		493/496, 534/540	541/608	408/434					
			542 550, 585/602	639/640	443/455				122	
			609/613, 615/638		460/464					
95			435/442, 457/458	562/564						
			465/479, 551/561						59	
			563, 565/579, 603/607							
90			456, 459			209/211		72	5	1
85					M. & A. 24		521/524		5	
80							300/311, 395/400	73, 101/110, 152/155	18	15
70							170/172, 174, 360, 371/373, 379/391, 393/394	117 119 (4 Wheel).	23	3
65							1/6, 20/44, 66, 74/87, 90, 93, 95, 97/99, 120/121 123/142, 173, 175/176, 229, 234/237, 239, 271/282, 285/297, 1299, 351/353, 355/358 361/365, 368, 374/378, 392, 525/527, M.& A. 27/30		5	
60							45/53, 62/64, 67/71, 88/89, 91/92, 94, 96, 143/145, 147/148, 177/179, 184, 230/233, 238, 255/257, 260, 262/267, 269/270, 298, 359, 366/367, 369/370, 508/510, 515/517, 528, 530		63	
55							186/188, 191/193, 240/241, 244/249, 345, 350, 511/513, 520		20	
50							17, 100, 157, 159, 507, 514, 518, M. & A. 11, 13/15, 17, 18, 25, 26		15	
							Total Locomotives, 723.		674	49

not fair, as will be readily understood from the beef & grain train illustration. For the same reason, this uniform percentage of tare should be used in testing the resistance of different grades. Schedules of loads for engines should therefore be based on trains having a uniform percentage of tare. This is what we have done. We adopted the 2 to 1 basis, because we have a large number of cars which weigh about 15 tons, & have a capacity of 30 tons, or 2 to 1. We have very few larger capacity cars of our own. Therefore, we cannot look for many, if indeed any, trains that would have a lower percentage of tare than one-third. The conditions on some other railways may be such that they should adopt, for instance, a 3 to 1 basis. If so, they can make up their schedule of loads & compile their charts on that basis.

The second proposition is, that having determined the haulage capacity of engines with trains having this uniform percentage of tare, that then there should be some method of determining the comparative resistance of every train, & that engines should be loaded accordingly. This is accomplished by the chart, which is compiled on the basis that 30% more power is required to move the same tonnage in empties than in loaded cars, loaded 2 to 1. This 30% is a point which I anticipated I would hear about, & in reference to it I have to say that this method of rating & loading engines is in use as yet only on our Eastern

TABLE 3. INDEX TO HAULAGE CAPACITY AND DESCRIPTION OF LOCOMOTIVES.

NUMBER.	%CAPACITY.	CLASS.	NUMBER.	%CAPACITY.	CLASS.	NUMBER.	%CAPACITY.	CLASS.	NUMBER.	%CAPACITY.	CLASS.
M&A 11	50	8 W,S	159	50%	8 W,S	321/335	115%	6 W,S	508 510	60%	8 W,S
" 13 15	50	"	170/172	70	"	336/341	120	"	511 513	55	"
" 17 18	50	"	173	65	"	342/344	140	"	514	50	"
" 24	85	MOGUL,S	174	70	"	345	55	8 W,S	515 517	60	"
" 25 26	50	8 W,S	175 176	65	"	350	55	"	518	50	"
" 27 30	65	"	177 179	60	"	351/353	65	"	520	55	"
1 6	65	"	184	60	"	355/358	65	"	521 524	85	"
17	50	"	186 188	55	"	359	60	"	525/527	65	"
20 44	65	"	191 193	55	"	360	70	"	528	60	"
45 53	60	"	194 199	120	10 W,C	361/365	65	"	530	60	"
62 64	60	"	200 202	120	10 W,S	366/367	60	"	532	105	10 W,S
66	65	"	203 208	110	"	368	65	"	533	105	10 W,C
67 71	60	"	209/211	90	ATL,C	369 370	60	"	534/540	100	10 W,S
72	90	6 W,S	212 223	110	10 W,S	371 373	70	"	541	100	10 W,C
73	80	"	224 227	110	10 W,C	374/378	65	"	542 550	100	10 W,S
74 87	65	8 W,S	229	65	8 W,S	379/391	70	"	551/561	95	"
88 89	60	"	230 233	60	"	392	65	"	562	95	10 W,C
90	65	"	234 237	65	"	393/394	70	"	563	95	10 W,S
91 92	60	"	238	60	"	395/400	80	"	564	95	10 W,C
93	65	"	239	65	"	401/406	100	CON,S	565/579	95	10 W,S
94	60	"	240 241	55	"	408 434	100	MOGUL,S	580/584	120	6 W,S
95	65	"	244 249	55	"	435 442	95	10 W,S	585 602	100	10 W,S
96	60	"	255 257	60	"	443 455	100	MOGUL,S	603 607	95	"
97 99	65	"	260	60	"	456	90	10 W,S	608	100	10 W,C
100	50	"	262 267	60	"	457/458	95	"	609/613	100	10 W,S
101 110	80	6 W,S	269 270	60	"	459	90	"	614	120	6 W,S
117 119	70	4 W,S	271 282	65	"	460/464	100	MOGUL,S	615/638	100	10 W,S
120 121	65	8 W,S	285 297	65	"	465/479	95	10 W,S	639/640	100	10 W,C
123 142	65	"	298	60	"	480/492	105	10 W,C	644/668	105	"
143 145	60	"	299	65	"	493/496	100	10 W,S	669 731	145	CON,C
147 148	60	"	300 311	80	"	497/498	115	CON,S	732/738	153	CON,S
152 155	80	6 W,S	312 315	120	CON,S	499 504	115	CON,C	739 740	145	"
157	50	8 W,S	316 320	140	"	507	50	8 W,S	741 786	145	CON,C

NOTE.—
8 W —Four driving wheels, coupled with four-wheel truck.
4 W — " " " " switcher.
6 W —Six " " " "
MOGUL— " " " " with two-wheel truck.
10 W — " " " " four " "
ATL—Four driving wheels, coupled with four-wheel truck and one pair idlers under firebox.
CON—Eight driving wheels, coupled with two-wheel truck.
S —Single expansion or "simple."
C —Double expansion or "compound."

TABLE 4.—RATINGS AND RULES FOR LOADING LOCOMOTIVES IN FREIGHT SERVICE.

Conditions	Ordinary		Bad Rail or Temperature 10° Above to 20° Below Zero		Temperature Colder Than 20° Below Zero	
Class of Rating	Ordinary Freight Trains A	Fast Freight Trains B	Ordinary Freight Trains C	Fast Freight Trains D	Ordinary Freight Trains F	Fast Freight Trains G
Reductions From Schedule Loads	% NIL	% 10	% 7	% 12	% 12	% 15

Such regular trains as may be so designated by Superintendents, and any train with ten or more cars of live stock, provisions and perishables will be rated as "FAST FREIGHT TRAINS."
Superintendents may, in special cases other than those provided for herein, authorize a special rating.
The loads for engines during snow and wind storms will be determined at time according to conditions.
In making deductions for "Temperature" or "Bad Rail" the probable conditions over ruling grade and not at starting point, must be considered.
Where tare is not stencilled on cars the following estimated weights will be used:—

	Tons.
28 Feet Box	10
30 " Box or Stock	11
33 " " "	13
34 " " "	14
35 " " "	16
33 " Palace Horse	14
50 " " "	19
35 " Refrigerators, Pass	20
35 " " " Fr't	18
33 " Ventilator	13
40 " Furniture	15
45 " "	19
28 " Flats	8
30 " "	9
33 " "	10
35 " "	12
33 " Coal	10
35 Feet Coal 30 Tons	15
35 " " 40 "	17
Empty Oil Tank	15
Derrick and Tool, Etc	20
Flangers	15
Large Snow Plow	50
Small " "	25
Caboose	14
Official, Long	54
" Short	36
Sleepers, Wide Vestibule	50
" Narrow "	43
" Ordinary Platform	40
Parlor, Wide Vestibule	54
" Narrow "	42½
" Ordinary Platform	40
Dining	45
Coaches, Wide	48
" Narrow Vestibule	38
" Ordinary Platform	28
Colonist	28
Tourist	30
" Wide Vestibule	37
Mail and Smoking	25
Baggage and Smoking	25
Box Baggage	17
Baggage Long	30
" Short	22
Baggage and Express, Long	30
" " Short	22
Mail and Express, Long	30
" " Short	22
Baggage, Mail and Express, Long	30
" " " Short	22

1,000 to 2,000 pounds inclusive shall count as one ton, less than 1,000 pounds shall not count.
A Flanger working is to be rated at 100 tons.
The loads for locomotives may be exceeded up to 15 tons, if by doing so another loaded car may be taken.
The schedules of loads are for use with prescribed chart for calculating loads for locomotives according to proportion of tare to gross weight behind the tender and are based on trains of which the tare weight, including van, is 33⅓% of such gross weight.
NOTE—Figures in italics in hauling capacity schedules are based on the trains passing the stations without stopping.

lines, on which the controlling grades, except in a few instances, are about 1%, & as we desired to avoid complicating the new method at the outset, by having more than one chart, we have as yet only put in use a chart compiled on this 30% basis. I am well aware that the percentage of additional power required to move the same tonnage in empty as in loaded cars, loaded 2 to 1, decreases as the grade increases. The rolling friction does not increase, while the resistance due to gravity does, &, therefore, the percentage of additional power required is not constant. We have in mind, & I may say in hand, several charts for use on the different sections according to the ruling grades thereon. I think that when we put these in use, we will have overcome the only difficulties that we have encountered in connection with this system. We have found that 30% is too much on grades heavier than 1%, & not enough on easier grades.

Mr. Daly has raised a point as to speed of freight trains on grades. The 7 miles per hour is the speed over summits, & I freely admit that where trains are thick more tonnage can be moved with lighter loads & faster speed than by loading engines to the limit, with resulting long occupation of track, especially on grades. Such conditions are local, & have to be dealt with as you find them. This point, moreover, does not affect the two propositions I have advanced.

As to testing engines, we determined the relative haulage capacity of the different classes of engines, as far as we could, on one grade, using a dynamometer car, not by one, but by a great many tests of each class—not with engines that were all in good condition, with good firemen & good coal, but with engines & men as they came along, & then we took what we thought was a fair average. Having determined the relative haulage capacity of the different classes of locomotives on this one grade we then, by testing one or more classes of engines on the other portion of the line—also with the dynamometer car—were able to fix the haulage capacity of all classes of engines over all parts of the line.

Mr. Chairman, with your kind permission, I will resume my seat, & later on, if I have the privilege, I will say something in explanation of the second portion of the paper respecting the supervision of the loading of engines.

F. POTTER—I would like to ask in what office the comparative figures are kept & what increase of office force is necessary; also what is the increased train load above the old method brought about by the new method?

The CHAIRMAN—Prof. Hibbard, can you favor us with any remarks on this question?

PROF. H. W. HIBBARD—I would like simply to call attention to a paper read before the Northwest Railway Club in Dec., 1895, by H. H. Vaughan, on the hauling capacity of locomotives, the paper being discussed at the Feb. meeting, 1896; I have just been reading over that paper & discussion. Possibly some of the members may have the numbers in their files & would be glad to refer to them.

I notice in the discussion some remarks of J. N. Barr, that I thought were in point. He said: In the midst of all this discussion, about how we could increase our trains hauled & how the motive power department had increased the number & hard-working of its locomotives, all the brunt of increased train loads & cheapening of freight transportation seemed to have fallen upon the motive power department; but if the civil engineering department would do a little something to help out, that little something that they might do would be a very important assistance. He said further: "You talk about hauling your trains up these grades. Why not take out some of those grades? Why not fix up some of those curves, & so on?" It seems to me we need more of co-operation between the civil department & the mechanical department & the department that loads 60,000 lbs. capacity cars with only 20,000 or 30,000 lbs. If all the departments would co-operate we would accomplish more than by simply ourselves bearing all the brunt.

G. L. FOWLER—I was speaking the other day with the general manager of a road that probably hauls the largest average net tonnage of any road in the world, & he said that in his original report to his board of directors, when the matter of reducing grades & easing off curves came up, it would be cheaper to put & maintain pushing engines on those grades to help up the hills than it would be to pay the interest on the increased investment required to ease the grades & the curves. And at the risk of repeating perhaps something that you are all familiar with, I will state in regard to this same road, which is the Bessemer Line, from North Bessemer to Conneaut, I had the pleasure recently of going over it very carefully, & noting their tonnage rating & method of operation. They have moguls & consolidation engines hauling their trains, & they have a system of tonnage rating there by which they take a car in units, as they call it. A unit, on their schedule, is 13,000 lbs., which is the weight of the lightest flat car which they have on the line. Of course their traffic is almost entirely conducted in steel cars of 100,000 lbs. capacity. They have a rating for their consolidation & mogul locomotives of 430 & 400 units each. That is, about 40 cars of about 100,000 lbs. capacity. But in their line from Albion to North Bessemer they have six hills, according to my recollection, & on each one of these they put pushing engines. On one of them they put two. Their schedule time for a freight train over the division, which is about 150 miles, is about 12 hours, & they maintain that speed clear through. The work that they do with pushing engines covers 27% of the total mileage of the road, & even on their climb up from Conneaut Harbor, where they have those largest engines in the world, with 24 by 32 in. cylinders, they put 40 cars on behind them & then give the engine a 10-wheel pusher to help up the first hill. But that train goes through practically without any break from Conneaut Harbor to North Bessemer, & their estimate is that they use only about half as many engines to carry the traffic through, using the pushers on the hills, that they would if they left each engine to a tonnage basis which they could carry over the controlling grades & let them go through with the trains without any assistance whatever. That this is a sensible method of operation is evidenced from the fact that, according to their own statement, they have the largest average net paying tonnage of any railway which reports to the Interstate Commerce Commission, & that practically means of any in the world. Their average net paying tonnage is between 900 & 1,000 tons. One month, I remember, it was 949 tons. That includes everything that goes over their lines behind a freight engine. If an engine goes over the road with a caboose car behind it, that is a train with no net tonnage, &, of course, that cuts down the average rate. Their expense of operation is phenomenally low, so low that most railway managers look at them with a good deal of envy. Possibly some of you may be as familiar with this line as I am.

J. S. EATON—May I ask Mr. Fowler a question? He speaks of their having the largest net tonnage. Does he mean per train? If so, does his second engine count for a second train? Does he include the return mileage light of road engines & helpers in computing his train mileage?

G. L. FOWLER—I do not think it includes the return mileage of the helper, but it includes light trains. As I said, if the engine goes over the road with nothing behind it but a caboose, that is a train with no net tonnage, so that if it is averaged up with a train that has 2,000 tons net behind the engine, the average net tonnage would be 1,000, & that

TABLE 5.—CANADIAN PACIFIC RAILWAY,

DAILY REPORT OF HAULAGE CAPACITY OF LOCOMOTIVES AND TONNAGE OF FREIGHT TRAINS OVER RULING GRADES ON HAVELOCK SECTION, NOVEMBER 1ST, 1900. DIRECTION OF BALANCE OF TONNAGE EAST.

TRAIN.	FROM	TO	LOCOMOTIVE.				TONNAGE OVER RULING GRADE.				COAL USED.	REMARKS.
			No.	Schedule Haulage Capacity, Tons.	Class of Rating	Net Schedule Haulage Capacity, Tons.	Contents.	Tare.	Total Actual.	Equivalent Tonnage.		
Extra	Havelock..	Smith's Falls	707	1,008	"A"	1,008	532	416	948	998	6	
54	" ..	" "	739	1,008	"A"	1,008	400	513	913	1,003	6	
56	" ..	" "	725	1,008	"B"	908	382	464	846	922	5	Live stock and Toronto shed freight
50	" ..	" "	723	1,008	"A"	1,008	427	487	914	1,004	5	
Way freight extra	" ..	" "	705	1,008	"A"	1,008	480	473	953	1,020	6.5	
52	" ..	" "	709	1,008	"B"	908	297	513	810	918	5	Dressed beef and provisions.
Extra	" ..	" "	743	1,008	"A"	1,008	537	423	960	1,007	6.5	
				7,056		6,856	3,055	3,289	6,344	6,872	40	

Percentage of Total Equivalent Tonnage taken to Net Schedule Haulage Capacity over Ruling Grades, 100%.

NOTE.—Under the old "actual tonnage" method of loading engines, these engines would each have been scheduled at "A" rating to take 913 actual tons through over the section, or a total for the seven engines (2 at "B" rating), of 6,209 tons—whereas under the new method they brought 6,344 tons through over the section—a gain of 135 tons, or 19.3 tons per train.

If the proportion of tare had been one-third on each train, this power would have taken 6,856 tons through over the section—or 512 tons more than it was able—owing to large proportion of tare—to bring through.

continues in all the local freight trains. Of course they are rather peculiarly situated. They haul ore from Lake Erie to Pittsburgh, & their net tonnage on leaving the lake is, of course, very high. They carry about 40 cars with 50 tons in each car up from the lake, & that helps matters. But they have a comparatively light tonnage coming the other way —a great many trains of empties, with absolutely no paying tonnage in them whatever, & that in turn cuts down their rate.

J. M. DALY—I am afraid the transportation men present will have to increase our tonnage unless we get further facts on the conditions that prevail on the Bessemer road. I would ask in regard to the question of the unit being 13 tons, what he would do in case he got a car of merchandise, the car weighing 13 tons, & there being 4 tons of merchandise in the car? Would he give the engine credit for the extra 4 tons? Or is that dropped entirely unless it reaches more than half of the unit or 6½, which on 40 cars would be quite an item?

G. L. FOWLER—Their method of reckoning the units is this: Their single unit is 13,000 lbs. They have made an examination of the average run of cars over the road to see how they would average up, reckoning by units. They jump to 32,000 lbs. for two units. Anything between 13,000 & 32,000 lbs. they reckon as 2 units; between 32,000 & 45,000 is 3 units; between 45,000 & 58,000 is 4 units; between 58,000 & 71,000 is 5 units; between 71,000 & 84,000 is 6 units; between 84,000 & 97,000 is 7 units; between 97,000 & 110,000 is 8 units; between 110,000 & 123,000 is 9 units, and between 123,000 & 136,000 is 10 units. The conductor or the yardmaster in making up his train has his net tonnage & the tare weight of his car. Of course that is added on his waybill. He puts down his figure, 3 or 5 or 10 units, or whatever it may be, to correspond to that weight, & when it foots up so that he has got 430 tons he stops, couples on his engine & starts down the road. If there is a pound more than 45,000, it is 4 units; if it is a pound less than that, it is 3 units. From 32,000 to 45,000 is 3 units. From 45,00 to 58,000 is 4 units. I will call attention to the fact that their points of division are about half-way between the actual even multiples of two consecutive units. For example, they call 3 units from 32,000 to 45,000. Now, 3 units actual is 39,000, so that they can run 6,000 lbs. over & 7,000 lbs. less on each side of the actual division. Of course it is an average method for rapid work in the yard, & it answers their purpose perfectly. They have no stalled trains & they haul a tremendous traffic.

J. M. DALY—We had a practical demonstration on tonnage during Oct., when our mines were closed on a strike. Instead of hauling 80,000 lbs. of coal per car, with about 36,000 lbs. of tare, we had to haul a lot of cotton & hay, & light-loaded cars, & our average tons per train went off very materially, & it showed there is no intelligent, fair & just comparison between one road & another, unless they both handle the same commodities. Consequently a road handling iron ore in 100,000-lbs. capacity cars, if they turned around & hauled cotton with the same engines I think their tonnage would be right down along with the balance of us.

G. L. FOWLER—I will say the management of that road acknowledged that. There is probably no other road in the world that is situated exactly as that is. They have this tremendous traffic loaded on to them at one end & absolutely nothing else to take care of, coming that way. Going the other way they have nothing in the world but coal & iron, except, of course, the ordinary, little, light traffic that comes from local conditions & what is called local freight. There is no other through traffic, & it is comparatively easy for them. It is given merely as an instance of locomotive rating & of successful operation under local conditions.

MR. EATON—A vital feature in that is the question whether all the traffic is balanced. If balanced, they can avail themselves of their heavy tonnage to greater advantage. I want to ask another thing: Is it not true that the Baltimore & Ohio had this system of units of 13 tons, which they discarded for a more accurate rating in actual tons?

G. W. WEST—I would like to ask Mr. Tait whether they have used the heavy capacity cars long enough to demonstrate whether the conditions he mentioned in regard to the beef & grain were actual or imaginary? Some tests that Mr. Daly & myself have watched for a few days have not demonstrated that to be a fact; that the car construction had as much to do with that as the loading. And then I question whether the heavier capacity cars, when they get down on their side bearings, will be able to haul the tonnage load in a fewer number of cars.

The CHAIRMAN—Mr. Sinclair, we would be glad to hear from you, if you will favor us.

A. SINCLAIR—There are so many practical railway men here that you have not heard from, that I think it is rather unfair for a theoretical man to get up & say anything about this subject at this part of the game. I have paid a great deal of attention to the tonnage rating of locomotives ever since it was first agitated. I must acknowledge that at first I was rather prejudiced against it, as I have been accustomed to the car rating; but it undoubtedly became a necessity with the great variation in the weight of carloads that have become common of late years, & consequently

I became convinced that it was the right thing. However, although I have no practical experience with the working of the thing myself, there are a great many men who send in accounts of their grievances to me—trainmen, & I find that there is about an equal division among trainmen againt the ton-rating of locomotives & the system of pooling locomotives. Neither of them seems to have many friends among trainmen, & I think the reason of that has been that the tendency of the new system has been to overload locomotives. There is a very important individual connected with terminals who is called the yardmaster. That man wants to get as many cars out of his yard as possible, & he is very often not very particular about the loading he puts on to a locomotive. A general superintendent of the railway who is opposed to this system said to me one day that the difficulty with the great mass of men is that they cannot add figures. A yardmaster can put whatever he likes on to a train, & there are few of them who would take the trouble of adding up the figures to see whether it is the right load or not, & that has certainly brought a good deal of onus upon the system among the trainmen, & has made them prejudiced against it. I think that the system which the C.P.R. has worked out & which we have just heard described by Mr. Tait, is the fairest of any that has been tried. It seems to meet all the objections as far as possible. You cannot establish any form of engine rating without having injustice or inequalities, & that seems to even it up as fairly as any that I have read about. There is no doubt that the tonnage system has increased the number of tons that locomotives have hauled, & I think that the railroads have been very much benefited thereby. I have a paper in my hand here describing a system on the Southern Pacific Ry., & in three years under the tonnage system their loads were increased 33%. That, of course, will induce all railway companies to go into some system of the kind sooner or later. I think that this system will become popular when railway men generally become acquainted with it, because it seems to be founded on justice. Most of the systems make no provision for difficult conditions, for bad wind-storm days, slippery track, from cold weather, & so on, & the consequence has been that the engines were overloaded & a great deal of delay consequently occurred. I noticed in that Southern Pacific system the loads have increased 33%, & it seems to me that the delays had increased in about the same proportion. I think the tendency is to overload locomotives without reasoning on what the effect of it is. There are two problems to be considered in that regard. It is quick movement & heavy loads. Quick movement does not agree with putting the last ton upon a locomotive. If a locomotive can only make 10 miles an hour, & another, more lightly loaded, can make 20 miles an hour, the chances are that the one making 20 miles an hour is earning more for the company than the one that is making 10 miles an hour. I think that has not been sufficiently considered by railroad companies, & where traffic is congested it very often happens, through the persistent efforts of yardmasters & others, their locomotives are loaded away beyond their capacity.

F. F. GAINES—I would like to ask Mr. West if I understood him to say that he doubted the economy of the large capacity cars.

G. W. WEST—No, I did not say that. I asked Mr. Tait whether they had experience enough with the heavy capacity cars to know whether the conditions that he referred to were actual or imaginary. On some tests that were recently made we were not able to haul a great deal more tonnage than the heavy capacity cars—in fact, not so much. But the prime cause was that the heavy capacity cars got down on the side bearings & it was a question with me whether the results were not due to car construction more than to the increased tonnage that he was able to get in the less number of cars. I can understand how 1,000 tons can be hauled in 10 cars if the cars are in proper condition, a good deal easier than in 20 cars. But that is due to the heavy capacity cars being of new & modern creation. When those cars get old, as some of our 40,000 or 50,000 lbs. capacity cars are, whether we will get the same conditions that we get now from the new cars is a question.

F. F. GAINES—I think that there is no question, if a car is properly designed, with stiff body bolsters and stiff truck bolsters as cars are designed to-day, there is no doubt that they will stay up as long as the cars last. I referred once before to figures I had here. In a test of 100,000 lbs. cars against 60,000 lbs. cars the actual increase in tonnage with the same engine was 20%. That is not imaginary, these are actual facts, after the cars had been in service for a year or a year and a half.

G. W. WEST—I do not think there is any one here who knows of any old 80,000 lbs. capacity cars. I know these cars were two years old.

F. F. GAINES—I would like to say that we have a lot of 80,000 lbs. cars. There is a little difference in favor of the 100,000 lbs. but not over 10 or 12%.

G. W. WEST—There are several Erie men here, & I know they have a system of loading by M's that I think includes light & loaded cars & is quite successful.

MR. MITCHELL—The system on the Erie R. R. of loading cars on the tonnage basis is to consider unit 1,000 lbs., or an M. Now, in taking the light weight of a car we take the number of thousand pounds. If the light or tare weight of the car is 23,700 lbs., we call it 24 M's. If the weight is 23,400, we call it 23 M's. We add the M's in the train together & to that add the tonnage carried in each car, & obtain the total M's behind the engine; dividing that by 2 will give us the tons. We have not gone into dynamometer tests as Mr. Tait has. We have a committee at the present time who are working on these lines with a dynamometer car. But where the dynamometer car has been used by us on certain divisions we have fully demonstrated that the pressure on side bearings controls in a great measure the pulling of the train. We took one train on the Buffalo division loaded with grain, in box cars, with metal trucks & metal body bolsters (about 97% of it, I think, was metal body bolsters), & also a train of grain with all diamond trucks & wooden body bolsters, & we found a vast difference in the pulling of the latter train, showing at once that the car of modern construction pulls easier than the old-style car. I am very glad to see our neighbor in the North has gone into the use of the dynamometer car so thoroughly. It is the way of demonstrating what we can do. The percentage of train we should haul, based on tare & load, was left in the hands of each division superintendent to do the best he could on his division, & I think whenever we have made use of the dynamometer car we have demonstrated that our engines are very well loaded. We are still working on the problem; the transportation department has it in charge & they will develop something before they get through.

E. CHAMBERLAIN—I was very much interested in the remarks of Mr. Gaines with regard to modern car construction as compared with that of a few years ago. There can be no question that the improvement made in recent years by the substitution of metal for wood parts, the elimination of factors that were a hindrance to starting & moving of cars, the positive center instead of side bearings on your car, the perfect tram of your trucks, & many more things of a like character, place you in a position to start & move greater tonnage with the same motive power than it did before such motive changes were incorporated. I cite, for instance, the cars built, I believe, by the Pittsburgh, Bessemer & Lake Erie R.R., I think, of a carrying capacity of 100,000 lbs., all of metal & improved construction. It is just possible that you would find—if it were possible to obtain figures, showing tonnage hauled in these cars with the same type of engines—that it would be quite a revelation & also show quite an attractive figure in mills per ton per mile. Mr. Mitchell very clearly pointed out the difficulties which existed in hauling trains with cars having bodies riding constantly on the side bearings. It is possible that the genius of the American mechanic will undoubtedly further improve & perfect the vehicles for freight carriage, possibly to that extent—let us hope - that one engine regardless of size of cylinder will haul a string of cars so great in extent that it will be a joy to the management & result in something tangible to the stockholder.

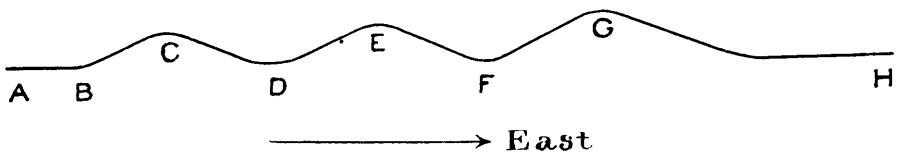
T. TAIT—Something has been said here about the large trains which the Pittsburgh, Bessemer & Lake Erie are hauling. I think that is one of the very best arguments in favor of large capacity cars, fully loaded (small percentage of tare), that has been advanced; that large capacity cars fully loaded will increase the tonnage which a given engine can take over a given grade will not, I am sure, be controverted.

Mr. Daly has pointed out that the class of commodity has much to do with the average size of train. True, coal, iron, etc., can be loaded to the full capacity of a car, again demonstrating the truth of the proposition that the percentage of tare should always be taken into consideration.

I agree with Mr. West that car construction has much to do with resistance of trains, but I submit that the side bearings can be taken care of on a 40-ton car as well as on a 20-ton car.

Before proceeding to deal with the second part of the paper, I would like to make a few remarks on the value of "equivalent" tonnage for purposes of comparison. When a comparison is made between engines & between men in fuel performance, & an engineman is called to account for a poor record, he may say, if actual ton miles per ton of coal is the basis of comparison, "I ran merchandise trains very often during the month, with many light loaded cars," or "I hauled a great many empties during the month." "I did not have as favorable conditions as the other men to make a good record." He would not perhaps have been required to explain at all, or if he was, such an explanation would not have been in order if "equivalent" tonnage had been the basis of comparison, for he then would have received credit for everything he had done. Under the "equivalent" tonnage method, every man & every engine receives credit for the resistance overcome according to the percentage of tare in trains handled by them, & an intelligent & fair comparison can be made.

I would now like to show you with the aid of the blackboard & of two of the tables accompanying the paper how we not only supervise the full loading, but check the overloading of engines. As a rule on our line, & I think on most lines, the tonnage preponderates on each section in one direction. Your power & your men must return in the other direction without full loads. That being the case, on any such section as that, what we want to watch is that engines are fully loaded over the controlling or limiting grades in the direction of the balance of tonnage. If we do that, if we see that our engines haul full loads over the controlling grades in that direction, we have done all we can. Now, supposing this profile A to H (referring to blackboard) represents a section or engine run of



say, 120 miles. We will assume that the grades B C, D E & F G are all the same, say 1%, & that the balance of tonnage is eastbound. If your engines are fully loaded over the grade F to G, & fills out to their hauling capacity with anything for the east offering at G, or at stations between there & H, we have done everything in the direction of fully loading our engines that can be expected of us. Now, if you will turn to table 1 (see page 67) you will find a load sheet, eastbound & westbound, on a section or engine run, viz.: between Havelock & Smith's Falls—109 miles, giving the load for each class of engine from station to station, at which the haulage capacity changes, in equivalent tons; that is, for a train of which the tare is 33⅓%, two tons of contents to one ton of tare. You will note that eastbound there are two ruling grades; that is, there are two similar grades limiting the tonnage which an engine can take through over the section. The 145% engines can, for instance, take 1,008 equivalent tons over the grade east from Tweed & east from Sharbot Lake. We debit the superintendent for every 145% engine run east on that section—with 1,008 equivalent tons, & we credit him with what equivalent tonnage he does take over the grade east from Sharbot Lake—the more easterly controlling grade. Now turn to table 5. There is the performance eastbound, the direction of the balance of tonnage, for one day, Nov. 1, on this same section. I invite you to study this table—in connection with engine load sheet—table 1—the rules—table 4, & the chart. You will note that we only debit the superintendent with the tonnage which he should take over the controlling grade at the reduced ratings authorized for unfavorable weather & other conditions; for instance, on a fast freight handled by a 145% engine under ordinary weather conditions, we charge him with 1,008 tons—the schedule load—less 10%—B rating—this reduced tonnage being necessary to enable him to make the faster time required with this train. On this day, Nov. 1, the power should have taken, you will see, 6,856 equivalent tons eastbound over the controlling grade between Havelock & Smith's Falls. It did take 6,872, or a trifle over 100%, & the officers of the transportation department with this return before them know that the power has on that section on that day been used to the best possible advantage. Such a return every day from every section of the line enables us to closely supervise the loading of our engines in freight train service, & to know whether or not we are getting all that we should out of our power.

Now I will answer Mr. Potter. What did we gain by the new method on that day on that section? Each of the 145% engines under the old "actual" tonnage system would have been scheduled to take 913 tons, or, as explained in the note to table 5, a total of 6,209 tons. They did take under the new method 6,344 actual tons, a gain of 135 actual tons, or 19.3 tons per train. In this case the gain is not large, but I may say that we are showing generally very satisfactory gains in the tonnage taken in the direction of the balance of the traffic due to this system—in Dec. certainly over 5%—& we are having more satisfactory service getting our trains over the road, because engines are not overloaded, especially on trains having a high percentage of tare. If the schedule load on any grade is too heavy for any class of engine we soon find out by such engines doubling or being assisted over that grade, which information must be reported in the "Remarks" column on the daily performance return—in which column must also be reported the explanation why any engine is light loaded over the controlling grade in the direction of the balance of tonnage.

Now, it may occur to you that we do not know by this system whether our engines after they are over the ruling grade are doing what they should, that is, for example, lifting cars from (see the profile) G & stations east of there to H. An engine can take larger tonnage from G to H than it can bring to G, but we can & do check this by our daily performance return. If trains reaching G from the west fail to lift cars from G & stations east to H, how can these cars be moved? An engine must be sent from H for that purpose. The engine must return & must then, moving as it then will be in the direction of the balance of tonnage, be reported on the daily performance return, & whoever is in charge of the train movement on this section will at once be requested to explain why he failed to lift these cars with the way-freight or other eastbound trains.

We use two forms, as to which I desire to make a few remarks for your better information. One of them is the coal ticket. Coal is very expensive with us, & we watch its consumption very carefully. When an engineman reaches the end of his run, having entered up on this coal ticket how much coal he had on the tender when he started & how much he took on the trip, he estimates the quantity he has left on the tender & enters this, also what

he has consumed on the trip & the work his engine has done, on this ticket. The ticket is then handed in to the locomotive foreman, & he then & there, not several days or weeks after, but then & there takes up with the engineman any excessive consumption of coal.

The other form is what we call the Conductor's Freight & Mixed Train Report, but the conductor does not make it up. These train reports are now made out in our yard offices. They are made in duplicate; one copy being kept in the yard office, forming the outward record of trains & cars, the other copy being filled in as required by the conductor & then turned in by him to the yard office at the other end of the run. After it has been completed by the yard office there, it is forwarded to the car accountant & becomes the basis for our train, car & tonnage statistics.

I think that in the course of these remarks I have answered all the questions & dealt with all the points raised, & I have only to repeat again the two propositions which I have advanced, & which, by experience, we are convinced are sound in principle & in the right direction.

1—That the haulage capacity of engines should be based on a uniform proportion of tare weight to gross weight behind the tender.

2—That in loading engines the resistance of every train, as compared with that of a train having this uniform proportion of tare, should be determined.

Thereby will we derive the benefit we should from large capacity cars fully or well loaded.

A vote of thanks having been passed to Mr. Tait, the Chairman, addressing him, said: The New York Railroad Club feels complimented that you should have come from Montreal all the way to New York to present this subject to us, & I am sure that we are all duly grateful to you for your kindness.

T. TAIT—It must be with some diffidence that any railway man offers any suggestions on a question that has been so much discussed as the rating & loading of engines. It was with more than this usual diffidence, possibly, that I consented, at Mr. Yereance's kind request, to read a short description of our method, because Montreal is not a very large railway centre, & we have not that advantage which you enjoy here of the exchange of thought & experience, & we have had therefore to do our own thinking along our own lines. It has occurred to me, however, that possibly it might be of some interest to the members of the New York Railway Club to know what thinking we had been doing, & the result of it, & I trust it has been. I thank you for your cordial reception & for your kind vote of thanks.

C.P.R. Earnings, Expenses, &c.

Gross earnings, working expenses, net profits & increases or decreases over 1900, from Jan. 1, 1901:—

	Earnings.	Expenses.	Net Profits.	Increase or Decrease.
Jan.	$2,054,015.68	$1,405,819.23	$648,196.45	$43,373.16—

Mileage increased to 7,467.

Approximate earnings for Feb., $1,965,000; increase over Feb., 1900, $12,000.

DULUTH, SOUTH SHORE & ATLANTIC.—Approximate earnings for Feb., $166,064; decrease from Feb., 1900, $21,735.

Gross earnings for 1900, $2,557,973; operating expenses, $1,628,839; net earnings, $929,134; income from other sources, $5,446; total $934,580. Interest on bonds, $859,700; taxes, $78,990; deficit for the year, $4,109. In 1899 was a surplus of $14,057.

HANCOCK & CALUMET.—Approximate earnings for Feb., $20,054; increase over Feb., 1900, $210.

MINERAL RANGE.—Approximate earnings for Feb., $19,885; increase over Feb., 1900, $6,319.

MINNEAPOLIS, ST. PAUL & SAULT STE. MARIE. — Approximate earnings for Feb., $293,880; decrease from Feb., 1900, $33,556.

Net earnings for Dec., 1900, $192,757, against $173,261 for corresponding period; making for the 12 months to Dec. 31, $2,105,521, against $2,261,529.

Canadian Pacific Railway Land Sales.

	Acres.		Amount.	
	1900	1901	1900	1901
Jan.	31,485	27,928	$100,857.85	$36,752.54
Feb.	23,613	29,370	75,771.19	91,189.58
	55,098	57,298	$176,629.04	$127,942.12

Grand Trunk Earnings, Expenses, &c.

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

	1901.	1900.	Increase.	Decrease.
Jan.	$2,225,878	$2,222,200	$ 3,678	....
Feb.	1,993,493	1,917,348	76,145	....
	$4,219,371	$4,139,548	$79,823	....

The following figures are issued from the London, Eng., office:

GRAND TRUNK RAILWAY.

Revenue statement for Jan., 1901:

	1901.	1900.	Increase.	Decrease.
Gross receipts	£370,200	£358,100	£12,100	....
Working expenses	259,100	257,200	1,900	....
Net profit	£111,100	£100,900	£10,200	....

GRAND TRUNK WESTERN RAILWAY.

Revenue statement for Jan., 1901:

	1901.	1900.	Increase.	Decrease.
Gross receipts	£70,300	£87,300	....	£17,000
Working expenses	58,700	64,500	....	5,800
Net profit	£11,600	£22,800	....	11,200

DETROIT, GRAND HAVEN AND MILWAUKEE.

Revenue statement for Jan., 1901:

	1901.	1900.	Increase.	Decrease.
Gross receipts	£16,800	£15,800	£1,000	....
Working expenses	12,400	13,000	....	£600
Net profit	£ 4,400	£2,800	£1,600	....

Government Railway Statistics.

The result of the operation of the Government railways for the year ended June 30, 1900, are stated as follows:—

	Mileage		Amount. $ cts.	Profit. $ cts.	Loss $ cts.
Intercolonial Ry.	1,315	Working expenses	4,431,404 69		
		Earnings	4,552,071 71	120,667 02	
Windsor branch	32	½ earnings	47,351 43		
		Maintenance	12,891 56	34,459 87	
P. E. I. Ry.	211	Earnings	174,738 73		
		Working expenses	220,931 81		46,193 08
		Deduct loss from profit		155,126 89	
				46,193 08	
	1,388	Net profit		108,933 81	

Gross earnings for two years:—

	1898-99.	1899-1900.
	$ cts.	$ cts.
Intercolonial Ry.	3,738,331 34	4,552,071 71
Windsor branch	42,474 03	47,351 43
P.E.I. Ry.	165,012 03	174,738 73
Total	3,945,817 40	4,774,161 87

Gross working expenses, including rentals of leased lines, for two years:—

	1898-99.	1899-1900.
	$ cts.	$ cts.
Intercolonial Ry.	3,675,686 21	4,431,404 69
Windsor branch	12,873 09	12,891 56
P.E.I. Ry.	218,053 01	220,931 81
Total	3,906,612 31	4,665,228 06

Working expenses for two years:—

	1898-99. $ cts.	1899-1900. $ cts.	Increase. $ cts.	Decrease. $ cts.
Locomotive power	1,138,655 18	1,457,956 08	299,300 90	
Car expenses	769,729 95	1,049,809 96	280,080 01	
Maintenance of way & works	942,382 20	1,041,071 06	98,688 86	
Station expenses	483,886 87	569,634 29	85,747 42	
General charges	269,062 00	321,038 95	51,976 95	
Car mileage	72,896 11	61,023 25		11,872 86
Rental of leased lines	210,000 00	164,694 47		45,305 53
	3,906,612 31	4,665,228 06	815,794 14	57,178 39
Deduct decrease			57,178 39	
Net increase			758,615 75	

A Tie Suit.—The Supreme Court of Canada gave judgment Mar. 18, in favour of G. P. Magann, of Toronto, reversing the judgment of the trial judge at Quebec & also reversing the judgment of the Quebec Court of Review. The case was recently argued in the Supreme Court. Auger & Sons sued Magann to recover the value of certain ties sold to him by correspondence. The ties were afterwards rejected as not being up to specifications, & at the trial judgment was given against Magann, which was subsequently confirmed by the Court of Review. In the result the action has been dismissed.

C.P.R. Equipment.—The Co.'s shops have the following orders in hand:—55 standard 30-ton flat cars, 6 standard fruit express cars, 50 ft. long, equipped with standard steel platforms, steel-tired wheels & C.P.R. standard trucks to be built at the Perth shops; 2 weed burners, 5 standard 50-ton flat cars, 6 standard baggage & express cars 60 ft. long, with standard steel platforms; 10 1st class coaches 65 ft. long, equipped with C.P.R. standard 6-wheel trucks, standard steel platforms & Pullman wide vestibules, to be built at Hochelaga car shops. The outlook is very promising, & from present indications the shops will be kept fully employed on new work or some time.

RAILWAY STATISTICS FOR YEAR ENDED JUNE 30, 1900.

In this table the minus mark (-) before figures in the net earnings column shows that there was a deficit in the operations of the line to the extent of the figures given. Where (E) appears after the name of a railway it signifies that it is an electric line. The numbers in brackets—thus (1)—after the name of a railway refer to notes alongside the table. The British Yukon Ry. appears in the returns for the first time.

Name of railway.	Mileage.	Gross earnings.	Net earnings.	Proportion of earnings to working expenses.	Earnings per train mile.	Operating per train mile.
		$ cts.	$ cts.	p.c.	Cents.	Cents.
Alberta Railway & Coal Co...	64.62	153,080 33	60,835 71	166	350.78	211.37
Albert Southern (1).....	19.00	1,203 00	- 244 50	83	21.48	25.84
Atlantic & Lake Superior	98.00	27,668 88	1,087 75	104	42.96	41.27
Bay of Quinte Ry. & Nav. Co. (2).....	64.82	199,313 91	96,658 53	194	145.68	75.03
Berlin & Waterloo (E).....	3.00	11,869 94	1,112 48	110	16.31	14.78
British Yukon..... ...	64.75	301,191 64	201,421 13	302	1,023.13	338.91
Brockville, Westport & Sault Ste. Marie.....	45.00	33,106 70	4,947 18	118	99.67	84.77
Buctouche & Moncton.....	32.00	15,460 20	- 2,402 49	87	74.30	86.41
Calgary & Edmonton (3)....	295.07	326,126 29	128,264 66	165	183.76	111.49
Canada Atlantic (4)...	456.80	1,869,139 58	366,036 70	124	115.64	92.99
Canada Coals & Ry. Co....	12.00	20,436 07	11,374 81	226	95.73	42.44
Canada Eastern.....	136.00	137,696 59	38,069 16	138	72.25	52.27
Canada Southern.....	382.19	4,621,595 23	280,015 67	106	119.00	111.79
Canadian Northern (5).....	216.70	183,473 80	86,681 34	189	243.44	128.43
Canadian Government Ry.'s—						
Intercolonial (6)	1,300.94	4,552,071 71	120,667 02	103	83.16	80.95
Prince Edward Island....	210.00	174,738 83	- 46,193 08	79	66.43	83,99
Canadian Pacific (7)..... .	6,873.00	30,193,172 57	12,443,284 17	170	162.64	95.61
Caraquet.....	68.00	19,860,79	517 75	103	47.17	45.94
Carillon & Grenville.....	13.00	1,707 42	- 1,993 33	46	28.45	61.67
Central Ontario (8).....	113.60	144,621 85	52,195 72	156	136.53	87.26
Central of New Brunswick...	45.66	10,615 83	- 9,881 02	51	34.02	65.69
Central of Nova Scotia (9)...	74.00	53,439 47	12,298 42	129	108.82	83.78
Cumberland Ry. & Coal Co..	32.00	119,439 46	64,847 68	219	166.79	76.23
Dominion Atlantic (10).....	220.50	820,215 90	160,362 16	124	156.02	125.52
Elgin & Havelock.....	28.00	8,160 97	- 903 46	90	46.62	51.79
Esquimalt & Nanaimo.....	78.00	183,860 90	- 22,765 17	89	71.85	80.75
Fredericton & St. Mary's Ry. Bridge Co. (11).....	1.33	5,292 36	3,836 33	363	.....	.....
Galt, Preston & Hespeler (E).	9.00	20,307 34	6,242 93	144	25.23	17.47
Grand Trunk (12)	3,138.44	20,430,166 68	7,430,795 67	157	123.90	78.83
Great Northwest Central (13)	51.00	42,055 98	13,201 57	146	306.57	210.33
Gulf Shore.....	16.78	1,857 32	849 83	184	61.99	33.62
Halifax & Yarmouth (14)....	50.10	28,781 50	2,037 39	107	66.38	61.68
Hamilton & Dundas (E).....	7.25	22,548 18	7,413 46	148	28.90	19.40
Hamilton, Grimsby & Beamsville (E)....	23.00	47,164 89	22,887 89	194	19.98	10.28
Hamilton Radial (E).....	12.00	32,784 87	14,181 22	176	18.81	10.67
Hampton & St. Martins.....	25.00	9,685 67	- 117 53	99	50.44	51.05
Hereford..... ...	53.30	47,450 25	- 23,387 48	67	51.07	76.24
Hull (E).....	13.63	64,954 64	31,993 11	197	17.96	09.11
Irondale, Bancroft & Ottawa.	48.00	18,731 66	- 2,017 40	90	06.23	06.90
Kaslo & Slocan	31.80	49,314 96	12,363 26	133	192.17	143.99
Kent Northern (15).....	34.00	10,898 75	3,133 75	140	59.34	42.27
Kingston & Pembroke.....	112.85	163,218 06	44,364 11	137	116.61	84.91
L'Assomption	3.00	1,164 42	- 160 58	88	16.92	19.25
Lake Erie & Detroit River (16)	179.72	418,081 84	136,610 87	149	120.42	81.07
Lotbinière & Mégantic.....	30.34	13,458 05	1,895 24	116	90.33	77.61
Manitoba & North-western (17)	252.60	349,082 53	94,407 76	137	219.93	160.45
Massawippi Valley (18).....	35.46	134,613 02	40,559 61	143	82.48	57.63
Metropolitan (E.).....	28.00	49,543 13	26,081 10	211	18.01	8.53
Montfort & Gatineau Colonization.....	33.00	15,472 05	- 930 57	94	30.04	31.84
Montreal & Atlantic (19).....	163.40	384,843 95	37,112 10	110	87.28	78.87
Montreal Terminal (E.)	14.10	40,177 32	15,792 65	165	17.27	10.48
Montreal Park & Island (E.)..	40.88	118,892 22	46,586 91	164	17.15	10.43
Montreal Province Line.....	40.60	56,202 04	19,911 50	155	109.04	70.41
Montreal & Vermont Jct.....	23.60	179,610 97	32,719 88	122	104.12	85.15
Nelson & Fort Sheppard.....	59.40	107,683 80	43,020 26	167	194.58	116.84
New Brunswick & P.E.I. ...	36.00	21,155 44	8,445 78	166	55.41	33.29
Niagara, St. Catharines & Toronto	12.27	27,625 30	3,716 81	115	105.60	91.39
Niagara Falls Park & River (E.)	13.68	62,482 71	24,535 86	165	22.50	13.66
Niagara Falls, Wesley Park & Clifton (E.).....	3.00	4,089 35	4,089 35	.....	.....	.....
Northern Pacific & Manitoba.	316.07	391,947 40	- 185,578 21	68	143.56	211.54
Nosbonsing & Nipissing.....	5.50	52,049 70	4,529 05	110	369.14	337.02

(1) The Atlantic & Lake Superior mileage 98, includes the Baie des Chaleurs, 98 miles, the Great Eastern, 23 miles, & the Ottawa Valley, 7 miles, the two latter not being under traffic. The Baie des Chaleurs line was in operation 8 months only.

(2) The Bay of Quinté's mileage, 64.82, is comprised of the Bay of Quinté, 4 miles & the Kingston, Napanee & Western, 60.82.

(3) The Calgary & Edmonton is operated by the C.P.R.

(4) The Canada Atlantic mileage, 456.80, includes two leased lines, the Central Counties, 37 miles, & the Pembroke Southern, 21.

(5) The Canadian Northern mileage is comprised of the Lake Manitoba Ry. & Canal Co.'s line, the Winnipeg Great Northern, the Manitoba Southeastern & the Ontario & Rainy River. The C.N.R. has running powers over the C.P.R. between Portage la Prairie & Gladstone Jct.

(6) The Intercolonial Ry. has running powers over the G.T.R., Point Levis to Hadlow, 1.50 miles; Chaudiere Curve to Chaudiere, 1.18 miles & Ste. Rosalie to Montreal, 37.62 miles; total, 40.30 miles.

(7) The C.P.R. mileage comprises C.P.R. lines owned 4,369.75 miles, Crow's Nest Pass & B.C. Southern, 288.75. Leased lines—Fredericton, 22.10; New Brunswick, 175; New Brunswick & Canada, 117.20; St. John & Maine, 92.10; St. John Bridge & Ry. Extension, 2; St. Stephen & Milltown, 4.60; Tobique Valley, 28; Cap de la Madeleine, 3; Montreal & Lake Maskinonge, 11; Atlantic & North-west, 201.40; Montreal & Ottawa, 93.90; Ontario & Quebec, 474.50; St. Lawrence & Ottawa, 58.40; Credit Valley, 175.70; Guelph Junction, 15; Toronto, Hamilton & Buffalo, 1.70; Toronto, Grey & Bruce, 191.10; West Ontario Pacific, 26.60; Manitoba Southwestern Colonization, 214.40; Columbia & Kootenay, 60.50; Nakusp & Slocan, 36.30; Shuswap & Okanagan, 50.80; Columbia & Western, 159.20.

(8) The Central Ontario mileage comprises the C.O.R. 104 miles, & the Ontario, Belmont & Northern, 9.60 miles.

(9) The Central of Nova Scotia has running powers over the Dominion Atlantic for 33 miles.

(10) The Dominion Atlantic mileage includes the Windsor & Annapolis, 87.50 miles; Cornwallis Valley, 14; Yarmouth & Annapolis 87 and Windsor branch of I.C.R., 32. The D.A.R. has running powers over the I.C.R. from Halifax to Windsor Jct., 14 miles.

(11) The Frederickton & St. Mary's Bridge receipts consists of tolls on trains run by Canada Eastern.

(12) The Grand Trunk mileage includes.—G.T.R., 884.25 miles; Great Western, 561.80; Brantford, Norfolk & Port Burwell, 34.39; Buffalo & Lake Huron, 161; G.T. Georgian Bay & Lake Erie, 171; Owen Sound branch, 12.42; London, Huron & Bruce, 68; Waterloo Jct., 10.25; South Norfolk, 17; Wellington, Grey & Bruce, 168.13; Northern, 172.10; North Simcoe, 33; Hamilton & Northwestern, 172; Northern & Pacific Jct., 111.37; Toronto Belt Line, 12.79; Midland, 166; Grand Jct., 85.21; Toronto & Nipissing, 83; Lake Simcoe Jct., 26; Victoria, 53; Whitby, Port Perry & Lindsay, 46; Jacques Cartier Union, 6.50; Montreal & Champlain Jct., 61.73; Beauharnois Jct., 19.50.

(13) The Great North West Central Ry. figures are from July 1, 1899 to April 5, 1900, balance of year included in C.P.R.

(14) The Halifax & Yarmouth was formerly the Coast Ry. of Nova Scotia.

(15) The Kent Northern includes the St. Louis & Richibucto.

(16) The Lake Erie & Detroit River mileage includes the Erie & Huron, & the London & Port Stanley, the latter 24 miles being leased.

(17) The Manitoba & Northwestern Ry.

RAILWAY STATISTICS FOR YEAR ENDED JUNE 30, 1900—Continued.

Name of railway.	Mileage.	Gross earnings.	Net earnings.	Proportion of earnings to working expenses.	Earnings per train mile.	Operating per train mile.
		$ cts.	$ cts.	p.c.	Cents.	Cents.
Nova Scotia Steel Co.'s Ry...	12.50	23,410 35	3,458 04	117	146.31	124.70
Orford Mountain	26.50	17,697 83	1,677 26	110	57.68	52.21
Oshawa (E.).....	8.02	33,477 14	13,173 24	164	68.84	41.75
Ottawa & Gatineau.....	56.50	73,199 52	20,092 11	138	124.40	90.28
Ottawa & New York	56.79	63,890 04	- 3,058 55	95	73.18	76.68
Phillipsburg Jct. & Quarry Co.	7.50	7,279 63	5,447 75	397	433.37	109.04
Pontiac Pacific Junction.....	70.60	46,105 08	- 1,797 10	96	94.91	98.67
Port Arthur, Duluth & Western (20)	85.50	14,482 05	- 3,866 42	79	107.44	136.12
Portage & North-western....	29.23	2,084 81	- 8,379 79	20	26.45	132.79
Qu'Appelle, Long Lake & Saskatchewan.....	253.96	100,702 68	- 14,776 56	87	154.07	176.67
Quebec Central (21).....	213.50	519,348 59	168,343 20	148	123.16	83.24
Quebec & Lake St. John (22)..	297.00	339,285 52	95,457 88	139	111.03	79.79
Quebec, Montmorency & Charlevoix.....	30.00	65,615 23	28,439 65	177	1078.44	61.10
Red Mountain.....	9.53	89,148 83	55,566 58	206	593.89	223.71
Salisbury & Harvey.....	45.00	24,533 26	- 411 00	98	87.09	88.54
Shore Line, New Brunswick...	82.50	31,344 03	- 4,349 52	88	56.63	64.48
Stanstead, Shefford & Chambly.....	43.00	70,253 87	14,049 40	125	108.11	86.49
St. Clair Tunnel	2.23	237,040 65	130,579 03	222	280.07	125.78
St. Lawrence & Adirondack (23).....	33.00	189,403 74	106,470 05	228	96.42	42.22
Sydney & Louisburg	48.96	548,982 64	282,316 65	206	317.50	154.22
South Shore.....	54.50	54,528 55	16,351 43	143	82.92	58.06
Témiscouata.....	113.00	78,238 49	15,958 69	125	91.26	72.64
Tilsonburg, Lake Erie & Pacific	20.00	11,122 30	3,293 30	142	55.61	39.14
Thousand Islands.....	4.33	23,273 11	9,994 83	175	117.00	66.75
Toronto, Hamilton & Buffalo..	83.94	391,461 64	140,737 55	156	141.56	90.67
United Counties (24).....	83.80	59,783 79	- 1,572 47	98	53.47	54.88
Victoria & Sydney.....	16.26	17,920 97	- 141 87	99	73.93	74.51
Total.....	17,656.80	70,740,270 45	23,040,471 83			

figures are for 11 months to May 30, 1900, the month of June being included in the C.P.R.

(18) The Massawippi Valley, operated by the Boston & Maine R.R., has running powers on the G.T.R. from Sherbrooke to Lennoxville, 2.95 miles.

(19) The Montreal & Atlantic, formerly the Southeastern, mileage includes the Lake Champlain & St. Lawrence, 60.70 miles. Both are operated by the C.P.R.

(20) The Port Arthur, Duluth & Western Ry. was sold to the Canadian Northern Ry. in May, 1900. The return for portion of year prior to sale not having been received in time, a proportion of traffic returned in 1899 has been inserted for the period prior to sale.

(21) The Quebec Central has running powers on the I.C.R., from Harlaka Jct. to Levis, 5 miles.

(22) The Quebec & Lake St. John mileage includes Q. & L.S.J., 242; Great Northern, St. Tite to St. Boniface, 20; & the Lower Laurentian, Riviere a Pierre to St. Tite, 35. The Great Northern does not appear in the returns, though it did in 1898-99.

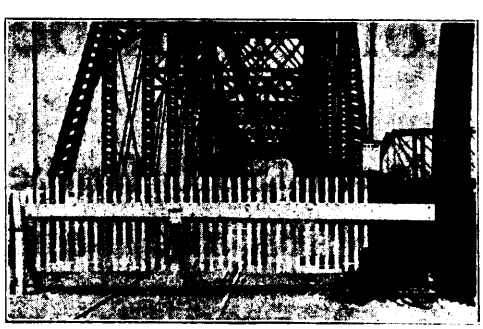
(23) The St. Lawrence & Adirondack Ry. has running powers on the G.T.R., 13.20 miles & on the C.P.R., 8.70 miles.

(24) The United Counties Ry. has running powers on the South Shore Ry., St Robert to Sorel, 5 miles. Its mileage includes the U.C., 61 miles & the leased East Richelieu Valley, 22.80 miles.

J. F. Dolan, recently transferred to Montreal as City Passenger Agent of the R. & O. Navigation Co., was, on leaving Toronto, presented by the members of branch 15, C.M.B.A., with a mahogany music desk, in token of their appreciation of his services as President of the branch.

Gates for Swing Bridges.

The illustration herewith shows one of a set of gates which have been in operation at the Burlington canal bridge at Hamilton, for three seasons. The gates are operated from the centre of the bridge by the attendant who swings the bridge. The operator has absolute control of the traffic, as each gate, or pair of gates at the ends of the draw, is operated by separate levers. The gates are on the approach to bridge at either



end, and being operated from centre of draw the connection necessarily requires to be broken each time the bridge is swung. This object is obtained by a very simple yet reliable clutch & receiver, which releases the connection by a trip, & allows the rod to be drawn back clear. This operation lowers the gates, & the attendant has a clear bridge with all traffic blocked at either end. The next move is to swing the bridge. An automatic device—consisting of a straight lever, the tail of which is moved aside by closing the bridge, and is attached to rods and cranks leading to lock which is operated by a very powerful spring, and engages the projecting rod at end of gate the moment bridge starts to open—immediately locks the gates down, & they cannot be raised until the bridge is swung back to its proper position for traffic. This releases the lock and allows operator to raise the gates, which operation locks the bridge, as when the levers are thrown over, the rodding attached is forced into the receiver and clutch at either end, & act as two powerful bolts. The gates, as will be seen, block the entrance to the open draw, so that not even a child can get through. Traffic over the Burlington canal bridge is very heavy, &, being at the entrance to Hamilton barbor, on busy days the bridge is swung over one hundred times, which necessitates, of course, the raising & lowering of gates each time. That these gates have stood this test for three seasons speaks well for their utility, as there has not been an accident of any kind. There were erected by the patentees, the N. L. Piper Railway Supply Co. of Toronto, the mechanism being especially constructed for the position by Hiram Piper. Major Gray, in charge of Dominion Public Works in Ontario, endorses the gates very highly.

Hudson's Bay Navigation.

A very interesting addition to the Hudson's Bay Co.'s fleet on the Atlantic & Hudson's Bay service has just been made, the Co. having purchased H.M.S. Pelican from the British Admiralty. The employment of this vessel marks a new departure in ice navigation. It has been customary to speak with a considerable amount of derision of the old type of Hudson's Bay ships. "Bluff-bowed," "old wooden tubs" they have been called, but they did their work well, & the long records of the Co.'s voyages are most remarkably free of wreck or disaster.

Latterly the Co. has had a steamer plying to Hudson's Bay, but of the same heavy wooded-build as the famous Dundee whalers & the vessels chartered for the Dominion expedition of 14 & 16 years ago. The Pelican belongs to quite a different type to the vessels hitherto employed in this service, & it seems very appropriate that a corporation with the long & unequalled experience in the navigation of Hudson's Bay that the H. B. Co. has, should be in the van in introducing to those seas a vessel up-to-date in every respect.

The Pelican is all that an ordinary ocean-going iron-built steamer is, with in addition a sheathing of two thicknesses of solid oak planks of 3 & 3½ ins. respectively, & the space just behind the bows is practically solid wood to buffet the icebergs. She is of 1,130 tons displacement, has screw propeller, & is of a beautiful model.

Doubtless when the whistle blows & this stately ship steams into view at one or other of the lonely ports of call on the desolate shores of Labrador or Hudson's Bay she will be the object of much curiosity to the dusky inhabitants. May she have a long & prosperous career, & as successfully combat the obstacles of free navigation as she would certainly have done the enemies of the empire before the H.M.S. had been replaced by the monogram more familiar in the North, "H. B.C.," cannot but be the wish of all who are watching with interest the readjustment of the Co.'s methods in keeping abreast of the times, under the progressive management of Commissioner Chipman.

H. Foster Chaffee, on leaving Montreal recently for Toronto to become Western Passenger Agent of the R. & O. Navigation Co., was presented with an illuminated address signed by a number of prominent citizens.

RAILWAY APPOINTMENTS, ETC.

Central Vermont.—E. H. Fitzhugh, Vice-President & General Manager, having resigned to accept a position with another company, R. S. Logan has been elected Vice-President & General Manager, with office at St. Albans, Vt.

J. E. Dalrymple, General Freight Agent, having resigned to become Assistant to the General Manager of the G.T.R., I. W. Gantt, heretofore Agent of the Great Eastern Line at Chicago, has been appointed General Freight Agent of the C.V.R., with office at St. Albans, Vt.

Delaware, Lackawanna & Western.—A. G. Elvin, heretofore Master Mechanic of the G.T.R. at Montreal, has been appointed Master Mechanic of the D.L. & W., with office at Scranton, Pa., succeeding D. Brown, promoted.

Grand Trunk.—J. E. Dalrymple has been appointed Assistant to General Manager, vice R. S. Logan, resigned to become Vice-President & General Manager of the Central Vermont Ry.

Capt. W. F. McGregor has been appointed Superintendent of Ferries, with headquarters at Windsor, Ont., with full charge of all offices & men employed on the ferry steamers Lansdowne, Great Western & Huron, plying between Windsor, Ont., & Detroit.

Intercolonial.—D. Pottinger, General Manager Government Railways, issued the following circular Feb. 23:—E. G. Russell has been appointed Manager of the Intercolonial Ry. He will have charge of the mechanical department, the station & train services, & the maintenance of way & works. His office & headquarters will be at Moncton. This will take effect Feb. 25.

Minneapolis, St. Paul & Sault Ste. Marie.—T. A. Foque, heretofore Assistant Mechanical Superintendent, has been appointed Mechanical Superintendent, succeeding E. A. Williams, appointed Superintendent of Rolling Stock for the C.P.R.

H. C. Pearce, formerly Storekeeper, has been appointed Purchasing Agent, to succeed J. E. Shaughnessy, resigned. O. W. Applegate has been appointed Storekeeper to succeed Mr. Pearce.

Richelieu & Ontario Navigation.—J. A. Villeneuve, heretofore Accountant & Treasurer, has been appointed Comptroller.

Mainly About People.

C. R. Hosmer, of the C.P.R. directorate, & Mrs. Hosmer & family are travelling in Europe.

Sir Wm. Van Horne left Montreal Feb. 22 to spend some weeks in Cuba, in his capacity as President of the Cuba Co.

L. Robinson, for many years Superintendent of the Montreal Park & Island Ry., recently resigned to take a position on one of the tramways in Paris, France.

Sir Wm. Van Horne & R. B. Angus, of the C.P.R. directorate, with others, have obtained incorporation as the Canadian Salt Co., capital $800,000, chief place of business Montreal, to mine, manufacture, purchase & sell salt.

Andrew Cowan, heretofore Soliciting Agent at Hamilton for the G.T.R., has been appointed General Agent for the Northern Navigation & the Northwest Transportation companies, succeeding W. Askin, promoted to be General Manager.

Henry Rowand, son of the late Dr. Rowand, of Quebec, & at one time in the head offices of the C.P.R. at Montreal, was fatally stabbed in East Kootenay about the middle

of Feb. by F. McG. Derverre, C.E., formerly engaged on the Crow's Nest Pass branch of the C.P.R The stabbing was the result of a row between the two men.

We are informed that there is no foundation for the report, at all events for the present, that F. W. Jones, formerly Assistant to the Manager of the C.P.R. Western lines, & now Manager of the Columbia River Lumber Co., is to take an important position in connection with the operation of the Canadian Northern Ry. lines. Mr. Jones has a very comfortable position at Golden, B.C., & it is said that he is not feeling any of the railway fever just now. He visited Winnipeg recently & had a hard time convincing people that the report was not true.

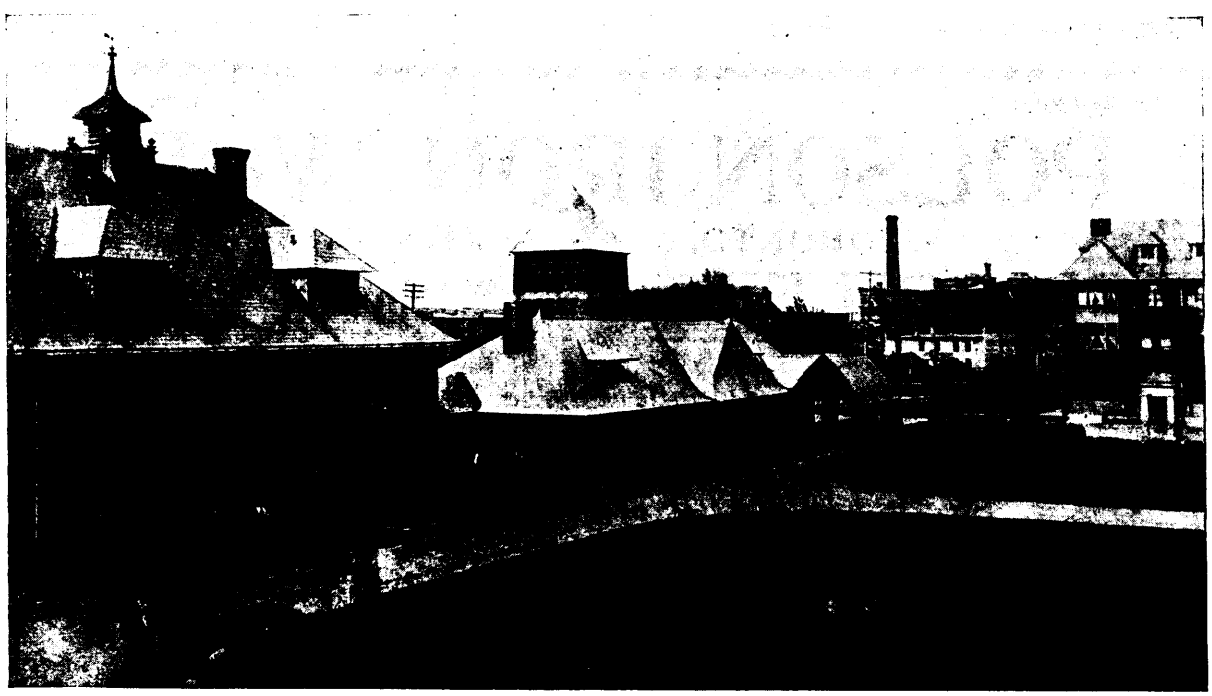
Captain B. H. O. Armstrong, R.E., son of C. N. Armstrong, of Montreal, of Atlantic & Lake Superior Ry. fame, who has for a number of years been in charge of the fortifications at Sierra Leone, on the west coast of Africa, has just been ordered to South Africa, & placed in charge of the construction of four forts, designed for the better protection of Cape Town. His brother, Captain C. J. Armstrong, who went out to South Africa as a subaltern in the Montreal company of the Royal Canadian Regiment, is on the staff of Lieut.-Col. Girouard, Director of Imperial Military Railways.

R. S. Logan, who has been appointed Vice-President & General Manager of the Central Vermont Ry., was born Feb. 13, 1864, & was educated in the St. Louis, Mo., public schools. He entered railway service in 1885 with the receivers of the Wabash, St. Louis & Pacific Ry. as clerk in General Manager Talmage's office, since which his career has been as follows:—Dec. 1, 1890, Secretary to General Manager Wabash Rd.; July 1, 1896, Secretary to General Manager G.T.R.; Jan. 1, 1901, Assistant to General Manager G.T.R.; Jan. 9, 1901, Secretary Grand Trunk Western Ry.; March 15, 1901, Vice-President & General Manager Central Vermont Ry.

Ira W. Gantt, who has been appointed General Freight Agent of the Central Vermont Ry. at St. Albans, Vt., was born in the little country town of Atkinson, Ill., a little over 40 years ago, & commenced railway life as yard clerk for the old Peoira & Pekin Union Ry. at Peoria, Ill. He was afterwards local & commercial freight agent of the C.P. & S.W. Ry., (now part of the Santa Fe System main line) & then for a short time represented the Blue Line at Evansville, Ind. For the past 19 years he has been associated with G.T.R. interests, first as agent of the Great Eastern Line at Peoria, Ill., & during the past 14 years as agent of the Great Eastern Line at Chicago.

G. A. Sharp, Superintendent of the Prince Edward Island Ry., whose portrait appears on page 65, was born at Studholm, N.B., in 1852, & was educated in the High School at Millstream, N.B., afterwards taking a course in the Commercial College at St. John, N.B. He entered railway service on the Intercolonial in 1874 as operator & relieving agent on the temporary staff. In 1875, on the opening of the P.E.I. Ry., he was appointed freight clerk at Charlottetown; in 1880 he was promoted to be freight agent, & in 1882 station master at Charlottetown, the duties of ticket agent being added in the same year. On July 1, 1897, on the voluntary resignation of A. McDonald, he was appointed Superintendent.

J. E. Dalrymple, who has been appointed Assistant to the General Manager of the G.T.R., was born in Montreal Jan. 1, 1869. He entered railway service as apprentice in the Treasurer's office of the G.T.R., July 1, 1883, in which office he served until 1890 in various capacities, & finally as correspondence clerk. He left Montreal April 1, 1890, & entered the service of the Chicago & G.T.R. at Chicago, as Secretary to Traffic Manager Reeve. On. Feb 1, 1896, he was appointed Secretary to General Traffic Manager Reeve, of the G.T.R. System at Montreal. On May 1, 1899, he was appointed Division Freight Agent, G.T.R. at Hamilton, Ont. On Aug. 1, 1899, he was appointed Division Freight Agent G.T.R., at Detroit, also Manager of the G.T. Despatch, a fast freight line operating over the G.T. Ry., West Shore Rd. & Fitchburg Rd. On May 1, 1900, he was appointed General Freight Agent of the Central Vermont Ry.



THE LAKE ERIE AND DETROIT RIVER RAILWAY'S GENERAL OFFICES, STATION AND GROUNDS, WALKERVILLE, ONT.

Western Railway Progress.

At the recent annual meeting of the Winnipeg Board of Trade the President in his report said: While the year 1900 has not seen a marked activity in railway building, yet some important branches have been extended in different parts of the country, opening up new districts, & giving needed accommodation to others.

Commencing east of us the C.P.R. has built a small spur east of Rat Portage, to one of the well-known mines in that district, & the Lac du Bonnet branch, of about 22 miles, has opened up communication with the largely timbered country, drained by the English & Winnipeg Rivers, both of which are tributary to this beautiful lake. Draining tiles, & superior brick for building & pavement purposes are being manufactured, thus adding another to the large & varied number of our industrial concerns.

Coming to the Prairie country, a line is being extended from MacGregor to a point on the Great North West Central Ry., & the Pipestone branch has been carried forward 100 miles into the well-known fertile & finely situated Moose Mountain district.

It has been found necessary by the C.P.R. to build a substantial steel bridge, supported on masonry piers, across the Red River, on account of the increased traffic & larger engines used, which make the present bridge inadequate for their requirements, & I have good reason to believe this will be followed soon by a large & commodious station. It seems unfortunate that some reasonable arrangement could not have been arrived at between the City Council & the C.P.R., & been ratified by the ratepayers, for the construction of a sub-way on Main St. The condition of things now existing is anything but satisfactory to either the railway company or the citizens, &, in addition to this, it has, I believe, caused the postponing for some time longer the erection of a splendid hotel in this city.

The volume of traffic, both through & local, is increasing so rapidly that the C.P.R. has practically decided to establish early next summer two daily trans-continental trains;

one a fast limited, making but few stops, & the other to accommodate local traffic.

Great progress, too, has been made by the Canadian Northern Ry. Co., which during 1900 constructed 224 miles of railway, & which expects before the end of the present year to have its line in operation from Port Arthur to Winnipeg, & from Winnipeg to a point within a very short distance of Prince Albert. It is now advertising for tenders for the construction of a magnificent steel bridge, with a draw span of 380 ft., to cross the Rainy River, & tenders are likely to be called for in a few days for a bridge across the Red River, at Winnipeg. With the completion of these works, & the additional mileage to be constructed this year, this Co. expects to have not less than 1,100 miles of railway in operation, thus bringing it into the rank of the third railway in Canada. It is pretty generally understood that a large portion of the fine timber through which this road runs will be brought into this city, & lumber mills established here for its manufacture, thus giving employment to a large number of men. Mining interests, too, should be greatly benefited, as the Canadian Northern runs largely through mining country tributary to the Seine River, & the improved transportation facilities will be of great value, both in shipping in machinery & exporting the product of the mines.

Thus it will be seen that some very important railway works have been carried on during the year, &, if we are to believe current reports, even more will be accomplished before another crop is harvested.

L.E. & D.R.R. Headquarters.—The illustration on page 79 shows the Lake Erie & Detroit River Ry.'s general offices, station & grounds at Walkerville, Ont. The General Manager & the traffic department occupy the building to the right; the audit office, accounting department, Roadmaster, Engineer, Storekeeper & other officials being located in the building to the left, the central building being the station. These buildings are of brown stone & brick throughout. They are heated by natural gas, lighted by electricity, & contain all modern improvements. In the station grounds is a fountain erected & given to the people of Walkerville by Hiram Walker & Sons, on the occasion of the Queen's jubilee in 1897.

The L.E. & D.R. Railway Subsidy.

In answer to a question by Mr. Robinson, of West Elgin, in the House of Commons recently, the Minister of Railways said:—The Government has entered into a contract with the Lake Erie & Detroit River Ry. for the payment of a subsidy of $3,200 a mile, on the completion of the Co.'s extension from Ridgetown to St. Thomas. The Government is aware of the fact that, for a limited number of miles the L.E & D.R.R. extension runs parallel or very nearly to the Michigan Central Ry. This fact was made the subject of discusssion in Parliament at the time the subsidy proposal was being passed upon. The Government in the bill providing for this subsidy, reserved the question of the grant for determination, after enquiry by the Railway Committee of the Privy Council, as to whether adequate & efficient running powers should be arranged for by the L.E. & D.R.R. over the M.C.R. An objection was taken in Parliament by gentlemen in opposition to such qualifying clause being introduced, & it was insisted that the grant should be made without any qualification whatever. This view was pressed strongly, & a motion in amend-

Form 120A 21-4-00

CANADIAN PACIFIC RAILWAY COMPANY

CHART

For Calculating Loads for Locomotives, according to Proportion of "Tare" to Gross Weight Behind the Tender.

(THIS CHART AND THE SCHEDULE OF "HAULAGE CAPACITY OF LOCOMOTIVES," FOR USE WITH IT, ARE BASED ON EMPTY CARS, REQUIRING 30 PER CENT MORE POWER TO HAUL THEM THAN LOADED CARS, THE "CONTENTS" OF WHICH WEIGH TWICE AS MUCH AS THE "TARE," INCLUDING THE VAN—THAT IS, 2 TO 1, OR "TARE" = 33⅓ PER CENT.)

EXAMPLE "A."—IT IS DESIRED TO MAKE UP A TRAIN OF LOADED CARS FOR AN ENGINE SCHEDULED TO HAUL 900 TONS OVER THE RULING GRADE ON SECTION—. THE "TARE" AND "CONTENTS" OF SUFFICIENT CARS, TO EQUAL TOGETHER ABOUT 900 TONS, ARE ASCERTAINED. IT IS FOUND THAT THE "TARE" IS 386 TONS, AND THE "CONTENTS" 458 TONS; OPPOSITE 390 ON BOTTOM SCALE—THE "TARE" SCALE—AND 460 ON SIDE—THE "CONTENTS" SCALE—IS 900, EXACTLY THE LOAD. IF THE "TARE" HAD BEEN FOUND TO BE 400 TONS AND "CONTENTS" 500 TONS, IN THE SAME WAY, OPPOSITE 400 ON "TARE" AND 500 ON "CONTENTS" SCALE IS 945, 45 TONS TOO MUCH.

EXAMPLE "B."—IT IS DESIRED TO MAKE UP A TRAIN CONSISTING PARTLY OF LOADED AND PARTLY OF EMPTY CARS (LOADED CARS HAVING PREFERENCE) FOR AN ENGINE TO HAUL 650 TONS OVER THE RULING GRADE ON SECTION—. THE WEIGHT OF THE "CONTENTS" AND OF THE "TARE" OF THE LOADED CARS, WHICH SHOULD FIRST BE ASCERTAINED, IS FOUND TO BE "TARE" 100, "CONTENTS" 150 TONS. FOLLOW THE LINE OPPOSITE 150 ON THE "CONTENTS" SCALE UNTIL 650 IS REACHED; BELOW 650 ON THE "TARE" SCALE IS FOUND 400. THE DIFFERENCE BETWEEN 100 TONS, THE "TARE" OF THE LOADED CARS, AND 400, VIZ., 300, WILL GIVE THE TONNAGE OF EMPTY CARS TO BE ADDED TO COMPLETE LOAD.

EXAMPLE "C."—FOR TRAINS EXCEEDING 1,000 TONS, DIVIDE "TARE" AND "CONTENTS" BY TWO, AND PROCEED AS ABOVE MULTIPLYING RESULT BY TWO, THUS OBTAINING LOAD.

NOTE—Five to nine tons (inclusive) of "Tare" or "contents," count as ten tons, less than five do not count.

"CONTENTS" SCALE

700	933	946	959	972	985	998	1011	1024	1037	1050	1063	1076	1089	1102	1115
690	925	938	951	964	977	990	1003	1016	1029	1042	1055	1068	1081	1094	1107
680	917	930	943	956	969	982	995	1008	1021	1034	1047	1060	1073	1086	1099
670	909	922	935	948	961	974	987	1000	1013	1026	1039	1052	1065	1078	1091
660	901	914	927	940	953	966	979	992	1005	1018	1031	1044	1057	1070	1083
650	893	906	919	932	945	958	971	984	997	1010	1023	1036	1049	1062	1075
640	884	897	910	923	936	949	962	975	988	1001	1014	1027	1040	1053	1066
630	875	888	901	914	927	940	953	966	979	992	1005	1018	1031	1044	1057
620	866	879	892	905	918	931	944	957	970	983	996	1009	1022	1035	1048
610	857	870	883	896	909	922	935	948	961	974	987	1000	1013	1026	1039

600	783	796	809	822	835	848	861	874	887	900	913	926	939	952	965	978	991	1004	1017	1030	1043	1056	1069	1082	1095
590	775	788	801	814	827	840	853	866	879	892	905	917	931	944	957	970	983	996	1009	1022	1035	1048	1061	1074	1087
580	767	780	793	806	819	832	845	858	871	884	897	910	923	936	949	962	975	988	1001	1014	1027	1040	1053	1066	1079
570	759	772	785	798	811	824	837	850	863	876	889	902	815	928	941	954	967	980	993	1006	1019	1032	1045	1058	1071
560	751	764	777	790	803	816	829	842	855	868	881	894	907	920	933	946	959	972	985	998	1011	1024	1037	1050	1063
550	743	756	769	782	795	808	821	834	847	860	873	886	899	912	925	938	951	964	977	990	1003	1016	1029	1042	1055
540	734	747	760	773	786	799	812	825	838	851	864	877	890	903	916	929	942	955	968	981	994	1007	1020	1033	1046
530	725	738	751	764	777	790	803	816	829	842	855	868	881	894	907	920	933	946	959	972	985	998	1011	1024	1037
520	716	729	742	755	768	781	794	807	820	833	846	859	872	885	898	911	924	937	950	963	976	989	1002	1015	1028
510	707	720	733	746	759	772	785	798	811	824	837	850	863	876	889	902	915	928	941	954	967	980	993	1006	1019

500	633	646	659	672	685	698	711	724	737	750	763	776	789	802	815	828	841	854	867	880	893	906	919	932	945	958	971	984	997	1010	1023	1036	1049	1062	1075
490	625	638	651	664	677	690	703	716	729	742	755	768	781	794	807	820	833	846	859	872	885	898	911	924	937	950	963	976	989	1002	1015	1028	1041	1054	1067
480	617	630	643	656	669	682	695	708	721	734	747	760	773	786	799	812	825	838	851	864	877	890	903	916	929	942	955	968	981	994	1007	1020	1033	1046	1059
470	609	622	635	648	661	674	687	700	713	726	739	752	765	778	791	804	817	830	843	856	869	882	895	908	921	934	947	960	973	986	999	1012	1025	1038	1051
460	601	614	627	640	653	666	679	692	705	718	731	744	757	770	783	796	809	822	835	848	861	874	887	900	913	926	939	952	965	978	991	1004	1017	1030	1043
450	593	606	619	632	645	658	671	684	697	710	723	736	749	762	775	788	801	814	827	840	853	866	879	892	905	918	931	944	957	970	983	996	1009	1022	1035
440	584	597	610	623	636	649	662	675	688	701	714	727	740	753	766	779	792	805	818	831	844	857	870	883	896	909	922	935	948	961	974	987	1000	1013	1026
430	575	588	601	614	627	640	653	666	679	692	705	718	731	744	757	770	783	796	809	822	835	848	861	874	887	900	913	926	939	952	965	978	991	1004	1017
420	566	579	592	605	618	631	644	657	670	683	696	709	722	735	748	761	774	787	800	813	826	839	852	865	878	891	904	917	930	943	956	969	982	995	1008
410	557	570	583	596	609	622	635	648	661	674	687	700	713	726	739	752	765	778	791	804	817	830	843	856	869	882	895	908	921	934	947	960	973	986	999

400	483	496	509	522	535	548	561	574	587	600	613	626	639	652	665	678	691	704	717	730	743	756	769	782	795	808	821	834	847	860	873	886	899	912	925	938	951	964	977	990	1003	1016	1029	1042	1055					
390	475	488	501	514	527	540	553	566	579	592	605	618	631	644	657	670	683	696	709	722	735	748	761	774	787	800	813	826	839	852	865	878	891	904	917	930	943	956	969	982	995	1008	1021	1034	1047					
380	467	480	493	506	519	532	545	558	571	584	597	610	623	636	649	662	675	688	701	714	727	740	753	766	779	792	805	818	831	844	857	870	883	896	909	922	935	948	961	974	987	1000	1013	1026	1039					
370	459	472	485	498	511	524	537	550	563	576	589	602	615	628	641	654	667	680	693	706	719	732	745	758	771	784	797	810	823	836	849	862	875	888	901	913	927	940	953	966	979	992	1005	1018	1031					
360	451	464	477	490	503	516	529	542	555	568	581	594	607	620	633	646	659	672	685	698	711	724	737	750	763	776	789	802	815	828	841	854	867	880	893	906	919	932	945	958	971	984	997	1010	1023					
350	443	456	469	482	495	508	521	534	547	560	573	586	599	612	625	638	651	664	677	690	703	716	729	742	755	768	781	794	807	820	833	846	859	872	885	898	911	924	937	950	963	976	989	1002	1015	1028	1041	1054	1067	1080
340	434	447	460	473	486	499	512	525	538	551	564	577	590	603	616	629	642	655	668	681	694	707	720	733	746	759	772	785	798	811	824	837	850	863	876	889	902	915	928	941	954	967	980	993	1006	1019	1032	1045	1058	1071
330	425	438	451	464	477	490	503	516	529	542	555	568	581	594	607	620	633	646	659	672	685	698	711	724	737	750	763	776	789	802	815	828	841	854	867	880	893	906	919	932	945	958	971	984	997	1010	1023	1036	1049	1062
320	416	429	442	455	468	481	494	507	520	533	546	559	572	585	598	611	624	637	650	663	676	689	702	715	728	741	754	767	780	793	808	819	832	845	858	871	884	897	910	923	936	949	962	975	988	1001	1014	1027	1040	1053
310	407	420	433	446	459	472	485	498	511	524	537	550	563	576	589	602	615	628	641	654	667	680	693	706	719	732	745	758	771	784	797	810	823	[illegible]	849	862	875	888	901	914	927	940	953	966	979	992	1005	1018	1031	1044

300	333	346	359	372	385	398	411	424	437	450	463	476	489	502	515	528	541	554	567	580	593	606	619	632	645	658	671	684	697	710	723	736	749	762	775	788	801	814	827	840	853	866	879	892	905	918	931	944	957	970	983	996	1009	1022	1035					
290	325	338	351	364	377	390	403	416	429	442	455	468	481	494	507	520	533	546	559	572	585	598	611	624	637	650	663	676	689	702	715	728	741	754	767	780	793	806	[illegible]	832	845	858	871	884	897	910	923	936	949	962	975	988	1001	1014	1027					
280	317	330	343	356	369	382	395	408	421	434	447	460	473	486	499	512	525	538	551	564	577	590	603	616	629	642	655	668	681	694	707	720	733	746	759	772	785	798	[illegible]	824	837	850	863	876	889	902	915	928	941	954	967	980	993	1005	1019					
270	309	322	335	348	361	374	387	400	413	426	439	452	465	478	491	504	517	530	543	556	569	582	595	608	621	634	647	660	673	686	699	712	725	738	751	764	777	790	803	816	829	842	855	868	881	894	907	920	933	946	959	972	985	998	1011					
260	301	314	327	340	353	366	379	392	405	418	431	444	457	470	483	496	509	522	535	548	561	574	587	600	613	626	639	652	665	678	691	704	717	730	743	756	769	782	795	808	821	834	847	860	873	886	899	912	925	938	951	964	977	990	1003					
250	293	306	319	332	345	358	371	384	397	410	423	436	449	462	475	488	501	514	527	540	553	566	579	592	605	618	631	644	657	670	683	696	709	722	735	748	761	774	787	800	813	826	8.9	852	865	878	891	904	917	930	943	956	969	982	995	1008	1021	1033	1047	1060
240	284	297	310	323	336	349	362	375	388	401	414	427	440	453	466	479	492	505	518	531	544	557	570	583	596	609	622	635	648	661	672	687	700	713	726	739	752	765	778	791	804	817	830	843	856	869	882	895	908	921	934	947	960	973	986	999	1012	1025	1038	1051
230	275	288	301	314	327	340	353	366	379	392	405	418	431	444	457	470	483	496	509	522	535	548	561	574	587	600	613	626	639	652	664	678	691	704	717	730	743	756	769	782	795	808	821	834	847	860	873	886	899	912	925	938	951	964	977	990	1003	1016	1029	1042
220	266	279	292	305	318	331	344	357	370	383	396	409	422	435	448	461	474	487	500	513	526	539	552	565	578	591	604	617	630	643	656	669	682	695	708	721	734	747	760	773	786	799	812	825	838	851	864	877	890	903	916	929	942	955	968	981	994	1007	1020	1033
210	257	270	283	296	309	322	335	348	361	374	387	400	413	426	439	452	465	478	491	504	517	530	543	556	569	582	595	608	621	634	617	660	673	686	699	712	725	738	751	764	777	790	803	816	829	842	855	868	881	894	907	920	933	946	959	972	985	998	1011	1024

200	183	196	209	222	235	248	261	274	287	300	313	326	339	352	365	378	391	404	417	430	443	456	469	482	495	508	521	534	547	560	573	586	599	612	625
190	175	188	201	214	227	240	253	266	279	292	305	318	331	344	357	370	383	396	409	422	435	448	461	474	487	500	513	526	539	552	565	578	591	604	617
180	167	180	193	206	219	232	245	258	271	284	297	310	323	336	349	362	375	388	401	414	427	440	453	466	479	492	505	518	531	544	557	570	583	596	609
170	159	172	185	198	211	224	237	250	263	276	289	302	315	328	341	354	367	380	393	406	419	432	445	458	471	484	497	510	523	536	549	562	575	588	601
160	151	164	177	190	203	216	229	242	255	268	281	294	307	320	333	346	359	372	385	398	411	424	437	450	463	476	489	502	515	528	541	554	567	580	593
150	143	156	169	182	195	208	221	234	247	260	273	286	299	312	325	338	351	364	377	390	403	416	429	442	455	468	481	494	507	520	533	546	559	572	585
140	134	147	160	173	186	199	212	225	238	251	264	277	290	303	316	329	342	355	368	381	394	407	420	433	446	459	472	485	498	511	524	537	550	563	576
130	125	138	151	164	177	190	203	216	229	242	255	268	281	294	307	320	333	346	359	372	385	398	411	424	437	450	463	476	489	502	515	528	541	554	567
120	116	129	142	155	168	181	194	207	220	233	246	259	272	285	298	311	324	337	350	363	376	389	402	415	428	441	454	467	480	493	506	519	532	545	558
110	107	120	133	146	159	172	185	198	211	224	237	250	263	276	289	302	315	328	341	354	367	380	393	406	419	432	445	458	471	484	497	510	523	536	549

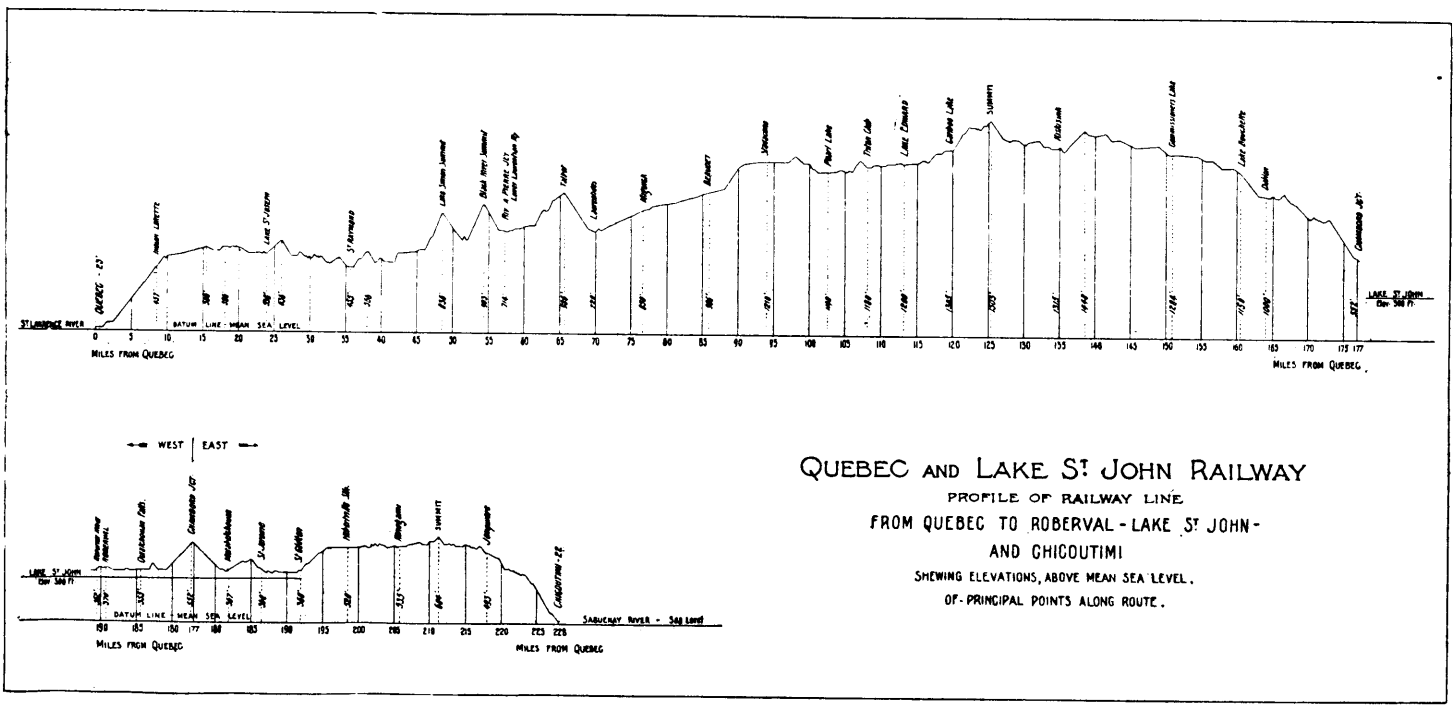
200	638	651	664	677	690	703	716	729	742	755	768	781	794	807	820	833	846	859	872	885	898	911	924	937	950	963	976	989	1002	1015	1028	1041	1054	1067	1080
190	630	643	656	669	682	695	708	721	734	747	760	773	786	799	812	825	838	851	864	877	890	903	916	929	942	955	968	981	994	1007	1020	1033	1046	1059	1072
180	622	635	648	661	674	687	700	713	726	739	752	765	778	791	804	817	830	843	856	869	882	895	908	921	934	947	960	973	986	999	1012	1025	1038	1051	1064
170	614	627	640	653	666	679	692	705	718	731	744	757	770	783	796	809	822	835	848	861	874	887	900	913	926	939	952	965	978	991	1004	1017	1030	1043	1056
160	606	619	632	645	658	671	684	697	710	723	736	749	762	775	788	801	814	827	840	853	866	879	892	905	918	931	944	957	970	983	996	1009	1022	1035	1048
150	598	611	624	637	650	663	676	689	702	715	728	741	754	767	780	793	806	819	832	845	858	871	883	897	910	923	936	949	962	975	988	1001	1014	1027	1040
140	589	602	615	628	641	654	667	680	693	706	719	732	745	758	771	784	797	810	823	836	849	862	875	888	901	914	927	940	953	966	979	992	1005	1018	1031
130	580	593	606	619	632	645	658	671	684	697	710	723	736	749	762	775	788	801	814	827	840	853	866	879	892	905	918	931	944	957	970	983	996	1009	1022
120	571	584	597	610	623	636	649	662	675	688	701	714	727	740	753	766	779	792	805	818	831	844	857	870	883	896	909	922	935	948	961	974	987	1000	1013
110	562	575	588	601	614	627	640	653	666	679	692	705	718	731	744	757	770	783	796	809	822	835	848	861	874	887	900	913	926	939	952	965	978	991	1004

ment was made to strike out the qualifying clause; it was lost on a division. The Railway Committee of the Privy Council subsequently heard evidence upon the whole question, examined into it carefully, & came to the conclusion that satisfactory arrangements could not be made over the M.C.R. for the running of the L.E. & D.R. trains.

The Regulation of the Level of Lake Erie.

By F. W. Farncomb, O.L.S., London.

The necessity for increasing the safety, certainty & facility of the navigation of the Great Lakes & the deep waterways between them & the Atlantic tide waters, is one of the great undertakings of international importance which will require the immediate action of the Canadian & U.S. governments. The comparatively great variation, both annual & periodical, in the height of the water, in Lake Erie alone, involves enormous loss to the shipping interest, as well as the expenditure of millions of dollars in deepening harbors, channels & waterways.



QUEBEC AND LAKE ST JOHN RAILWAY
PROFILE OF RAILWAY LINE
FROM QUEBEC TO ROBERVAL - LAKE ST JOHN - AND CHICOUTIMI
SHEWING ELEVATIONS, ABOVE MEAN SEA LEVEL, OF PRINCIPAL POINTS ALONG ROUTE.

How to regulate or minimize this variation is the subject of a special & exhaustive report prepared by G. Y. Wisner, a member of the U.S. Board of Engineers on Deep Waterways, from data gathered by this board, & endorsed by his colleagues, as a preliminary report upon the whole subject to be investigated, for which the necessary data & conclusions have not been completed. Records taken at Cleveland since 1865, up to 1898 inclusive, show that the mean elevation of the water in Lake Erie above mean tide at New York is 572.4 ft., and using the same datum, the highest mean monthly water mark, which was reached in 1876, is 574.3 ft., & the low water mark reached in 1895 & 1896 was 570.6 ft. The greatest variation in the height of the water in the last 35 years was therefore 3.7 ft., and the mean annual variation, which continues about the same in recent years, is about 20 ins. The chief source of supply to Lake Erie is drawn from the Great Lakes above, which with their respective watersheds include an area of over 150,000 square miles, or about six times the area of Lake Erie & watershed; it is, therefore, the fluctuation in the supply from these lakes due to varying rainfall, ice, etc., which practically governs the variation of its water level. The flood water pouring into the upper end from the Detroit river, the lake water at normal height must rise until the sectional area & slope of the upper portion of the Niagara river, which forms the outlet, is increased till its capacity is equal to the increased supply from above, when the lake water level becomes once more stationary until the conditions are again changed.

It is evident that no matter what system be adopted for regulating the water to a uniform height, or in other words making the discharge equal to the supply, that the capacity of the Niagara river must be increased below the required lake level so that it will at all stages be sufficient to carry off the maximum supply. It is also evident that this can only be accomplished by deepening or widening its bed for a certain distance, or by raising the water in the lake above the river bed until a like result is obtained. With this result accomplished, by either method, means must be devised to regulate the discharge into this huge tail race when its full capacity is not required, so that it will equal the volume of water flowing into the lake. This can only be done by means of a dam & flood gates, in either case. For economical reasons alone, therefore, the scheme recommended for raising the water to or near high water mark, seems to be the proper one, apart from all important questions of the actual height which will be most convenient & beneficial to the majority of interests that will be affected.

By means of accurately measured cross sections of the river & careful observations taken at different stages of the water level, the volume of each mean monthly discharge from the lake has been accurately determined from 1865 to 1898 inclusively, & from these results the necessary height of the proposed submerged weir & width of sluice gates have been calculated, which fixes the height to which the water will have to be raised & maintained at 574.5 ft., or a little over 2 ft. above the mean elevation & about 2 ins. over high water mark; for the period referred to, which was reached in 1876. The location chosen for the proposed fixed weir & sluices will follow a rock reef which extends into the river from the breakwater of Black Rock harbor, Buffalo, for about 1,300 ft., & then deflecting about 35 degrees northerly & running in at right angles to the Canadian shore, a total distance of 2,810 ft. Of this 1,600 ft. will be a fixed weir, 1,040 ft. will be sluice openings, & the remainder will be taken up by sluice gate piers. About 1,200 ft. of the reef will be utilized at small cost for the proposed weir as it is about the required height, viz., 6.6 ft. below the surface of the water when regulated to the height proposed. The river bed deepens suddenly at the end of this rock, & it is from there the piers & sluice gates will be placed. They will be 13 in number, 80 ft. each in width, & have a depth of 20 to 24 ft. To each gate will be attached suitable hoisting gear & counter weights so arranged that the variation in weight due to immersion will be so equalized that the hoisting gear will only be required to overcome the friction, etc. So nicely will this adjustment be made, that it is stated two men only will be required to operate each sluice & the whole system will be opened in three-quarters of an hour. The piers, 52 ft. long & 12 ft. in width, will be built of concrete faced with granite, & paving stone will be carried up 9½ ft. above the water, & upon these the steel superstructure, 40 ft. in height, to carry the weights & hoisting gear, will be placed. The weir will be made with concrete, 5 ft. wide on top with rounded crest with upper side sloped 1 to 1, the lower side vertical. & both sides filled in with large stones. The foundation is upon rock bottom throughout.

In calculating the discharge in the last 35 years, it is estimated that the mean monthly discharge was 220,430 cubic ft. a second, & the greatest mean discharge for the first six months (which occurred in 1876), 285,200 cubic ft. a second. The volume of discharge over the weir with the water at 574.5 ft. will be 113,400 cubic ft. a second, which can be increased at will up to 159,500 cubic ft. a second by opening the sluice gates, & making the total discharge 272,900 cubic ft. a second, exceeding by 1,900 cubic ft. a second the average supply for the storage season for any year excepting 1876. But it is pointed out that in the last six months of 1895 the discharge was 60,000 cubic ft. a second less than the capacity of the proposed regulating works, which could then have lowered the water 1 ft. in two months, & that this contingency, as well as

those in the future, could be readily dealt with by lowering the water sufficiently during the season of limited supply, after navigation closes, to leave a safe margin for any extraordinary increase of supply in the coming season.

In conjunction with this work a channel & lock will be necessary on the Buffalo side of the river to a point below the gorge where it widens, & the current is slower, in order that vessels may pass around the works, & at the same time do away with the present dangers & difficulty in navigating the shoals & swift current in this part of the river. The estimated cost of the regulating work is about $800,000, while the cost of the 17-ft. channel & lock, 600 x 60 x 21 ft., is estimated at about $1,600,000, or about $2,400,000 in all. The probable effect of the proposed works upon the lakes & waterways above & below is also one of great interest & importance. Perhaps the latter is more particularly so to Canada, for any further lowering of the waters of Lake Ontario & the St. Lawrence River would almost amount to a national calamity. While the report is not conclusive upon this particular point, the investigations in that respect not having been completed, it is claimed that regulation will not materially change the annual discharge through the Niagara River, & will only modify the distribution of flow about 5% of the average discharge, & therefore cannot materially affect the level of Lake Ontario & the St. Lawrence.

It seems that through the deepenings of the channels of the St. Clair & Detroit Rivers in recent years, the low water levels of lakes Huron & Michigan have been lowered 1 ft. It is estimated that the direct result of raising the level in Lake Erie 3 ft. will be a corresponding rise of 2 ft. in Lake St. Clair & 1 ft. in lakes Huron & Michigan, thus restoring to the latter their former natural low water level previous to the year 1886, & at the same time diminish the fluctuations of these lakes 1 ft. It is shown also in favor of this scheme that the aggregate cost of improving Lake Erie harbors alone has averaged $1,000,000 for every foot in depth of permanent improvement, & also that the enlargement of the navigable channels of the St. Clair & Detroit rivers to a width of 600 ft., is at present a matter of urgent necessity, & the favorable effect that the proposed work would have in this instance also is apparent. The report states that the stage at which the lake level would be regulated, that is with an elevation of 574.5 ft. above mean tide water, would be 6 in. below high water mark, but the date upon which this height was reached does not appear to be given.

Bell Telephone Co. of Canada.

At the 21st annual meeting at Montreal, Feb 28, the following report was submitted :— 3,437 subscribers have been added during the year, the total number of sets of instruments now earning rental being 38,360.

The Co. owns and operates 343 exchanges & 494 agencies. 2,430 miles of wire were added to the long distance system in 1900 ; of these, 1,497 miles are in the Ontario department, 755 in the Eastern department, & 178 in the Northwest. The long distance lines owned & operated by the Co. comprise 21,350 miles of wire on 6,525 miles of poles. $190,000 of 5% bonds were sold during the year, the net premium on which was $18,775 ; & 500 shares of stock were sold at a net premium of $35,105.80. These premiums, aggregating $53,880, have been carried to Contingent Account. $46,-119.20 has been carried from revenue account to contingent account, making it $900,000 ; $32,898.64 to insurance reserve account, making it $100,000 & $50,000 written off the plant & patent account. The entire capital stock having been issued, & funds for construction being required, the shareholders, at a special meeting held Dec. 5, 1900, authorized application to Parliament for power to increase the capital from $5,000,000 to $10,-000,000, & the petition will be presented in due course. At the same meeting the directors were authorized to issue $2,550,000 of bonds.

REVENUE ACCOUNT, DEC. 31, 1900.

RECEIPTS.

Exchanges	$1,125,911 88
Long distance lines	359,800 99
Private lines	11,749 01
Miscellaneous	116,801 00
	$1,614,262 88

EXPENSES.

Operating	$1,146,852 84	
Legal	8,999 18	
Insurance	15,743 26	
Bond interest	52,395 55	
Miscellaneous	5,986 73	
		$1,229,977 56
Net revenue for 1900		384,285 32
Less dividends (inc. Jan. 15, 1901)		371,304 99
		12,980 33
Balance revenue from 1899		190,123 38
		$ 203,103 71
Carried to insurance reserve account	$ 32,898 64	
Carried to contingent account	46,119 20	
Written off plant and patent account	50,000 00	
		$ 129,017 84
Carried forward to 1901		$ 74,085 87

BALANCE SHEET, DEC. 31, 1900.

Stock account	$5,000,000 00
Bond account	1,200,000 00

LOW RATES WEST AND NORTHWEST.

On February 12th, and on each Tuesday until April 30th, the Chicago, Milwaukee & St. Paul Railway will sell one-way second-class tickets at the following very low rates :

To Montana points	$25.00
To North Pacific Coast points	30.00
To California	30.00

These tickets will be good on all trains, and purchasers will have choice of six routes and eight trains via St. Paul and two routes and three trains via Missouri River each Tuesday. The route of the Famous Pioneer Limited trains and the U.S. Government Fast Mail trains.

All Ticket Agents sell tickets via the Chicago, Milwaukee & St. Paul Railway, or for further information address A. J. Taylor, Canadian Passenger Agent, 8 King Street East, Toronto, Ont.

Contingent account, 1899	$ 800,000 00	
Add premium on stock sold	35,105 80	
Add premium on bonds sold	18,775 00	
Add brought from revenue account	46,119 20	
		900,000 00
Revenue account		74,085 87
Unearned rental reserve		203,417 50
Insurance reserve	$ 67,101 36	
Add brought from revenue account	32,898 64	
		100,000 00
Accident reserve		21,623 43
Bond interest reserve		15,000 00
Sundry creditors		202,736 09
		7,716,862 89
Plant and patent account, Dec. 31, 1899	$5,244,436 33	
Plant & patent account, added in 1900	$ 858,578 94	
Less brought from revenue account	50,000 00	
	808,578 94	
Plant & patent account, Dec. 31, 1900	$6,053,015 27	
Stores on hand	246,163 29	
Real estate	785,252 84	
Stock in other companies	414,331 50	
Sundry debtors	102,834 94	
Due from agencies	59,343 99	
Cash	55,921 06	
		$7,716,862 89

President Sise, in referring to the public's use of the telephone, said that from carefully prepared reports covering all parts of the Dominion it was found that each instrument was used on an average nine times each day. The average period elapsing between the time the subscriber rang the central until he had the desired communication was 11 seconds. The President said that after a careful investigation of the different telephone systems of the world, he had come to the conclusion that Montreal and Canada had the very best.

The following were elected for the ensuing year:—C. F. Sise, President; Robert MacKay, Vice-President; A. Cochrane, R. Archer, H. Paton, C. Cassels, W. R. Driver & T. Sherwin, other directors.

Western Grain Storage Capacity.

The following figures including Port Arthur, Fort William, Keewatin & points in Manitoba & the Territories show how rapidly the elevator & other storage capacity has increased in recent years:—

1891	7,628,000	bushels.
1892	10,366,800	"
1893	11,467,100	"
1894	11,817,100	"
1895	12,000,000	"
1896	13,873,600	"
1897	14,999,300	"
1898	18,378,500	"
1899	19,958,000	"
1900	20,908,000	"
1901	21,000,000	"

The Roadmasters' Association of America will hold its 19th annual convention at Washington, D.C., Oct. 8, 9 & 10 next.

Aid to the Victoria Bridge.—In answer to a question in the House of Commons the Minister of Railways recently said:—The total amount contributed by the present government towards the reconstruction of the Victoria Bridge at Montreal was $500,000. The amount paid annually by the government for the use of the bridge by the government railway is $40,000. The amount paid annually by the government for the use of the G.T.R. from Ste. Rosalie to St. Lambert for the government railway is $37,000. The amount paid annually by the government for the use of the G.T.R. terminal facilities at Montreal is $62,500. There is nothing in the conditions of the grants or arrangements referred to between the government & the G.T.R. Co. which restricts the latter from making a shipping port of Portland.

C.P.R. Western Division Operating.

General Superintendent Oborne has issued the following circulars:

TO CONDUCTORS & ENGINEERS.—Hereafter the engines of all freight & mixed trains, irrespective of the number of cars behind the tender, will cut for water, & I trust it will not be necessary to discipline anyone for the non-observance of this rule, for which conductors & engineers will be held equally responsible.

TO TRAINMEN & YARDMEN.—The number of skidded wheels removed from freight cars is increasing, & the following are some of the causes to which the increase is attributed. 1. Cars lifted from sidings without trainmen first satisfying themselves that brake shoes, as well as brake chains, have been released. In winter the shoes sometimes freeze to the wheels. 2. By yardmen & trainmen not seeing that brakes are released before switching cars in terminal & other yards. 3. By piston travel being too short: but this is a rare occurrence. 4. The improper use of the emergency brake. 5. The improper use of the hand brake, some inexperienced men still making use of clubs in applying brakes, which is contrary to rules. The fact that we are able to operate our passenger equipment with comparatively few skidded wheels indicates that the train & yardmen have not been exercising proper care in the handling of freight cars, & they are earnestly requested to do so hereafter. The average life per wheel removed on some roads on this continent is from 150,000 to 250,000 miles, & as the wheels under our cars are equally as good as those under the cars of the roads referred to, & our men are as loyal to the Co.'s interest, it is hoped that we shall soon succeed in establishing an equally good record.

Subterranean Telegraph Cable.

The British Postal Telegraph Department has recently completed the laying of the underground telegraph cable, in place of the overhead wires, between London & Birmingham, 117½ miles—the longest underground telegraph cable in the world. The overhead telegraphic wire system in England, especially in the midland counties, suffers considerably from the effects of storms, notably in winter, when the wires are often broken down by the weight of the snow, completely disorganizing the telegraphic communication for hours & sometimes days. In view of the fact that the principal great north trunk telegraph lines to Manchester, Liverpool, Glasgow & the other important industrial centres, radiate from Birmingham, some of the magnitude of the block caused by such a disruption of the lines may be conceived. Then again enormous expense is entailed in the constant repairs of the wires, since some disaster invariably occurs even in a moderate gale. In view of these circumstances the postal authorities determined four years ago to bridge over as far as practicable these exposed zones where overhead wires suffered so severely from storms by laying the cables underground. The most important & largest section of this scheme proved by the survey to be that between London & Birmingham.

The cable consists of 76 wires, each of which is insulated in specially desiccated paper, & the whole inclosed in a leaden sheath to prevent the admission of moisture. It is laid in cast iron socket pipes built in sections of 150 yards each. These pipes are buried at a depth of about 4 ft. below the roadways, &, where the cable passes beneath the pathways, at a depth of only 2 ft. The cable was manufactured in sections of 152 yards, thus leaving a yard at either end of the pipe sections to enable the connections between the sections to be made.

When a section of pipes had been laid the drum containing the cable was brought to the end of the conduit, a pulling clip fixed to the end & the cable pulled through the pipes. As the cable passed off the drum into the pipes it was freely lubricated with petroleum jelly. Great care had to be exercised in joining the sections, so that the insulation was rendered perfect. The lead coverings at the ends of the two cables to be joined were first removed to lay bare the ends of the conductors which were laid back in flakes to facilitate the process of separately joining each pair of wires. The joints were effected by means of a split copper tube tinned inside, with paper wrapped longitudinally round the exterior, & the wires secured tightly together with thread. No two joints were made in the same place, so that the wires did not present a bulged appearance at one spot. More paper insulator was then wrapped round and a lead sleeve pulled over the exposed wires and sealed up thoroughly at each end, so that the cable was converted into practically one length.

At intervals of five miles throughout the whole route test boxes are placed on the roadside. They are built upon a foundation of 9-in. brickwork, set in cement mortar, forming an underground chamber through which the cable passes into the connection box inside the test pillar. By this means the individual wires may be tested & crossed quickly & readily.

At Weedon, which is a junction of several lines from the north, there is a test box where the wires cross from the open to the underground. When a breakdown, therefore, occurs beyond Weedon the wires are immediately crossed, & the underground portion of the cable utilized, by which means all delays are avoided. The work has been executed throughout with great skill & care, so that the possibility of a breakdown between London & Birmingham is now very remote.

Monster Ocean Steamships.

Great as are the dimensions of the latest transatlantic freight & passenger steamers, there are ships now under construction which will exceed them in every point of comparison. The past decade has seen a similar increase in the dimensions of the motive power & rolling stock used in land transportation; but in that field it is safe to say that the limits imposed by the size of tunnels, the height of bridges, & the width of platforms, will prevent any considerable increase in the future, either of locomotive or cars. Transportation on the high seas, however, has no such limitations to contend with; for whereas to accommodate larger rolling stock on the railways it would be necessary to rebuild numerous costly structures, from one end to the other of the system, on the high seas there is absolutely no restriction to size, & the only changes that are necessary to accommodate these mammoth steamships are those incidental to the deepening of harbor channels & the provisions of docks of sufficient length & capacity.

There are now under construction three freight & passenger steamships which will exceed in size anything now afloat, not even excepting the Oceanic. Two of these, which are being built by the Eastern Shipbuilding Co., New London, Conn., for the Great Northern Steamship Co., are intended to ply between Seattle, the terminus of the Great Northern Ry., & Oriental ports. The third vessel, which is being built for the White Star Co., is nearing completion at the yards of Harland & Wolff, Belfast. The New London vessels will be, primarily, cargo boats, but they are also arranged to carry a very large number of passengers. Although these ships are only 630 ft. long—or 74 ft. less than the Oceanic, which is the longest ship in the world

thay have 4 ft. 8 ins. greater beam, the beam of the new boats being 73 ft., against 68 ft. 4 ins., & their molded depth is greater. So large is their midship section that on their maximum draught it is estimated they will displace 33,000 tons. On a maximum draught of 35 ft., the displacement of the Oceanic is estimated at 32,500 tons. The new passenger steamship for the White Star line, which will be launched at Belfast April 4, will be a larger ship than the Oceanic, larger, indeed, than the two New London vessels. Her length is to be 700 ft., or 4 ft. less than that of the Oceanic, but her beam is to reach the unprecedented width of 75 ft., & her estimated maximum displacement will be about 36,000 tons.

A comparison of this beginning-of-the-century vessel with those at the commencement of the last two decades proves at what an astonishing rate the dimensions of the modern steamship are growing. In the commencement of 1881 the longest & the largest steamer in the world was the City of Berlin, now the Meade, of the U.S. army transport service. She is 520 ft. long & her displacement is 8,000 tons. Ten years later, in 1891, the City of Paris, 560 ft. long & about 16,000 tons displacement, was the largest vessel afloat, while in 1901 the largest vessel will have a length of 700 ft. & a displacement of 36,000 tons. It will be noticed that the displacement, which is the true measure of a vessel's size, has doubled during the one decade, & more than doubled during the next. If this rate of increase is kept up, the question arises, What kind of ships will be building when the century is two or three decades old? The dimensions would be so huge that one hesitates to put them down in sober print.

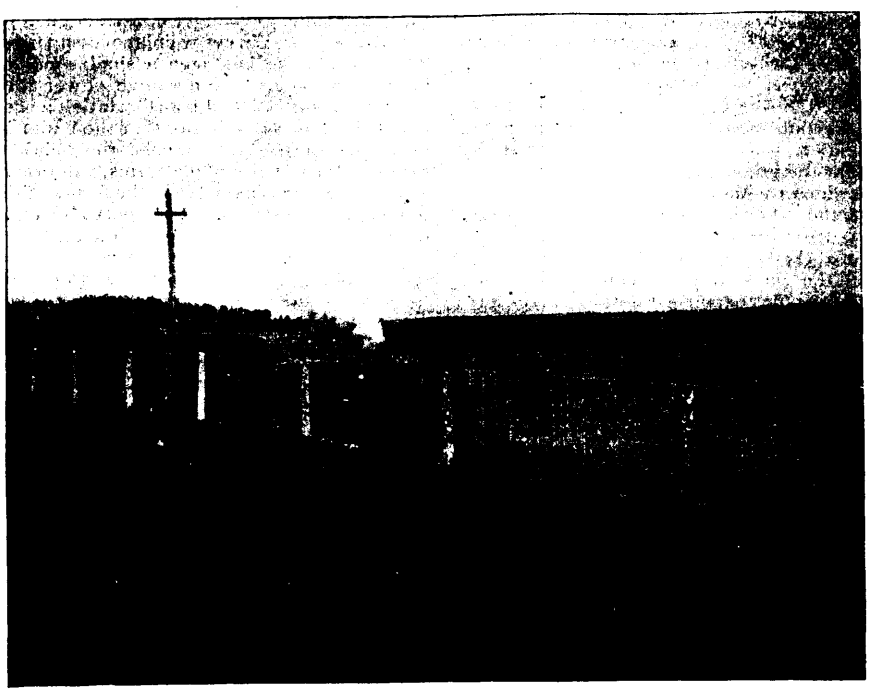
Shuswap & Okanagon.—Gross earnings July 1 to Sep. 30, 1900, $10,907; expenses, $6,544.

Under a recent act of the U.S. Congress automobiles using gasoline may be transported on ferryboats or other steam vessels. The act provides that nothing in the revised statutes shall forbid the transportation of these vehicles, provided the flame used in connection with the motive power be extinguished while the vehicles are on the vessel. It is provided, however, that the owner or master of a vessel may legally refuse to transport vehicles containing tanks of gasoline or other explosive liquid, if he is disposed to do so.

NOTICE.

The Canadian Northern Railway Company will apply to have added to its bill before the Parliament of Canada, at its present session, the necessary provisions confirming a contract dated 11th February, 1901, made between the Company and the Government of Manitoba, relating to the lease of certain railways in Manitoba now being operated by the Northern Pacific Railway Company, and providing for the carrying out of such contract and relating to the guarantee by the said Government of certain bonds of the Company, and to other matters, and providing for the acquisition of said railways for the consideration in said lease mentioned. Dated March 7th, 1901.

J. M. SMITH,
Secretary.



PAGE FENCE ON GRAND TRUNK RAILWAY, NEAR BARRIE.

CROW'S NEST PASS COAL CO.

The Proposed Railway to the U. S. Boundary.

At the annual meeting in Toronto, Mar. 1, the following report was submitted:

The net profits for the year, after paying all operating expenses & all charges of every kind at the head office & mines, amounted to $141,064.10. This amount has been derived from the various departments of the Co.'s business, viz.: The sale of coal & coke, & from waterworks, house rentals, general store, etc., etc. As no dividend was paid for the year on the Co.'s capital, the above sum has been carried forward to credit of profit & loss, making a total sum at credit of that account (including the amount already there from the earnings of 1899) of $188,874.52.

The coal produced during 1900 amounted to 220,458 tons. Of this tonnage 114,063 tons were sent to the Co.'s coke ovens at Fernie, & produced 73,496 tons of coke, while the balance of 106,395 tons was disposed of as merchantable coal.

During the year the Co. paid out in cash $874,080.83, of which the pay rolls amounted to $419,037.09, the balance of $454,943.74 having been disbursed for new coke ovens, additions to plant & for development work at Fernie & Michel. One hundred and ten new coke ovens were built in 1900, which makes, with the 202 in operation at the end of 1899, a total of 312 ovens, with a capacity of over 450 tons of coke per day.

The number of men at present in the Co.'s employ is about 800, & this number will, of course, steadily increase as our mines are developed.

ELIAS ROGERS, Managing Director. GEO. A. COX, President.

FINANCIAL STATEMENT, DECEMBER 31, 1900.

ASSETS.

Mines, real estate, plant, development, etc.		$2,266,016 65
Cash in bank	$37,501 62	
Accounts receivable	67,005 42	
		104,507 04
		$2,370,523 69

LIABILITIES.

Capital stock, paid-up		$2,000,000 00
Profit & Loss Account:		
Balance at credit, Dec. 31, 1899.	$ 47,810 42	
Added in 1900	141,064 10	
		188,874 52
Bills payable	$121,795 72	
Accounts payable	59,853 45	
		181,649 17
		$2,370,523 69

E. R. WOOD, Treasurer.

I have examined the above statement of assets & liabilities with the books & vouchers of the Company, & find the same correct.

A running audit has been maintained during the year, and I certify that the books are well & truly kept.

R. W. MACPHERSON, Auditor.

Toronto, March 1, 1901.

PRESIDENT'S ADDRESS.

In congratulating you upon the success of the last year's operations, it may be worth while to refer to the erroneous ideas that have gone abroad with regard to the management & control of the Crow's Nest Pass Coal Co. We are, in every respect, a Canadian enterprise, with a large majority of Canadian stockholders, under Canadian control & management, & are giving employment to a great force of labor on Canadian soil. We are developing Canada's natural resources in one of the most important economic minerals, & are building up an immense Canadian industry, which is bringing wealth to the Dominion, & which, we feel assured, will constitute a most important factor in the Canadian industrial development of the future, unless our operations are restricted by a limited market & inadequate railway facilities.

It affords me great pleasure to announce that we are prepared to proceed at once with construction & development work involving an immediate expenditure of $835,000, & we already have this money in the treasury of the Co. for this purpose. This large sum does not include the railway project, to which I will refer later, but will be devoted exclusively to development work, the building of coke ovens, dwellings, offices & other works in connection with the coal & coke industry of the Co. We intend to build at Fernie, Michel, & at another suitable point, 720 coke ovens, which will involve an expenditure of $540,000 under this head alone. We will then have 1,032 ovens, which will increase our capacity for coke production from over 450 tons a day, as at present, to more than 1,500 tons a day. Our expenditure will also include more than $250,000 on mine improvements, offices & miners' dwellings. These expenditures & the extensive mining & coke-producing operations that are to follow will create & maintain two new towns in the coal district as large as Fernie, which now owes its existence to the works carried on by this Company.

There is a prospective demand, provided we obtain access to the American market, as I shall hereafter mention, for 4,500 tons of coal a day within a year, & in three years we expect to increase our output to about 6,000 tons of coal a day, a large portion of which will be converted into coke in our ovens, & within five years we expect to have a pay roll of fully $10,000 a day, which will be sufficient to maintain three important industrial centres in the coal district.

All business men will at once realize how important such a development will be to the country at large, as mining camps are invariably extensive consumers of supplies. Not only will there be the direct employment for several thousand Canadian working men, but a new & most extensive demand will be created for the products of Canadian factories in the east, & the food supplies from the western farms & cattle ranches.

It is only fair to you, however, to state that the present demand of British Columbia for coal & coke would not justify any such expenditures as we propose to make. This is self-evident when I state that the present demand of British Columbia does not exceed 1,000 tons of coal & coke a day, & we cannot expect this demand to increase in the near future, even under most favorable conditions, so as to justify such expenditures.

In order that we may proceed with this development, it will be absolutely necessary to secure access to the American markets by a route that will put us in a position to successfully compete with the coal & coke producers already in the field. If denied access to the American markets, except by roundabout routes, if delayed in our operations by legislative obstruction, if prevented in any way from cutting down the cost of production to the narrowest possible margin, our success in the field will be proportionately cramped, & it will be quite impossible to undertake the development now proposed.

Recognizing, therefore, the necessity of obtaining direct access to the adjacent markets of the United States, an application has been made to Parliament by five of your directors for a charter to build a railway from the coal fields to the boundary, where it is intended to connect with a spur line from Jennings on the Great Northern Railway.

This is simply an effort to secure an entrance, by the best possible route, to an almost unlimited market for coal & coke, where we must meet the keenest competition. And without this market any large development of these British Columbia coal fields will be practically impossible.

The fear has been expressed in some quarters that the establishment of railway connection between the Crow's Nest coal fields & the Great Northern Railway System will deprive the Canadian mining & smelting industries of a supply of coal & coke, & that the Co. may create a shortage in the Canadian supply to benefit American smelting interests. These fears are groundless. From geological reports, it appears that there are over 250,000 acres of coal lands in the Crow's Nest country, containing a supply of coal which is conceded by all authorities to be practically exhaustless, it being estimated that there are in this area 20,000,000,000 tons of coal. This would admit an output of 10,000 tons a day, allowing 300 working days a year for over 6,000 years. This is entirely independent of the immense coal areas in Alberta & in other parts of British Columbia.

We are at present prepared to enter into time contracts with the smelters of British Columbia to supply any quantities of coal or coke they may require; but so far as the local supply is concerned, its safety can be best assured by such development of the Crow's Nest mines as will be made possible by the building of the proposed line.

Successful operation of the mines on a large scale would be impossible if our market were limited to British Columbia, & it were subject to the fluctuations we have experienced this last year.

With an immense coal & coking industry in operation, turning out from six to ten thousand tons of coal a day, the British Columbia smelters now in operation could close down or open up without notice, as often as they might feel inclined, & the change would not be felt. The smelters now in operation on the Canadian side only require about 300 tons of coke per day. If we are restricted as to markets, there will be higher initial cost, risk of suspension through accidents, difficulty in securing labor, & in meeting any variation in the demand.

Although there is an immense area of coal in the Crow's Nest country that is of the best quality for coking, we should not harbor the delusion that this district has all the coking coal on the continent. There will be competition from the existing sources of supply—from Cokedale, on Puget Sound, Pennsylvania, West Virginia, Utah & Colorado. There are also immense coal deposits in Montana, Washington, & other places, which may prove, when tested, to be of good coking quality.

To enter & hold this market, which means from 5,000 to 6,000 tons of coal a day, the Crow's Nest Pass Coal Co. must have the best railway facilities available, & that is why it is absolutely necessary to build the proposed spur.

There is hardly any industry so universally beneficial to a country as coal mining & coke making for export trade. The coal & coke are both brought to the last stage of perfection before being shipped out. All labor is expended on them in the country, & there is nothing further to be done with them except consume them. Not so with logs, not so with lumber, not so with pulp, with wheat, with wool, & with many other products exported. Every dollar that comes into the country in return for coal or coke exports makes the country just that much richer. The farmer, the rancher, the miller, the merchant & the manufacturer will all profit. There will also be an enormous direct revenue to the British Columbia Government from the royalty. That Government is now deriving a revenue of about $100 a day from our present operations.

In addition to the development of the coal & coke industry, the proposed railway will open up a prospect, & an assured prospect, of smelting development which will prove, from a public standpoint, of the very greatest importance.

The success of the smelting industry depends upon the ability to assemble the various materials essential to profitable smelting at the lowest possible cost, & if the proposed line

of railway is built, connecting the Crow's Nest fields with the American railway systems, the balance of advantage will be decidedly in favor of the Canadian side as the place for establishing a large & profitable smelting industry. The Canadian people have but to improve their opportunity, to stand out of the way & let the good fortune in.

In order to illustrate what I have said, permit me to point out how suitable a place Fernie, or some point adjacent thereto, would be for the establishment of a smelting industry. There we have the coke, without any charge for hauling, while to carry it to any smelting point south of the line would involve a hauling charge as well as an American duty of 60c. a ton. The limestone required is to be found at Fernie, with no expense except the cost of quarrying.

The lead ores of southern British Columbia are now seeking a market, which is almost impossible for them to find, & those adjacent to the coal fields could, at a trifling cost for transportation, be laid down at Fernie, or some other convenient point. The dry ores necessary to make workable & profitable mixtures & blends are not at present to be obtained in British Columbia, but are to be found through the adjacent mining states along the lines & connections of the Great Northern & Northern Pacific Railways ; & the ore cars taking the coal & coke from the mines at Fernie to supply the railways & established industries in these states, instead of coming back empty, would, at a low cost for transportation, bring back these dry ores to such a smelter. There is no point south of the boundary line where a smelting industry could so easily or so profitably be established.

If a smelting industry were established south of the line, there would be, as above mentioned, the cost of transportation of the coke to the site of the smelting industry ; the duty on this coke entering the United States ; the cost of transporting the lead ores from British Columbia to the site of the proposed smelter, & the American duty on the lead ores entering the United States, which, upon the quality of ore found in some of the best mines in British Columbia, would probably be about $9 a ton.

Simply on the item of transportation there would be the serious handicap of the ore cars bringing down the coke & ore from British Columbia to a smelter on the American side being compelled to return empty, & this would necessarily entail a proportionately higher freight rate.

Not the least important factor in the situation is the fear in the minds of American capitalists interested in the mining industry of the west that an export duty may be put upon ores by the Canadian Government, & this would cripple any smelting industry established on the American side dependent upon Canadian ores as its source of supply.

That this is not simply theory, but the mature judgment of practical smelting men is evidenced by the fact that we have the most positive assurances from a smelting man of large capital & experience that if we obtain the proposed railway connection he will at once commence the erection of a large smelting plant in British Columbia adjacent to the coal field ; & we have assurances scarcely less definite from others of the establishment of three or four more smelting industries atother suitable points in southern British Columbia, provided the proposed road is built.

The prospect, therefore, for southern British Columbia would appear to be exceedingly bright. Once the charter for the railway is assured, the construction of the coke ovens, the building of the homes for the miners, & the virtual establishment of two new towns in southern British Columbia, will await only the opening of the season. Scarce more time will elapse, from the assurances we now have, before more than one large smelting industry will be put under way, & hundreds of thousands of dollars will be invested in developing this important industry in that country.

With improved transportation facilities, as well as the improved smelting facilities, which would be secured, a smelter could secure freight charges & give rates for treatment that are now impossible. It is hardly necessary to dwell at length on the resultant bene-

fits to mining & other enterprises in British Columbia. These benefits are self-evident.

In every lead mine there are masses of ore that will not pay at the present rate for treatment; in every camp there are propositions & mines just too lean to tempt operators or investors. Every dollar taken off the charge for treatment means thousands of tons more of ore available, & proportionately swells the pay rolls of every camp. Every dollar of reduction in smelter charges widens the pay streak of every mine, & brings new mines within the paying class.

It would be a great misfortune to British Columbia & to the Dominion at large if this opportunity should be lost, through the failure to secure adequate means of transportation. There are rival projects south of the boundary. Immense coal areas in the States of Washington & Montana are in process of development, & if the parties interested in these properties once secure possession & control of the market in these States for coal & coke I fear the coal & coke in British Columbia will stand a very poor chance of ever taking it from them.

The promotors of this railway ask no cash bonus or land grant of any kind; they simply desire the opportunity of expending their own money to construct a railway which will be of great public benefit.

We now have a prospect of building up a city as large as Butte in the Crow's Nest coal district; & I cannot think it possible that either the Parliament of Canada or the Legislature of British Columbia will place any barrier in the way of the industrial development of our country, or will adopt a course which may delay that development half a century. I, therefore, look forward with confidence to a charter being granted; &, this being done, the development which I have outlined will be at once proceeded with; but unless the charter is granted the development outlined cannot be undertaken.

The President moved the adoption of the report, which was seconded by R. Jaffray, first Vice-President of the Co

Elias Rogers, Managing Director, gave an interesting address, detailing the past year's operations of the Co. The usual formal resolutions were adopted, & all the members of the board were re-elected for the ensuing year.

Wireless Duplex Telegraphy.

From an ill-understood curiosity wireless telegraphy seems at last to have become an important & valuable branch of electrical science. Much of the credit for this evolution is due to Prof. Slaby, of Charlottenburg, & to his indefatigable collaborator, Count Arco, both of whom have systematically investigated the phenomena of the Hertzian waves, & formulated laws by which these phenomena can be explained. As a result of their labors the uncertainty & whimsicality of wireless telegraphy have disappeared. Much that was formerly considered indispensable in the ethereal transmission of electrical waves has been proven unnecessary, & even disadvantageous.

The balloon at the upper end of the transmitting wire, supposed to serve the purpose of increasing the capacity; the peculiar plates at the receiving station, formed like butterfly-wings, & likewise designed to increase the capacity; the careful insulation of the receiving wire from the earth; & other details of the old system have been rudely thrown aside. Nothing more is heard of the law that the distance to which messages can be transmitted is proportional to the square of the length of the transmitting & receiving wires. That there is a definite relation between distance & length of wire or height of mast may well be assumed; but that relation, whatever it may be, plays no very important part in Slaby's system, since the tension to which the coherer is subjected is augmented by means different from those hitherto known.

The waves sent forth by a transmitter loop are augmented by a condenser. An induction coil is connected with the upper end of the loop, & is so wound that it permits the passage of low frequency currents, but checks the high frequency currents generated by the discharge of the condenser. At the moment of discharge the loop acts as a single vertical wire. By varying the nature of the induction-coil & the condenser, waves of any length can be sent forth. At a lecture delivered before the German Emperor, waves varying in length from 140 to 600 metres were utilized.

In direct opposition to Marconi, Slaby grounds his receiving wire. An ordinary lightning rod is used instead of a mast. If the length of the receiving wire be exactly one-fourth the wave length, a node is formed at the connecting point with the earth, & the maximum amplitude of the alternating tension appears at the upper end. Evidently the coherer should be attached to the point of greatest amplitude; but such an arrangement is impossible in practice. The difficulty is very simply & ingeniously overcome by connecting with the receiving wire at the earth-node a horizontal auxiliary wire of equal length. At the free end of this horizontal wire the wave-amplitude is equal to that of the upper end of the main wire. To the free end of this auxiliary wire the coherer is attached. The auxiliary wire need not be extended in a straight line; it can be wound to form a coil.

If the main receiving wire, which is usually a lightning rod, & which cannot, therefore, be readily lengthened & shortened, be subjected to the action of electrical waves of greater length than the wire can receive, it is necessary merely to lengthen the auxiliary wire in order to receive the message. In this manner a nodal point can be formed in the auxiliary wire, so that the receiving wire may be subjected to electrical impulses by which it would not otherwise be influenced. The auxiliary wire in Slaby's system is of the utmost importance; for by its use the receiving apparatus will be affected only by certain waves. Thus he has succeeded in overcoming one of the most glaring deficiencies in wireless telegraphy—the impossibility of secretly transmitting a message to one station alone.

In order to increase the effect of the waves a peculiarly wound induction coil is placed in the circuit between the coherer & the auxiliary wire. The coil Slaby terms a "multiplier." By means of this instrument a trustworthiness & certainty of operation have been attained which are as gratifying as they have been conspicuously lacking in previous methods of ethereal telegraphy.

Not the least interesting feature of Slaby's invention is the possibility of receiving two messages simultaneously at a single station—an end which has been attained largely by means of the auxilliary wire of variable length already mentioned.

Conversion from Steam to Electricity.

W. Langdon, Superintendent of the Electrical Department of the Midland Ry. of England, recently read a paper before the Institute of Electrical Engineers, upon the practicability of converting the trunk railways from steam to electric traction, & the numerous benefits that would accrue from such a change. He contended that the utilization of electric traction for this purpose was perfectly feasible, & he was of opinion that the railways could be worked much more economically by this means. He had obtained returns of the trains running over the main road of the Midland Ry. between London & Bedford, a distance of 50 miles, in order to ascertain the amount of current required to deal with it, & the cost of installing & maintaining the necessary generating plant. From his deductions, he discovered that the capital outlay for the installation of the plant would amount to $2,350,000, & the annual expenditure would aggregate about $194,800. In comparison with the cost of working the same distance by steam traction, an economy of nearly 2c. a train mile would be effected by the employment of electricity. At present, owing to the high price of coal, the saving would be much greater. If all the railroads of the United Kingdom were to adopt electricity for the propulsion of their trains in place of steam, no less than 3,000,000 tons a year would be saved.

Niagara Frontier Summer Rates.

The annual meeting of the Niagara Frontier Summer Rate Committee was held at the Windsor Hotel, Montreal, Jan. 30, for the purpose of making tourist rates from Detroit, Port Huron, Niagara Falls, N.Y., Montreal, & Quebec, the same to be on sale from June 1 to Sep. 30, valid until Nov. 1, with certain exceptions.

The following lines were represented:— Algoma Central Ry. & S.S. Line; Anchor Line; Bangor & Aroostock Rd.; Boston & Maine Rd.; Canada Atlantic Ry.; Canadian Pacific Ry.; Central Vermont Rd.; Champlain Trans. Co.; Cleveland, Cincinnati, Chicago, & St. Louis Ry.; Cleveland & Buffalo Transit Co.; Delaware & Hudson Rd.; Delaware, Lackawanna, & West. Rd.; Dominion Atlantic Ry.; Grand Trunk Ry.; Great Northern Ry. of Canada; Intercolonial Ry.; International S.S. Co.; Lake George S.B. Co.; Lake Ontario & Bay of Quinte S.S. Co.; Lake Ontario Nav. Co.; Lake Shore & Michigan Southern Ry.; Lehigh Valley Rd.; Maine Central Rd.; Maine S.S. Co.; Manitou S.S. Co.; Michigan Central Rd.; Montpelier & Wells River Rd.; Mint. & Roch. Trans. Co.; Muskoka Navigation Co.; New England Passenger Association; New York & Ottawa Ry.; New York Central & Hudson River Rd.; New York, Chicago & St. Louis Rd.; New York, New Haven, & Hartford Rd.; New York, Philadelphia, & Norfolk Rd.; Niagara Gorge Rd.; Niagara Navigation Co.; Northern S.S. Co.; North Michigan Trans. Co.; Ottawa River Navigation Co.; Pennsylvania Rd.; Portland, Mt. Desert, & Machias S.B. Co.; Portland S.S. Co.; Quebec Ry.; Quebec Central Ry.; Quebec & Lake St. John Ry.; Richelieu & Ontario Navigation Co.; Rideau Lakes Navigation Co.; Rutland Rd.; St. Lawrence River S.B. Co.; Thousand Island S.B. Co.; Toronto, Hamilton, & Buffalo Ry.; Trunk Line Association; West Shore Rd.

T. Henry, Traffic Manager of the Richelieu & Ontario Navigation Co., was elected Chairman, & G. C. Wells, Chief Clerk Passenger Traffic Department C.P.R., was re-elected permanent Secretary.

The rate sheets, as checked by the rate clerks, were reported by the Secretary, & certain difficulties which had been encountered were stated & dealt with.

New York was selected for the next annual meeting, the date being left to the Chairman, it being understood that it should be as soon as possible after the meeting of the New England lines.

The Secretary was instructed to compile & issue a division book, showing divisions of all rates quoted in the Niagara Frontier excursion rate sheet. The expense of compiling the division book & rate sheet, together with $100 additional for Secretary's services, to be assessed on the basis of mileage of each line over which rates are quoted in the sheet.

The U.S. representatives at the meeting tendered their sympathy to their Canadian confreres in the loss which they have sustained through the death of the Queen.

International Ticket Agents' Association.

At a meeting of the representatives of initial transportation lines, held at the office of the Niagara Navigation Co., Toronto, Mar. 5, to take action in reference to the annual convention of the International Association of Ticket Agents, which is to be held in Toronto Sep. 11 & 12 next, the following organization was effected :—

Executive Committee, Chairman, Jno. Foy, Manager Niagara Navigation Co. ; Honorary Secretary-Treasurer, Acton Burrows, Publisher of THE RAILWAY & SHIPPING WORLD ; A. H. Notman, Assistant General Passenger Agent, C.P.R. ; H. Foster Chaffee, Western Passenger Agent, Richelieu & Ontario Navigation Co. ; & M. C. Dickson, District Passenger Agent, G.T.R.

General Committee, the members of the Executive Committee & B. H. Bennett, General Agent, Chicago & Northwestern Ry. ; C. E. Bunting, City Ticket Agent, C.P.R. ; G. Bazzard, Agent, Delaware, Lackawanna & Western R.R. ; H. C. Bourlier, Passenger Agent, Allan Steamship Line ; Barlow Cumberland ; W. A. Geddes ; C. W. Graves, District Passenger Agent, Great Northern Ry. ; S. B. Heath ; R. S. Lewis, Canadian Passenger Agent, Lehigh Valley R.R. ; R. M. Melville ; G. W. McCaskey, District Passenger Agent, Northern Pacific R.R. ; G. McMurrich, Passenger Agent, Anchor Line ; C. A. Pipon, Agent, White Star Line ; J. A. Radcliffe, Ticket Agent, C.P.R. ; W. Robinson, General Travelling Agent, I.C.R. ; J. W. Ryder, City Passenger Agent, G.T.R. ; J. A. Richardson, Canadian Passenger Agent, Wabash Ry. ; J. A. Sharp, Western Manager, Elder Dempster S.S. Line ; A. J. Taylor, Canadian Agent, Chicago, Milwaukee & St. Paul Ry. ; W. G. Thurston, Lakeside Navigation Co. ; G. W. Torrance, Agent, Dominion Steamship Line ; J. A. Telfer, Ticket Agent, G.T.R. ; W. A. Webster.

The International Association of Ticket Agents comprises members from all over the United States, men who have daily to do with the routing of passengers, & recognizing the fact that it is of great importance to show them thoroughly the attractions of Toronto as a tourist centre, the committee will take active steps to make their visit a pleasant one.

Life Insurance Statistics.

The prosperity of a country may be gauged by the financial condition of its inhabitants. In that respect it must be admitted that the Dominion during the past few years has certainly been prosperous, because the various savings institutions in which the mass of the people invest their money have shown large increases. In no way is this more evidenced than by a reference to the report recently issued by the Dominion Superintendent of Insurance, wherein it was shown that during the past five years the life companies have, with few exceptions, made great increases in all the elements tending to the best interests of the policyholders. In the case of the Canadian companies during that time the insurances in force have grown from $177,511,846 to $252,201,516, & the premium income & assets have shown a like satisfactory increase.

Among the companies enjoying participation in the large increases referred to is the North American Life. At its last annual meeting the statement submitted showed a highly satisfactory state of affairs, the increases in all departments tending to its progress & prosperity being very marked.

The President pointed out that the year just ended was the twentieth in the history of the Co., & he showed that during the last five years the income had just about doubled, while the assets had increased by $1,700,000, nearly touching the four million mark.

The most important item was the net surplus, which, notwithstanding that large amounts had been paid to holders of investment policies during the past five years, had increased by about $100,000, & now exceed $500,000. The insurances in force had increased by $10,000,000, almost as much as the total business the Co. had in force at the end of the first 10 years.

Prof. Fessenden, of the U.S. Weather Bureau, is making experiments with wireless telegraphy on the southern coast. Stations will be established at Capes Hatteras & Henry & at other coast points north of Cape Hatteras. It is the government's intention to communicate storm warnings to vessels at sea off this dangerous locality. It is also intended to send storm signals to life-saving stations when the wires are disabled. If the tests are successful, the entire coast will be similarly equipped.

The G.T.R.'s Victoria Bridge.

T. F. Savage, Travelling Freight Agent of the C.P.R., with headquarters at Toronto, who is an enthusiastic collector of old books, has lent us a copy of Hunter's Hand Book of the Victoria Bridge, by F. N. Boxer, architect & civil engineer, published in Montreal in 1860, by Hunter & Pickup, & printed by Jno. Lovell. The book, which is illustrated with wood cuts, gives a brief history of the work, from the time that the first practical idea for its construction was submitted to the public in 1846, up to its completion in 1859. Believing that a description of the original bridge would now be of historic interest, we reproduce that portion of the book as follows:—

The Victoria Bridge is that known as the tubular or beam bridge, & consists of a series of iron tubes resting on 24 stone piers, with a distance between each pier of 242 ft., except the centre opening, which is 330 ft. in length. Its total length between the abutments is 6,600 ft. The bridge is approached by two massive embankments, the one on the Montreal side being 1,200 ft., & that on the south shore 800 ft. in length, which together, including the abutments, make the total length of the bridge 9,084 ft., or nearly 1¾ miles.

The first step taken after the surveys were fully completed, & the line over which the bridge was to pass decided upon, was to lay off the line of the abutments & piers. This work the engineers were able to do whilst the ice was on the river, with the most minute correctness. Then the centre of the foundation of each pier was marked, which was thus performed. "Guides" were framed, so that long iron rods could be lifted & let fall on one spot, technically called by masons "jumped," until a hole was drilled into the rock, in the bed of the river, into which a bolt was driven & a float attached. By these means the precise centre of each pier was established to within a few inches.

The first step to be taken before the foundations of the piers or abutments could be laid, was the formation of coffer-dams which, for such a structure & in such a river as the St. Lawrence, required to be of no ordinary magnitude & cost. Two kinds of dams are said to have been used, each possessing over the other certain advantages. Those called floating dams were framed & consisted of two parts. One part had three sides of a rectangular form, the sides being longer than the ends, but the upper end was formed of two pieces meeting in an angle up stream, in order to turn off the current. They were carefully & strongly built, & caulked, & were then towed into position by a powerful steamboat, & their places determined by a transit from the shore. On a given signal the sluice-gate was opened & the dam sunk into its required place. The area within the dam was of course still water, & within its sides was constructed another dam, on completion of which the water was pumped out.

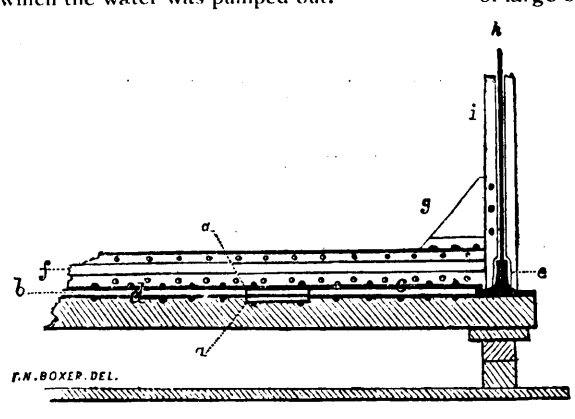


FIGURE 2.—VICTORIA BRIDGE.

The other form of dam was of the ordinary cribbing of the country, & owing to the rapidity of the stream, unusual care had to be observed in its construction. A dam of this form consisted of a double row of cribbing, each 14 ft. wide, & with 7 to 8 ft. of puddle, & between them & the part turned up stream was a regularly built ice-breaker to withstand the ice of the winters if necessary.

The comparison between the respective merits of these two classes of dams may thus be made. The floating dam could be used several times, & was found to answer best in deep water; but its great disadvantage was, that the masonry of the pier had to be completed within the working season, as it could not be made sufficiently strong to resist the pressure of the ice in winter, hence it had to be removed; also when the period arrived to construct the tube, the side of the pier was naked, & there was no point whence to start the scaffolding to support the tube-truss. With the coffer-dam this foundation for the scaffolding existed, & hence it was only necessary to frame one centre-scaffold; whereas with the floating dams three such constructions were necessary, viz., the centre, the frame, & the scaffold foundation at the side of each pier. Nor was this consideration an unimportant one, for such foundation had to be obtained by sinking scows & driving piles around them to keep them in position.

From either dam the framing was carried up above the height of the pier, & on the capping piece or sill was run a railway to admit of the passage of a travelling machine which, mounted with a crab, admitted a contrary passage on itself. Hence stones of 17 tons were moved into position with the greatest facility. On the platform of the dam were erected sheds to cover the steam engine, the blacksmiths' & carpenters' shops & store-room. The foundation of the piers seldom exceeded 22x90 ft., whereas the area required for the dams was 120x210 ft. to allow a large margin in case of their not sinking in the exact spot.

Nothing could be better than the pumps used by Mr. Chaffey, the contractor for masonry on the south side of the river. They worked centrifugally, & threw 800 gallons a minute. It was calculated that his pumps lowered the area of the water in the dam at the rate of 2 ft. per hour, & emptied a dam in 8 or 10 hours. When the dams were perfected & emptied of water, the staging constructed, & the travelling machine in operation, stone delivered & cut ready to be laid on its bed, the next process was that of cleaning out the bed of the river for the foundation.

It was the general impression that the bed of the river was trap rock, but in the progress of the work it was found that it was formed of large boulders headed together in masses, the interstices being filled up with gravel, sand, & mud, in many instances forming a hard concrete mass, & in others the reverse, beds of quicksand & mud being as frequent as any other. Three thousand tons of such material had to be cleared out of the foundation of no. 5 pier. One of the boulders taken out weighed 30 tons, & masses of 3 & 4 tons were strewed thickly over the surface. The depth, therefore, to be excavated before reaching rock greatly increased the cost to the contractors of the masonry in the piers.

In the southern half of the bridge (for it was commenced at both ends at once) the scaffolding was not used, but a compound derrick,

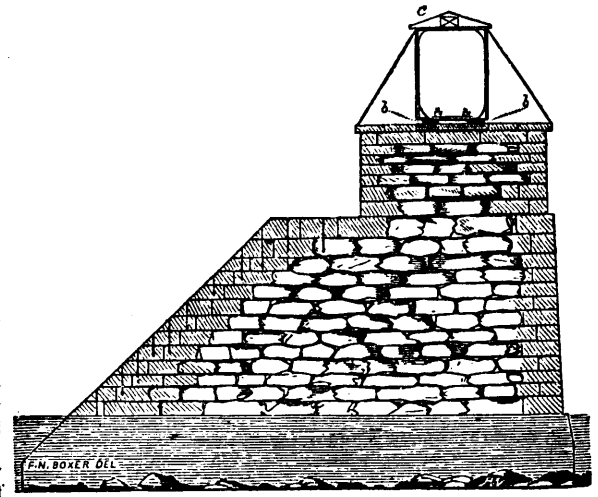


FIGURE 1.—VICTORIA BRIDGE.

worked by a high pressure engine, supplied its place. Much ingenuity was shown in obtaining this motion, as the stone could be placed by it in any position, for the derrick had a motion which admitted of precisely placing the stone in position. It was capable of handling stones 11 tons in weight.

The bridge is approached from the north shore by an embankment 1,200 ft., & another from the south shore 800 ft. in length, & the waters thus embayed, now find their way through the piers of the bridge, by which the velocity of the current has been much increased.

The abutments are each at the base 278 ft. long, & are built hollow, having 8 openings or cells 48 ft. in length & 24 ft. in width, separated by cross-walls 5 ft. in thickness. The flank-wall on the down-stream side rises nearly perpendicular, & is 7 ft. in thickness; that on the up-stream has a slope from its foundations upwards, the thickness of the walls is 12 ft., & they present a smooth surface to facilitate the operation of the ice, on which account its form had been thus determined. To insure greater resistance to the pressure of the ice, the cells are filled up with earth, stone & gravel, so that one solid mass was thus obtained.

The embankments are solid, composed of stone 36 ft. above the summer water level, & of the width of 30 ft. on the upper surface, formed with a slope of 1 to 1 on the down side of the stream, & a hollow shelving slope of about 2½ to 1 on the upper side. The slopes are faced with stones set on edge at an average angle of 45°.

The piers are solid, & constructed, as well as the abutments, of the finest description of ashlar masonry, laid in horizontal courses, measuring from 7 to 12 ft. on the bed, & from 3 ft. 10 ins. to 2 ft. 6 ins. thick above the water level, & thence varying into a course of 18 ins. under the plates. The stones were cut with the greatest exactness, seldom requiring to be redressed after being laid. They weigh from 7 to 17 tons, the average weight of each stone is 10½ tons. All the beds & vertical joints are square, dressed in the most efficient & workmanlike manner, the external face rough, & without any pick or tool marks, but with the natural quarry face preserved. The string courses & copings are fair picked, dressed throughout, & neatly pointed & weathered, & a tool-draft, 8 ins. wide, on each quoin. Each course of the ice breaker is secured with fox-wedged bolts of 1½ in. iron, which pass through into the second & third courses under it, & the horizontal joints are cramped together with iron cramps 12x5 in., through which the bolts pass.

The stone used is Chazy, a limestone of the lower Silurian order. The average height of the piers above the summer water level is

48 ft., gradually rising from a height of 36 ft. at the abutments to 60 ft. at the centre pier, giving a grade of 1 in 132, or 40 ft. to the mile. The centre span is level. Each pier is furnished with a solid cut-water, or ice-breaker, which forms a portion of the pier itself. They are of wedge form & slope from their foundations upwards, terminating in an angle 30 ft. above the summer level of the river. The dimensions of the pier at the junction, with the cut-water, are 16x48 ft., but the whole transverse side of the pier at the foundation, including the cut-water, which extends up the stream, is 16x90 ft. The foundations, of course, vary; some are as low down as 20 ft. below the water. The whole of the ashlar is laid in hydraulic cement, in the proportion of 1 part sand to 1 part cement. The backing from the level of the surface water upwards is in common mortar. A section of a pier & of the tube is given in fig. 1, page 89.

The plates of the tubes are of various dimensions & thicknesses. Those forming the sides are reduced in thickness from the ends towards the middle, varying from 4-16 to 12-16 of an inch. The joints are strengthened with tee irons. The kelsons are placed transversely across the bottom of the inside of the tubes, & are 10 ins. in depth. They are spaced 7 ft. apart, & are secured to the tee bars by gussets, & support the pine longitudinals, or stringers which carry the rails. The longitudinals are about 12x12 ins. in section, & are kept in place by wrought iron flanges, which are bolted to the kelsons. This arrangement allows the tubes to contract & expand without disturbing the pine longitudinals & the rails which rest upon them. They move freely between the flanges which form their lateral support. The plates are all butt-jointed, having a covering plate over the joints on the outside, which is firmly riveted through to the tee iron on the inside of the tube; & covering plates, both inside & out, are placed over all the horizontal joints.

The centre tube, being so much longer than the others, has an additional thickness in the plates, & longitudinal kelsons are riveted to the top in place of the tee bars used in the small tubes. The tee bars & gussets are also considerably larger. This tube is connected, at one end, to one of the large piers; the other end is left free, resting upon the iron rollers. The iron brackets protecting the exposed surface of the top of the two large piers are partly glazed, & at the sides of the brackets are iron blinds, through which a splendid view of the massive masonry of the piers & ice-breakers can be obtained. Between the bottom of the tube & the stone work of the pier is introduced creosoted tamarac, covered with asphaltic felt. The object of this is to give elasticity between the iron work & the stone. On one side of the interior of the bridge is a planked footpath 3 ft. in width, resting on the kelsons. It is only intended for the use of the employes in charge of the bridge. There is no footway for passengers on the outside of the bridge.

The greatest difference caused by expansion in the length of a tube 260 ft. registered between the greatest extremes of temperature, is under 3 inches. At one end of the bridge is placed an indicator for registering the daily expansion & contraction of a tube. The telegraph wires pass underneath the tubes. The deflection of a single tube, under the severest test that could be brought to bear upon it was 7-8 of an inch; that of the largest tube was 1 7-8 ins. Upon the load being removed, the tubes return immediately to their original level.

The following was the method adopted for putting the tubes together:—After the staging or scaffolding was completed, upon which a tube was to be built, blockings, supporting cross ties, were placed at intervals of about 4 ft. for the whole length of a tube, & were raised sufficiently above the floor of the scaffolding to admit of the riveters working between this floor & the bottom of the tube; at the same time the requisite camber of the tube was carefully preserved, to allow of its settling down to a level when the scaffolding was removed. The centre line of the tube was then carefully struck on the cross ties which were placed to support the bottom plates. The plating was then commenced, either at the "bearing" or "roller," end as the case might be. As the plates were already marked, punched, & numbered, each plate having its own particular place assigned for it in the tube, it was but a simple process to place them in position, which was thus performed:—

1st. The "bottom strips" a on figure 2, page 89, which join the plates making up the width of the tube, were laid down; then the "bottom plates," d; next the "cover plates," c; the packings, b; the angle irons, e; the cross kelsons, f; & the tee irons, i. As the plating proceeded, the riveters followed up their work here & there with rivets, to keep the pieces together; & when the bottom was completed, the side plates which were riveted into large sheets on shore, were commenced at the centre of the tube & proceeded with towards the ends. As fast as these large sheets, h, were placed together, the bottom "gussets," g, which joint the sides with the

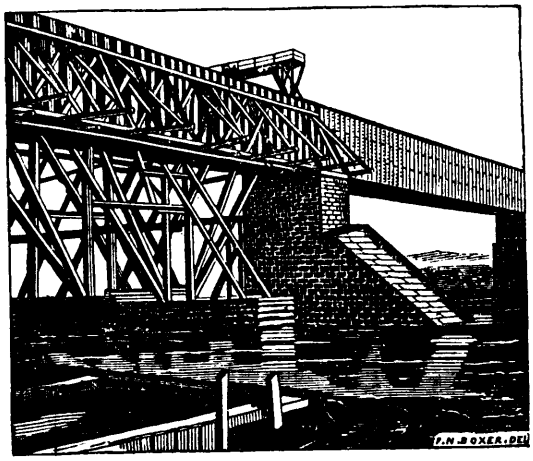


FIGURE 3.—VICTORIA BRIDGE.

kelsons, were bolted in, & the top kelsons raised to position. The laying of the top plates of the tube was but a repetition of the mode adopted for the bottom ones. Particular care, however, had to be taken in watching the camber of the tube as its weight increased, & wedges were provided under the blocking to raise it up if required.

The tubes of the Britannia Bridge, over the Menai Straits, after being placed in position, were connected with short tubes built in the towers so as to form one continuous length from shore to shore. In the Victoria Bridge a different arrangement was necessary on account of its grade, & the greater expansion & contraction of iron during the sudden extremes of temperature in this variable climate. The tubes of the Victoria Bridge are only connected in pairs. They cover two openings of 516 ft. in length, including bearings, & contract & expand on iron rollers. They are 16x19 ft. at the ends of the bridge, but they increase in depth towards its centre, at which point they are 16x22 ft. The weight of two united tubes, with rails, etc., is about 514 tons, or 257 tons for each opening.

The construction of this character of work is now so well known that much allusion to it is not necessary. Moreover it is simple in the extreme, being formed of boiler plates riveted together with angle irons & lateral & transverse braces, as shown in fig. 2. The skill lies in reducing this boiler iron to such dimensions that there is no unnecessary material to add to the weight & to the expense, & yet obtaining a sufficiency of strength. Accordingly, where the sides of the tube require strength, is at the abutment. Thus it will be seen that for the top & bottom of the tube the greater strength is at the centre, whereas the sides have most material where the span starts. The immediate part of the tube resting on the pier is likewise strengthened by increased lateral bracing.

At the line of neutral axis a few circular holes are perforated in the sides of the tube to throw light into the interior. Over the top of the bridge is constructed a light roof of wood, on the ridge of which is a footwalk 26 ins. wide; & a track is also provided for the painting travellers. The roof is covered with tin & the frame & tin-work are so arranged as not to be injured by the expansion or contraction of the tubes. The sides of that portion of the top of the piers on which the tubes do not rest, are covered with iron brackets, which protect the masonry of the pier, & also prevent snow from blowing in through the space left for the expansion of the tubes.

The tubes themselves were constructed in position, & the difficult & expensive process of floating them from the shore & lifting them by hyraulic pressure was thus dispensed with. Where the coffer-dams were in use the framing was carried up from them; & in the centre a scow was anchored & piles driven in around it, on which the scaffolding rested. It was here that the difference between the two systems of dams was apparent. In the one three scows secured with piles was necessary; in the other but one. On these supports a truss was formed on which the tube was put together.

Figure 3 shows the description of truss used for this purpose. The expansion rollers are seven in number in each set, of 6 in. diameter, in a cast iron frame, rolling on planed bed-plates. The rollers themselves being turned and the beds plated, they run as smoothly as on glass.

The rivets are an inch in diameter, & are arranged in rows. They were heated in portable furnaces, which were moved from place to place as the work proceeded. From these forges the rivets were taken up with tongs by one of the boys attending & thrown to the riveters on the stage above; & it was extraordinary to remark with what dexterity & preciseness these lads would throw the rivets & make them curve & fall over the stage to right or left on any spot they desired. The rivets were then placed in the holes punched for them, & the ends firmly clenched with heavy hammers before cooling. The rivet head thus formed is in a rough shape, & is finished by placing a steel cup-shaped tool upon it, which being struck with a heavy hammer, the head of the rivet becomes formed perfectly smooth & convex in the steel mould. The contraction of the length of the rivet in cooling draws the plates close together with considerable force.

RAILWAYS AND CANALS.

Annual Report of the Department.

Following is a summary of the report of the Deputy Minister & Chief Engineer for the year ended June 30, 1900, the report of the Chief Engineer also dealing with works of construction up to Dec. 1, 1900.

The number of railways in actual operation, including the two Government roads, the I.C.R. & the P.E.I.R. was 154; some of these, however, are amalgamated or leased, making the total number of controlling companies 86, not including the Government railways. The number of companies absorbed by amalgamation is 36, and the number of leased lines is 33.

On June 30, 1900, the number of miles of completed railway was 17,824; an increase of 466, besides 2,558 miles of sidings. The number of miles laid with steel rails was 17,694, of which 591 was double track. The number of miles in operation was 17,657.

The paid-up capital amounted to $998,268,404, an increase of $33,568,620. The gross earnings amounted to $70,740,270, an increase of $8,496,486, and the working expenses aggregated $47,699,798, an increase of $6,993,581 compared with those of the previous year, leaving the net earnings $23,040,472, an increase of $1,502,805. The number of passengers carried was 21,500,175, an increase of 2,366,810, & the freight traffic amounted to 35,946,183 tons, an increase of 4,734,430. The total number of miles run by trains was 55,177,871, an increase of 2,962,664. The accident returns show 7 passengers killed.

The above figures indicate a year of great activity in railway operations, the large increase in working expenses due to the demands of a much increased traffic and the maintenance of a high standard of equipment & service, being more than offset by the additional earnings obtained. Out of the total increase in expenses, four roads, the C.P.R., the G.T.R., the Canada Southern & the I.C.R. are responsible for over $5,700,000, while at the same time they gained over $6,700,000 out of the total increase in earnings.

The Federal Government expenditure on railways prior to & since Confederation (July 1, 1867) amounts, on capital account, to $127,636,988.07 (including $25,000,000 granted to the C.P.R. Co.) which together with $296,872.90 expended on the Nova Scotia Ry. & the European & North American Ry., & transferred to the Consolidated Fund, & for railway subsidies charged against the Consolidated Fund, the further sum of $23,227,562.51, makes a total expenditure of $151,161,423.48. In addition, there has been an expenditure since Confederation for working expenses of $81,391,472.11, covering the maintenance & operation of the Government roads, or a grand total of $232,552,895.59, all of which, with the exception of 13,881,460.65, paid out before Confederation, has been expended on railways during the past 33 years. This includes the annual subsidy of $186,600 to the Atlantic & Northwest Ry. Co. for 20 years from July 1, 1889, amounting for the past 11 years to $2,054,600, which is paid through the Finance Department, & now, for the first time, noted here. It does not include the annual payment of $119,700 as interest at 5% on $2,394,000, payable to the Province of Quebec for the line from Quebec to Ottawa, which has been transferred to the Public Debt. The revenue derived from the Government roads during the same period amounts to $73,225,382.16.

Government Railways.—The railways maintained by the Government are: The I.C.R., the Windsor branch (maintained only), & the P.E.I.R. The gross earnings of all the Government roads for the fiscal year, 1899-1900, were $4,774,161.87, an increase of $828,344.47 over the preceding year. The gross working expenses were $4,665,228.06, an increase of $758,615.75. The net profit on the operations of the year was $108,933.81. The I.C.R. gave a profit of $120,667.02; the Windsor Branch (⅓ of total earnings) gave a profit of $34,459.87, & the P.E.I.R. a loss of $46,193.08. The above figures include the rental of leased lines for the extension of the I.C.R. into Montreal.

Intercolonial Ry.—On Mar. 1, 1898, the operations of the I.C.R. were extended to Montreal by means of leases obtained from the G.T. & Drummond County Ry. Companies, making an addition of 169.81 miles to the operation of the Government line, its length being 1,314.67 miles, instead of 1,145. The leasing agreement with the G.T.R. Co., dated Feb. 1, 1898, granted to Her Majesty for 99 years from Mar. 1, 1898, an undivided half share or leasehold interest in the Co.'s railway & property between Ste. Rosalie & Bonaventure Station, Montreal, together with an equal right of user with the Co. of its bridge across the River Chaudiere; the annual rental being fixed at $140,000. With regard to the Drummond County Ry., the act of 1899 authorized the acquisition by the Dominion of the Co.'s entire railway, for $1,600,000, less subsidy paid under the subsidy Act of 1897, for 42 miles thereof between Moose Park & the River Chaudiere. The amount of this subsidy was $136,000, making the amount payable to the Co. $1,464,000. On Nov. 7, 1899, a deed was executed by the Co. conveying to Her Majesty the whole of this railway from Ste. Rosalie to Chaudiere & also the branch line from St. Leonard to Nicolet, for the consideration mentioned, less $5,000 held pending settlement of certain details. The accountant of the railway has dealt with the rental paid under these leases as an addition to the ordinary working expenses, & in his comparative statement of averages gives such averages for each year, both with the rental included, & also with rental omitted. The figures in the report of the Deputy Minister & Chief Engineer are based on his statements with the rentals included. The statements of

the General Manager, however, are based on figures from which these rentals are omitted.

During the fiscal year, in addition to $1,459,000 paid for the Drummond County Ry., & $1,290.31 for improvements to the Governor-General's car, there was an addition of $1,796,348.89 to the capital account expenditure, making the total expenditure chargeable to capital on the whole road as amalgamated up to June 30, 1900, $60,341,425.21. The additions made during the year included for increased accommodation at Halifax $22,714.07, at St. John $449,854.20, & at Levis, $79,999.95, also for increased siding, station, & other facilities $176,902.92, for the elevator at St. John $140,781.50, for the elevator at Halifax $82,671.12, for strengthening bridges $77,091.10, for rolling stock $533,223.40, for refrigerator cars $30,016.69, for applying air brakes to freight cars $19,965.48, & for the Indiantown branch $52,128.44.

The gross earnings of the year amounted to $4,552,071.71, an increase of $813,740.27, and the working expenses to $4,431,404.69 (including $164,694.47 rent paid for the extension into Montreal), being an increase in comparison with the previous year (when $210,000 was paid for rental) of $755,718.48; the excess of earnings over expenditure being $120,667.02, against an excess of expenditure over earnings in the previous year of $62,645.23, or a betterment of $58,021.79. Comparing the earnings with those of the previous year, the passenger traffic produced $1,404,469.87 or 30.85% of the gross earnings, an increase of $237,006.71; the freight traffic amounted to $2,912,790.52 or 63.99%, an increase of $564,693.94, and the carriage of mail and express freight produced $234,811.32 or 5.16%, an increase of $12,029.62. The earnings per mile of railway were $3,462.52, an increase of $618.97. These figures are based on a mileage for both 1898-99 & 1899-1900 of 1,314.67 miles.

The number of passengers carried was 1,791,754, an increase of 188,659, & 2,151,208 tons of freight were carried, an increase of 400,447. Of flour & meal 1,234,076 barrels were carried, an increase of 76,826. Of grain 2,720,453 bush. were carried, an increase of 125,100. Lumber showed an increase of 2,796,043 superficial ft., the total quantity carried being 379,350,074 ft. There was a decrease of 17,008 in the number of live stock, of which 92,813 were carried. 603,209 tons of coal, an increase of 109,003 were carried. Of raw sugar, 96 tons were carried, the quantity in the previous two years having been nil. Of refined sugar 29,007 tons, an increase of 3,743 were carried. A total of 8,939 tons of fresh fish, an increase of 2,356, & a total of 6,643 tons of salt fish, an increase of 1,169 were carried. Of manufactured goods, 507,024 tons were carried, an increase of 107,497. Of ocean-borne goods, other than deals, to & from Europe via Halifax, the aggregate was 39,794 tons, an increase of 5,531. Of this 37,108 was local traffic. In addition 55,086 tons of deals were carried.

In the winter of 1899-1900 the removal of snow & ice entailed an expenditure of nearly $89,000, about $19,000 more than the cost the previous year. The permanent way & all structures & works are in good order. The train mileage (or number of miles run by trains) of the year was 5,473,710, an increase of 592,015. The cost per train mile was 80.95c., 5.66c. more than in the previous year (in both years the rental of lease lines is included). The working expenses per mile of railway amounted to $3,370.73, an increase of $574.83 per mile. The rental of leased lines is included in both years. The commencement in July, 1899, by the Dominion Iron & Steel Co. of extensive iron works at Sydney has given a great impetus to traffic, necessitating the increase of equipment and accommodation on the line.

The Windsor Branch is 32 miles in length. It extends from Windsor Jct., on the I.C.R., to Windsor, & is operated by the Dominion Atlantic Ry. Co., formerly the Windsor & Annapolis Ry. Co. The Co. pays all charges in connection with the working of the traffic, two-thirds of the gross earnings being allowed it, the Government taking the remaining one-third, & assuming all costs of maintenance of the road & works. This arrangement is carried out under an agreement dated Dec. 13, 1892, which extends, for a further term of 21 years, arrangements similar to those made in 1871. All charges for superintendence & supervision of maintenance of works are borne by the Government; the duty of supervision being performed by the chief officers of the I.C.R. The gross earnings of the Government (one-third of gross receipts) credited to this branch amounted to $47,351.43, an increase of $4,877.40. The expenses of maintenance amounted to $12,891.56, an increase of 18.47, leaving the profit to the Government $34,459.88. The road has been maintained in good order.

Prince Edward Island Ry.—The total cost of the road & equipment chargeable to capital account at the close of the fiscal year was $3,843,653.28; there being an addition during the year of $53,546.02; the main item being an expenditure of $28,502.67 for a branch to Murray Harbour; $9,995 for reducing curves & shortening the line between Loyalist & Colville; $8,000 for rolling stock, & $6,338.75 on a survey for a combined railway & carriage bridge over the River Hillsborough, Charlottetown.

The gross earnings were $174,738.73, & the working expenses $220,931.81; the expenditure in excess being $46,193.08. Compared with the previous year, the gross earnings show an increase of $9,726.70, & the working expenses an increase of $2,878.80. The railway carried 147,471 passengers, an increase of 17,804, producing $72,908.42, an increase of $7,615.31. Of freight there were carried 62,227 tons, an increase of 4,259, producing $83,627.41, an increase of $3,738.89, while the earnings from mails & sundries amounted to $18,112.90, a decrease of $1,627.50. Compared with the previous year, the working expenses were greater by $2,878.20. The train mileage (the number of miles run by trains) was 264,895, an increase of 1,560. The cost per mile run by trains was 83.40c., an increase of 0.60c.; and per mile of railway $1,038.35, an increase of $13.70. The road, with its buildings & rolling stock, has been maintained in a satisfactory condition.

Railway to the Yukon.—During the seasons 1898, 1899 & 1900, in accordance with parliamentary provisions, surveying parties were engaged in the work of endeavoring to find a feasible route for a railway, on Canadian territory entirely, to give communication with the Yukon district from a point on an existing Canadian railway, & also from a Canadian port on the Pacific coast, & the

The Canadian Pacific Railway Company.

Dividends for the half year ended 31st December, 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 1st April to Shareholders of record at the closing of the books in Montreal, New York and London respectively.

The Preference Stock dividend will be paid on Monday, 1st April, 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, 22nd February, and in Montreal and New York on Friday, 8th March. The Preference Stock books will close at 1 p.m. on Saturday, March 2nd.

All books will be re-opened on Tuesday, 2nd April.

By order of the Board,

CHARLES DRINKWATER,
Secretary.

Montreal, 11th February, 1901.

approximate cost of such a railway. Reports from the officers in charge of these surveys were printed in the annual report of 1898-99. The results of the work of the season of 1900 cannot yet be given, but the reports & plans are being prepared. The Chief Engineer, however, states that he is able to say that a practicable line can be obtained upon which a road could be constructed at a reasonable cost. In the annual report for the year ending June 30, 1901 (before the preparation of which no doubt the reports of the engineers in charge of the surveys will be received, covering, it is expected, the entire route) it is proposed to give a full description of the entire line from Edmonton to the Yukon & to an ocean port, as regards alignment, grades, cost of construction, & a general description of the country through which it passes.

Subsidized Railways. — The following shows the aggregate of the payments made on subsidy account :

Fiscal year	1883-84	$ 208,000 00
do	1884-85	403,245 00
do	1885-86	2,171,249 00
do	1886-87	1,406,533 00
do	1887-88	1,027,041 92
do	1888-89	846,721 83
do	1889-90	1,678,195 72
do	1890-91	1,265,705 87
do	1891-92	1,247,215 93
do	1892-93	811,394 07
do	1893-94	1,229,885 10
do	1894-95	1,310,049 10
do	1895-96	834,745 49
do	1896-07	416 955 30
do	1897-98	1,414,934 78
do	1898-99	3,201,220 05
do	1899-1900	725,720 35
		$20,202,312 51
To the above there have to be added the following exceptional subsidies :		
Canada Central Ry., paid between 1878-83		1,525,250 00
C.P.R. extension from St. Martin's Jct. to Quebec, paid in 1885		1,500,000 00
Total subsidies paid from Consolidated Fund up to June 30, 1900		$23,227,562 51
The main line subsidy to C.P.R. paid from Capital		25,000,000 00
Total paid as subsidies		$48.227,562 51

The above does not include $2,394,000, due to the province of Quebec for the railway between Ottawa & Quebec, which has been transferred to the public debt, & on which interest at 5% is paid, amounting to $119,700 a year. The subsidy of $186,600 a year payable to the Atlantic & Northwest Ry. Company, for 20 years from July 1, 1889, is now, for the first time, included. The $500,000 granted in 1887 to the Western Counties Ry. Co., in settlement of matters in dispute with the Government, towards the construction of a link of railway between Annapolis & Digby, has, in previous years, been included in this statement as a subsidy ; it is now omitted, as under authority of the act of 1889, the Government itself constructed the link, which was handed over to the Co. in 1891. The cost was charged against "Capital."

The following contracts were entered into after the close of the fiscal year :

Great Northern Ry.—Shawenegan Falls Branch, 6½ miles, July 4, 1900. Montcalm to St. Tite, 53½ miles, July 26, 1900.

Central Ontario Ry.—Coe Hill or Rathbun to Bancroft, 21 miles, Aug. 29, 1900.

Cape Breton Ry. Extension—Port Hawkesbury to St. Peters, 30 miles, Sept. 15, 1900.

St. Mary's River Ry.—From Alberta Railway & Coal Co.'s line to Cardston, Alberta, 30 miles, Sept. 10, 1900.

Montreal & Province Line—Farnham to Freleighsburg & Boundary, 21 miles, Oct. 31, 1900.

Ottawa & New York Ry.—Bridge over St. Lawrence at Cornwall $90,000, Oct. 4, 1900.

Quebec Bridge Co.—Bridge over St. Lawrence at Chaudiere Basin, $1,000,000, Nov. 12, 1900.

Pontiac Pacific Junction & Ottawa & Gatineau Rys. Bridge over River Ottawa between Ottawa & Hull, additional $100,000, Nov. 26, 1900.

ADDITIONAL PAYMENTS.

Massawippi Valley Ry.	$ 5,376 00
Inverness & Richmond Ry.	132,800 00
Canadian Northern Ry.	537,600 00
Great Northern Ry.	187,911 00
Grand Trunk Ry. (Victoria Bridge)	228,371 75
Canadian Pacific Ry. (Pipestone Branch)	92,800 00
Central Ontario Ry.	32,000 00
Midland Ry.	170,264 00
Ottawa & New York Ry. (Bridge)	90,000 00
Quebec Bridge Co.	26,670 00

Canals.—The total expenditure charged to capital account on the original construction & the enlargement of the several canals of the Dominion up to June 30, 1900, was $79,043,-784.09. A further sum of $16,273,125.98 was expended on the repairs, maintenance & operation of these works, making a total of $95,316,910.07. These figures are the aggregate expenditure on specific canals & do not comprise certain items charged to "Canals in general." The total revenue derived, including tolls & rentals of lands & water-powers, amounted to $12,401,917.32.

The total expenditure for the fiscal year ended June 30, 1900, including canals in general, was as follows : on construction & enlargement $2,639,564.93, & $711,600.06 for repairs, renewals, & operation, a total for the year of $3,351,164.99. The total net revenue collected for the fiscal year was $322,642.86, a decrease compared with the previous year of $46,401.52. The net canal tolls were $272,533.82, a decrease of $49,751.30. The total expenditure on canal staff & maintenance, repairs & renewals for the year was $711,600.06, an increase of $78,284.45, & the total net receipts amounting as above, to $322,642.86, the amount of expenditure in excess of receipts was $388,957.20, compared with an excess expenditure the previous year of $264,271.23.

The total traffic through the several canals of the Dominion for the season of 1899 amounted to 6,225,924 tons, a decrease of 392,551 tons compared with the previous year. This includes 3,006,664 tons passing through the Sault Ste. Marie Canal, which is free of toll. On the Welland Canal 789,770 tons of freight were moved, a decrease of 350,307 ; of which 462,523 were agricultural products, a decrease of 269,947, & 103,589 produce of the forest ; 637,268 passed eastward & 152,502 westward ; 769,618 were through freight, of which 622,104 passed eastward. Of this through freight Canadian vessels carried 309,546 tons, a decrease of 740, & U.S. vessels 460,072 tons, a decrease of 350,372. The total freight passed eastward & westward through this canal from U.S. ports to U.S. ports was 360,529 tons, a decrease of 127,010 tons compared with the year 1898. The quantity of grain passed down the Welland & the St. Lawrence canals to Montreal was 332,746 tons, a decrease of 186,786 compared with the previous year : of this 48,828 were transhipped at Ogdensburg, as against 40,-257 transhipped in 1898. The further quantity of 39,545 tons of grain passed down the St. Lawrence canals, only, to Montreal, making the total 372,291 tons. The rate of toll on grain for passage through the Welland (giving free passage through the St. Lawrence canals) was 10c. a ton.

On the St. Lawrence canals 1,349,093 tons of freight were moved, a decrease of 90,041 ; of which 609,454 were east bound through freight, & 29,810 west bound through freight; 811,616 were agricultural products, 380,127 merchandise, & 81,951 forest products. Two cargoes of grain, aggregating 558 tons, were taken down direct to Montreal through the Welland & St. Lawrence canals.

On the Ottawa river canals the total quantity of freight moved was 520,105 tons, a decrease of 29,981, of which 507,722 were produce of the forest. On the Chambly Canal 362,635 tons were moved, an increase of 91,-299, of which 218,977 were produce of the forest. On the Rideau Canal 69,905 tons were carried, an increase of 15,409 ; 37,189 being the product of the forest. On the St. Peter's Canal 70,804 tons were carried, an increase of 6,314, of which 50,666 were merchandise. On the Murray Canal 16,788 tons passed, an increase of 1,245, & 1,651 of this were the produce of the forest. On the Trent Valley Canal 40,160 tons were moved, of which 38,135 were product of the forest.

On the Sault Ste. Marie Canal the total movement of freight was 3,006,664 tons, being a decrease of 48,623, carried in 3,769 vessels, the number of lockages being 2,610. Of wheat 12,759,318 bush., & of other grain 1,737,956 bush. were carried ; 1,078,668 barrels of flour, 1,680,064 tons of iron ore & 7,-927,000 ft. b.m., of lumber ; all these items except lumber show a considerable decrease. The total traffic at this point, accommodated by the two canals, the Canadian & U. S., amounted to 25,258,803 tons, an increase of 4,019,365, carried in 20,249 vessels, a decrease of 2,516. The total quantity of wheat carried was 58,301,682 bush., an increase of 4,138,322, & of other grain 30,079,806, an increase of 3,940,689. Of lumber the total was 1,032,602,000 ft., b.m., an increase of 133,-814,420.

As having an interesting bearing on the question of canal versus railway transport of grain from the West, it may be noted that whereas grain & peas passed down to Montreal through the Welland & St. Lawrence canals to the extent of 332,746 tons, a decrease of 186,786 over the previous year, the quantity carried to Montreal via the C.P. & G.T. railways amounted to 209,170 tons, a decrease of 84,221. In addition, during the past two seasons, a new system of grain traffic has come into operation, from Depot Harbor on Georgian Bay, over the Canada Atlantic Ry. to Coteau Landing at the head of the Soulanges Canal, thence by barge to Montreal. In the season of 1898, the total freight carried by this route to Montreal was 263,735 tons, of which 226,406 were grain. In the season of 1899 309,573 tons were carried, of which 259,531 were grain ; going through the Beauharnois Canal, the Soulanges not then being opened. Of the grain so carried in 1898 59,063 tons were wheat & 149,169 corn, & in 1899 66,635 were wheat & 174,932 corn. The quantity of grain carried to tide-water on the New York State canals was 416,-700 tons, a decrease of 42,704, while the quantity carried by the railways of the State to tide-water amounted to 4,642,952 tons, a decrease of 728,548. Of the total east & west bound freight carried by the canals of the State of New York (the Erie, the Champlain, the Black River, the Cayuga & Seneca & the Oswego), & the competing railways (the New York Central & the Erie) respectively (amounting in 1899 to 51,702,761 tons—greater by 2,391,731 than in 1898), the proportion carried by the canals has fallen steadily from 68.9 % in 1859 & 47.0% in 1869 to 6.8% in 1898 & 7.2% in 1899. These canals carried in 1899 3,686,051 tons : 1,692,972 were through freight from Lake Erie to New York, & of this quantity 1,165,217 went eastward.

On the opening of navigation in the spring of 1900, by means of the enlarged canal systems & the intermediate water ways (though not fully completed), passage to vessels drawing 14 ft. of water from Lake Superior to the head of ocean navigation at Montreal was afforded. The extent of the improved facilities of communication so obtained, & their value to commercial interests may be understood from the fact that in place of the old limit of lock dimensions, viz., length, 200 ft. ; width, 45 ft. ; depth of water on the sills, 9 ft. ; the enlarged locks are 270 ft. in length, 45 ft. in width, with 14 ft. of water on sills, accommodating vessels 255 ft. long & 44 ft. wide. As an index to the carrying power of the new canal works, it may be observed that a typical vessel, the propeller Aragon, whose length is 247 ft. & width 42.6 ft., has passed through

ASSESSMENT SYSTEM

INDEPENDENT ORDER OF FORESTERS.

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Registration fee	1 00	" " $4,000 " "	9 00
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7.—**A Sick Benefit** of $3 to $5 per week, subject to provisions of the Constitution and Laws of the Order; optional, and when taken costs extra.
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9.—**A Funeral Benefit** of $50 at death of a member enrolled in Sick and Funeral Benefit Department.
10.—**Social and Fraternal Privileges** of the Court Room.

The Members, the Benefits, and Their Assurance

At 31st December Each Year.

Year.	Total Membership.	Benefits Paid.	Total Surplus.	Surplus per Capita.	Death Rate per 1,000.
1881	1,919	$ 1,300 00	$ 4,568 55	$ 4 48	4.50
1882	1,134	12,058 86	2,967 93	2 61	11.00
1883	2,210	9,493 68	10,857 65	4 91	4.73
1884	2,558	13,914 31	23,081 85	9 01	4.23
1885	3,642	26,576 99	29,802 42	8 18	7.76
1886	5,804	28,499 82	53,981 28	9 30	4.85
1887	7,811	59,614 67	81,384 41	10 44	5.78
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	6.49
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
1899	163,610	1,430,200 33	3,778,543 58	23 09	6.30
1900	180,717	1,543,498 11	4,483,359 07	24 81	6.30

For Further Information Respecting this Great Fraternal Benefit Society, Apply to

Oronhyatekha, M.D., S.C.R., Toronto, Ont. John A. McGillivray, K.C., S.S., Toronto, Ont.
James Marshall, 24 Charing Cross, London, Eng. A. E. Stevenson, 431 E. Sixty-Third St., Chicago, Ill.
Or Any Officer or Member of the Order.

the enlarged Welland Canal, drawing 14 ft. of water & carrying 2,212 tons of corn. The through route between Montreal & Port Arthur at the head of Lake Superior, now open for a 14 ft. navigation, comprises 73 miles of canal & 965 miles of river & lake waters, a total of 1,038 miles. To Duluth, the total distance is 1,162 miles. The approaches to the canals & the channel through the intermediate river reaches are well defined & are lighted with gas buoys, rendering their navigation by night as well as by day feasible & safe. In the case of the Soulanges Canal, the canal is well lighted throughout by electricity, a system which will be extended to other canals before long.

With the more intimate knowledge of the new channel through the St. Lawrence now possessed by the river pilots, full advantage will, no doubt, be taken of the improved facilities afforded by the enlargement works; & this great water highway from the west will realize the aims of its projectors & constructors in giving rise to the establishment of lines of deep draught vessels on the route, with the beneficial result of a vast impetus to the trade & commerce of the country. Already, indications of movement on all sides promise the early & rapid delevopment of the new era of progress, not only in the direction of the production & transport of crude materials, ores, grain, coal & lumber, but in the enormous expansion of manufactures & industries on the shores of the great lakes & their connecting rivers, notably the iron & steel & ship building industries, to all of which the ability to employ vessels earrying 3,000 tons of freight direct to the seaboard & Europe, which Canada has now afforded, must inevitably prove a great stimulant. The growth of the main centres of production & collection on the lakes as shown by the last U.S. census of 1900 is sufficient indication of the prodigious vitality of the region. Since 1890 Buffalo has increased 37% to a population of 352,000. Cleveland, the great ship building centre, 46% to 382,000. Toledo, 61% to 132,000. Detroit, 38% to 286,000. Milwaukee, 39,% to 285,000, & Chicago, 54% to 1,699,000. To this has to be added the fact that during the fiscal year ended June 30, 1899, vessels were built on the great lakes to the extent of a total gross tonnage of 183,317, of which 139,765 tons were steam vessels. In the previous year this total amounted to 190,743 tons, & the total for the past 11, 1889 to 1899 inclusive, to 816,297 tons.

Though, naturally, not marked in equal degree, the tendency to a similar industrial development on the Canadian side is very evident, especially so at Sault Ste. Marie, where, in addition to the existing important pulp & paper mills, the establishment of large iron & steel works is in progress. At Collingwood, also, & Kingston like works are projected, while at Depot Harbor, on Georgian Bay, a system of wharfs & elevators has been constructed for the accommodation of the grain trade. The very extensive harbor improvement works at Montreal, with the system of wharfs & elevators in that connection will naturally tend to attract traffic down the canals to that port. The improvements at Port Colborne, the Lake Erie entrance of the Welland Canal, are in progress. They comprise the deepening of the approaches to the canal to 22 ft., & the construction of two docks, with piers 200 ft. wide, upon which grain elevators will be erected to transfer grain to the 14 ft. draught canal boats when required. The deepening of the approaches to the Sault Ste. Marie Canal, at present limited to accommodating vessels of 17½ ft. draught, so as to give a depth of 22 ft., thus enabling the canal works to be utilized to their full extent (which is the same as the U.S. canal on the other side of the river), will probably be carried out next year.

The construction of the new works for the improvement & extension of the Trent Canal system is proceeding. When the present contracts are completed a 6 ft. navigation will be afforded from Lake Simcoe to Heely's Falls, a distance of about 160 miles, leaving the portion between Heely's Falls & the Bay of Quinté, Lake Ontario, & the portion from the head of Lake Simcoe to Georgian Bay, Lake Huron, still to be dealt with. A question has, however, arisen as to the expediency of adopting Port Hope as the Lake Ontario terminus instead of Trenton, & a survey has been made with a view to ascertaining the feasibility & cost of that route. The letting of the contract for the Trenton-Frankford section has, meantime, been postponed.

During 1899 & 1900, under special appropriations voted by Parliament, surveys have been conducted on the upper River Ottawa with a view to ascertaining the feasibility & probable cost of constructing a canal system which will give a 14 ft. navigation from Georgian Bay down that river to Montreal, a scheme proposed many years ago & lately revived by private parties with considerable energy. It appears to be clearly established that such a series of works can be built at reasonable cost, which would attain the end desired.

St. John's, Nfld., Electric Railway.

By R. F. Markill.

Newfoundland abounds with small & large fresh-water ponds, many of which are so situated that, with very little expense, they can be turned into valuable sources of power. About eight miles from St. John's, high in the hills which form the rugged coast line of the island, are a number of these ponds, emptying into the sea at a small fishing village called Petty Harbor, & here it is that R. G. Reid, of Montreal, the proprietor of the Newfoundland Ry., has built the power-house for the electric transmission plant that, on May 1, 1900, began to supply energy for the operation of the St. John's Electric Ry.

At present only two lakes have been dammed, one having an area of 25,000,000 sq. ft. & the other 1,000,000 sq. ft., making a total of 26,000,000 sq. ft. Besides these two reservoirs now in use, there are two others within close proximity having areas of 9,000,000 & 31,000,000 sq. ft., respectively. A dam & gate are at the mouth of the larger lake to regulate the flow of water, as is required, so that there may be no waste.

From the mouth of the smaller lake a wooden flume 3,468 ft. in length, carried along the side of the hill, conducts the water to a point 187 ft. above the power-house. It is constructed of native spruce 8 ft. x 8 ft. framed timbers on 3 ft. centers, planked on the bottom with 2½ in. & sides 2 in. The flume practically ends in a rock tunnel 368 ft. long, cemented at the junction. Not any lining is used inside, the rock being sufficiently water tight. At the other end are located the pen-stock & gate. From here a pipe 318 ft. long, 6 ft. 6 ins. in diameter, brings the water into the power-house below. This pipe is made of steel plates ⅜ of an in. thick, anchored to 22 concrete pillars, embedded in solid rock. Two anchor bolts 5 ft. long, riveted to the sides of the pipe, run through the basin & are bolted to timbers at the back.

The generating station is 138 ft. long by 24 ft. wide, constructed of native blue stone, with wooden roof covered with sheet iron, cemented floor, & well lighted by large windows. Only two generators & one water-wheel have been installed, but everything is ready for placing another wheel of the same capacity & also two more electrical units. The wheel is of the turbine type, having a rated capacity of 1,868 h.p. when operating under a head of 187 ft. The wheel is regulated by an electrical governor. On the shaft is a 9-ton fly-wheel, made up of sheet steel plates, bolted together & turned in a lathe. Two Westinghouse generators are directly connected to the water-wheel, one on either side. They are rated at 600 kilowatts each, revolving armature, 3-phase type, running at 237 revolutions a minute, & delivering 500 volts at 60 periods a second. Two exciters furnish the field current for generators & lights for the station. They are directly connected to a 50 h.p. turbine, one on either side of the wheel, arranged in the same manner as generators. They have a capacity of 15 kilowatts each, 4 pole, 110 volts, 605 revolutions a minute.

The switch-board is the ordinary Westinghouse type, consisting of 4 white marble panels, 2 for the generators & 2 for the exciters, with the usual number of ammeters, Niagara-type wattmeters, volt-meters & a Mershon compensator for loss on the line. The current is conducted from the switchboard to the primary side of the step-up transformers on twelve 500,000 circular mil lead-covered tables. On each transformer is mounted a Westinghouse 500-ampere quick break switch for the purpose of opening the primary side if necessary. Three Westinghouse transformers of 400 kilowatts each, oil cooled, raise the voltage to 15,000 volts for transmission. They are connected in delta. From the secondary side the current goes through 6 high tension pole switches & circuit breakers to the bus-bars & thence to the pole switches connected to the line circuits. The Worts lightning arrester is used. These are installed in loft at the end of the building over the high-tension switches.

Current is brought into St. John's over two pole lines, in order to insure against interruption of the service. The poles are about 125 ft. apart; three wires of no. 5 B. & S. medium drawn on each line, Locke three petticoat glass insulators & locust wood pins, boiled in paraffine wax, are used, as they are believed to give best results where there is so much fog & rain. There is one cross-arm on each pole, with a pin at either end & a pin in the top of the pole, thus forming an equilateral triangle. The wires are not spiraled. A telephone line connects the generating station with the sub-station, wires being transposed every 4 poles.

The sub-station is at the west end of the city, just beside the dry dock. In appearance it very much resembles the power-house, being constructed of the same material & having a concrete floor, etc. The dimensions are 90 by 30 ft. Line wires enter the end of the building through high tension pole switches similar to the one in generating station, thence to the high-tension bus-bars & distributing switches to four 100-kilowatt Westinghouse oil-cooled transformers for 2 rotary converters. The transformers are connected Scott system, giving a 2 phase current at 400 volts. The sub-station also contains four 150 kilowatt transformers, giving 2-phase currents at 2,040 volts, used for city circuits. The high-tension switches are pole-switches, with fuses, each having a marble slab with an air gap of 3 ins. between slabs & a shield of asbestos 38 by 30 ins. Two rotary converters are at present installed, but foundations are ready for 2 more. These converters are rated at 200 kilowatts each, speed 720 revolutions, & 500 volts for street railway circuits. The switchboard is of white marble, 9 panels in all, 4 of which are used for the rotary converters & 1 for railway feeders, the remaining 4 for light & power, 2 panels for each. All station appliances are of standard Westinghouse types of latest forms. The remaining interesting feature of the sub-station is that the Manhattan series alternating enclosed arc system will be installed immediately for the street lighting. This will necessitate the addition of one more panel to the switchboard.

The rolling stock of the St. John's Electric Ry. consists of 6 cars, 32 ft. long, equipped with Westinghouse "12a" 30 h.p., series-parallel, 38 controllers. Four of the cars are double-enders. Two sweepers are provided for the winter season. The track is narrow gauge, to be in keeping with the Newfoundland Ry., which has a gauge of 3½ ft. Five miles of 50-lb. T. rails have been laid & cars are running over them every day; also, 5,700 ft. of 83-lb. girder rails on the principal street, which at present is being paved. The trolley wire is no. 0 & suspended from poles on either side of the street. Rails are bonded in the usual way & cross-bonded every 400 ft., no. 0 bonds used for 50-lb. rails & 00 for 83-lb. A number of very steep grades are encountered, one short grade of 14%, and several of 7 & 8%. Two or three curves of 45-ft. radius are also met with. As can be imagined, the cars, motors & trucks have had a severe test, but notwithstanding that they have stood it admirably.

The city has a population of 35,000, of which the majority are interested in the fishing industry. Quite a lot of manufacturing is done, & as coal is very expensive there is a good demand for electric power.

C. H. Massy is Consulting Engineer, W. A. McKay is Superintendent & Electrical Engineer, & F. H. Wing is Electrical Engineer in charge of the generating station at Petty Harbor; while R. F. Markill is in charge of the sub-station.

Grain Received at Lake Huron Ports.

Collectors of Customs report the grain received by water at the following ports during 1900 as follows:—

	Bushels.
At Depot Harbor, from Chicago	11,010,643
" " " Duluth	2,305,371
" " " Fort William	76,313
Total	13,392,327
At Midland, from Chicago	4,742,147
" " Duluth	2,229,048
" " Milwaukee	1,460,606
" " Fort William	1,783,040
Total	10,214,841
At Sarnia, from Chicago	2,536,680
" " Duluth	997,204
" " Fort William	423,195
Total	3,957,079
At Goderich, from Chicago	604,025
" " Duluth	151,106
" " Fort William	911,199
Total	1,666,330
At Owen Sound, from Chicago	78,179
" " " Duluth	97,000
" " " Fort William	1,014,637
Total	1,189,816
At Collingwood, from Duluth	153,108
" " Fort William	297,674
Total	450,782

Liverpool Marine Electric Railway.

There has recently been installed in Liverpool, N.S., an electric marine railway of quite a novel character. The equipment consists of a 30 h.p. induction motor, the motor shaft being geared to a heavy worm shaft & wheel; the worm wheel shaft carries a pinion wheel which gears into another large wheel, on the shaft of which is placed a large heavy sprocket wheel; over this sprocket wheel the heavy 2 in. chain meshes into heavy sprocket teeth. This chain hauls the vessel up on a cradle over a track projecting out into the River Mersey to a distance of 500 ft., on a grade of ½ in. to the foot. The track & cradle are built in a very solid & substantial manner, being constructed of heavy pine timbers. On Jan. 11 the first vessel was hauled up & lowered down again, all the apparatus & gear working in an entirely satisfactory manner.

Liverpool possessed the first marine railway in the Maritime Provinces, the motive power used being horses. It formerly took from 4 to 5 hours to haul up a vessel, whereas the same work is now performed in 20 minutes. This railway is, without doubt, the first one in America, & probably the first one of its kind in the world to which electrical energy has been applied as the motive power.—Electrical News.

Rome will soon be connected with Paris by a telephone line. The work has been in progress for many months, & the Italian government has completed the installation of the wires on the Italian slope of the Alps. The French government is at work on the line on its side, & it is thought that communication between the two cities will be accomplished during the summer.

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.

Aerated Waters
E. L. Drewry.....Winnipeg.

Air Brakes & Fittings
Westinghouse Mfg. Co.....Hamilton, Ont.

Ales
E. L. Drewry.....Winnipeg.

Anchors
Rice Lewis & Son.....Toronto.

Axles
James Hutton & Co.....Montreal.
Rhodes, Curry & Co.....Amherst, N.S.

Babbit
Rice Lewis & Son.....Toronto.

Blankets & Bedding
The Hudson's Bay Company.....

Block & Tackle
Rice Lewis & Son.....Toronto

Boat Fittings & Hardware
Rice Lewis & Son.....Toronto.

Boiler Covering
Mica Boiler Covering Co.....Montreal.

Boilers
Polson Iron Works.....Toronto.

Bolts
Rice Lewis & Son.....Toronto.

Brake Shoes
F. E. Came.....Montreal.

Bridge Numbers
Acton Burrows Co.....Toronto.

Buckets
Rice Lewis & Son.....Toronto.

Carpets
The Hudson's Bay Company.....

Cars
Rhodes, Curry & Co.....Amherst, N.S.

Car Wheels
Rhodes, Curry & Co.....Amherst, N.S

Castings
Rhodes, Curry & Co.....Amherst, N.S.

Chains
Rice Lewis & Son.....Toronto.

Cross Arms, Top Pins & Side Blocks
The Firstbrook Box Co.....Toronto.

Curtains
The Hudson's Bay Company.....

Cuts
Acton Burrows Co.....Toronto.

Door Signs
Acton Burrows Co.....Toronto.

Dry Goods
The Hudson's Bay Company.....

Electric Car Route Signs
Acton Burrows Co.....Toronto.

Electric Trucks
Baldwin Locomotive Works..Philadelphia, Pa.

Enameled Iron Signs
Acton Burrows Co.....Toronto.

Engines, Stationary & Marine
Polson Iron Works.....Toronto.

Engraving
Acton Burrows Co.....Toronto.
Toronto Engraving Co.....Toronto.

Express Office Signs
Acton Burrows Co.....Toronto.

Fencing
Page Wire Fence Co.....Walkerville, Ont.

Ferry Signs
Acton Burrows Co.....Toronto.

Flags
Rice Lewis & Son.....Toronto.
The Hudson's Bay Company.....

Foghorns
Rice Lewis & Son.....Toronto.

Gas & Gasoline Engines
Northey Manufacturing Co.....Toronto.

Gates
Page Wire Fence Co.....Walkerville, Ont.

General Supplies
The Hudson's Bay Company.....

Grain Elevators
John S. Metcalfe Co.....Chicago, Ill.

Groceries
The Hudson's Bay Company.....

Half Tones
Acton Burrows Co.....Toronto.

Hand & Push Cars
F. E. Came.....Montreal.

Hardware
Rice Lewis & Son.....Toronto.
The Hudson's Bay Company.....

Headlights
Noah L. Piper & Sons.....Toronto.

Hose
Rice Lewis & Son.....Toronto.

Illustrations
Acton Burrows Co.....Toronto.

Iron
Rice Lewis & Son.....Toronto.

Iron Signs
Acton Burrows Co.....Toronto.

Japans
McCaskill, Dougall & Co.....Montreal.

Lager Beer, &c.
E. L. Drewry.....Winnipeg.

Lamps & Lanterns
The Hudson's Bay Company.....
Rice Lewis & Son.....Toronto.
Noah L. Piper & Sons.....Toronto.

Launches
Polson Iron Works.....Toronto.

Life Insurance
Independent Order of Foresters.....Toronto.
Travelers' Insurance Co.....Montreal.

Linoleum and Floor Coverings
The Hudson's Bay Company.....

Locomotives (Compressed Air)
Baldwin Locomotive Works..Philadelphia, Pa.

Locomotives (Electric)
Baldwin Locomotive Works..Philadelphia, Pa.

Locomotives (Steam)
Baldwin Locomotive Works..Philadelphia, Pa.
Richmond Locomotive & Machine Works.....Richmond, Va.

Locomotives (Rack)
Baldwin Locomotive Works..Philadelphia, Pa.

Lubricators
Rice Lewis & Son.....Toronto.

Lumber
The Haliburton Lumber Company.....Toronto.

Matches
The Hudson's Bay Company.....

Milepost Numbers
Acton Burrows Co.....Toronto.

Mohair
The Hudson's Bay Company.....

Numbers
Acton Burrows Co.....Toronto.

Oakum
Rice Lewis & Son.....Toronto.
The Hudson's Bay Company.....

Oils
Galena Oil Co.....Franklin, Pa.
The Imperial Oil Company.....
The Queen City Oil Company.....Toronto.
Signal Oil Company.....Franklin, Pa.

Office Signs
Acton Burrows Co.....Toronto.

Packing
The Fairbanks Co.....Montreal.

Pipe Covering
Mica Boiler Covering Co.....Montreal.

Plushes
The Hudson's Bay Company.....

Pneumatic Tools
F. E. Came.....Montreal.

Porter
E. L. Drewry.....Winnipeg.

Portland Cement
Rice Lewis & Son.....Toronto.

Printing
The Hunter, Rose Co.....Toronto.
The Mail Job Printing Company.....Toronto.

Pumps
Rice Lewis & Son.....Toronto.

Rails (New)
James Cooper.....Montreal.
J. J. Gartshore.....Toronto.
Rice Lewis & Son.....Toronto.

Rails (for relaying)
James Cooper.....Montreal.
J. J. Gartshore.....Toronto.

Rail Saws
F. E. Came.....Montreal.

Rope
Rice Lewis & Son.....Toronto.
The Hudson's Bay Company.....

Scales
The Gurney Scale Company....Hamilton, Ont.

Semaphore Arms
Acton Burrows Co.....Toronto.

Shafting
Rice Lewis & Son.....Toronto.

Shingles
The Haliburton Lumber Company.....Toronto.

Shipbuilders' Tools & Supplies
Rice Lewis & Son.....Toronto.

Ships
Polson Iron Works.....Toronto.

Shovels
James Cooper.....Montreal.
The Hudson's Bay Company.....
Rice Lewis & Son.....Toronto.

Signal House Numbers
Acton Burrows Co.....Toronto.

Signals
Noah L. Piper & Sons.....Toronto.

Signs
Acton Burrows Co.....Toronto.

Snow Ploughs
Rhodes, Curry & Co.....Amherst, N.S.

Spikes
Rice Lewis & Son.....Toronto.

Station Name Signs
Acton Burrows Co.....Toronto.

Steamboats
Polson Iron Works.....Toronto.

Steamboat Signs
Acton Burrows Co.....Toronto.

Steam Shovels
James Cooper.....Montreal.

Steel
James Hutton & Co.....Montreal.
Rice Lewis & Son.....Toronto.

Steel Castings
F. E. Came.....Montreal.

Switch Targets
Acton Burrows Co.....Toronto.

Switches
F. E. Came.....Montreal.
Canada Foundry Co.....Toronto.

Telegraph Office Signs
Acton Burrows Co.....Toronto.

Telephone Office Signs
Acton Burrows Co.....Toronto.

Timber
The Haliburton Lumber Company.....Toronto.

Tires
James Hutton & Co.....Montreal.

Tobacco and Cigars
The Hudson's Bay Company.....

Toilet Paper
The Hudson's Bay Company.....

Tools
Rice Lewis & Son.....Toronto.

Track Jacks
Duff Manufacturing Co.....Allegheny, Pa.
A. O. Norton.....Coaticook, Que.

Track Tools
F. E. Came.....Montreal.
James Cooper.....Montreal.
Rice Lewis & Son.....Toronto.

Tramway Equipment
J. J. Gartshore.....Toronto.

Trucks
Rice Lewis & Son.....Toronto.

Uniform Caps
W. H. Coddington.....Hamilton, Ont.

Varnishes
McCaskill, Dougall & Co.....Montreal.

Vessels
Polson Iron Works.....Toronto.

Waste
Rice Lewis & Son.....Toronto.
Noah L. Piper & Sons.....Toronto.
The Queen City Oil Co.....Toronto.

Water Meters
Westinghouse Mfg. Co.....Hamilton, Ont.

Wheelbarrows
James Cooper.....Montreal.
Rice Lewis & Son.....Toronto.

Window Blinds
The Hudson's Bay Company.....

Wines and Liquors
The Hudson's Bay Company.....

Wire & Wire Rope
Rice Lewis & Son.....Toronto.

Yachts
Polson Iron Works.....Toronto.

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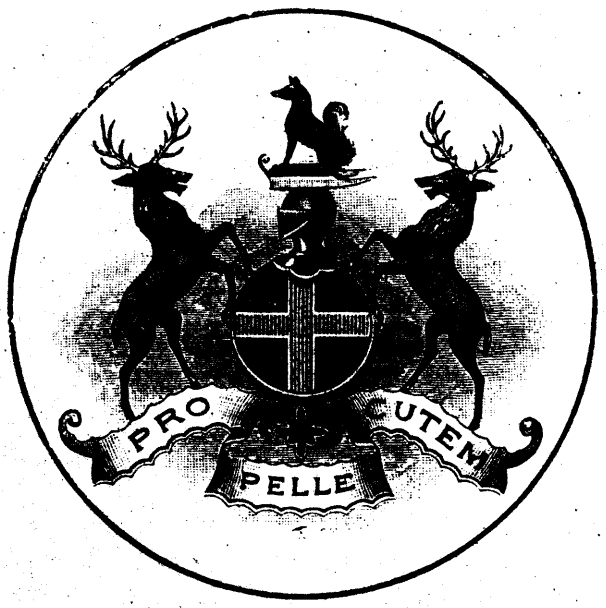

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