CIHM
Microfiche
Series
(Monographs)

ICMH
Collection de
microfiches
(monographies)

Canadian Institute for Historical Microreproductions / Institut canadien de microreproductions historiques

Technical and Bibliographic Notes / Notes techniques et bibliographiques

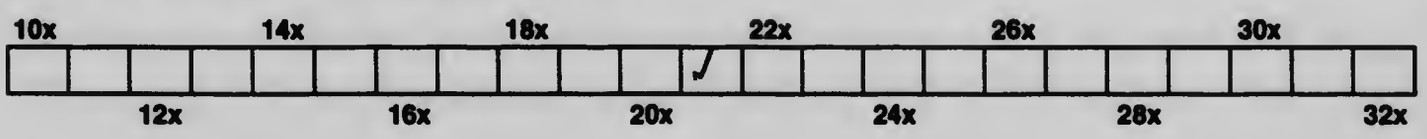
The Institute has attempted to obtain the best original copy available for filming. Features of this copy which may be bibliographically unique, which may alter any of the images in the reproduction, or which may significantly change the usual method of filming are checked below.

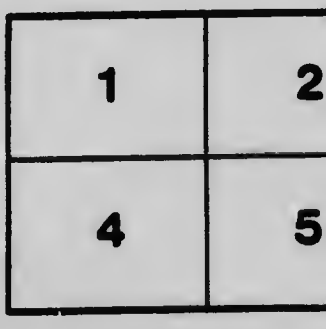
- ☐ Coloured covers / Couverture de couleur
- ☐ Covers damaged / Couverture endommagée
- ☐ Covers restored and/or laminated / Couverture restaurée et/ou pelliculée
- ☐ Cover title missing / Le titre de couverture manque
- ☐ Coloured maps / Cartes géographiques en couleur
- ☐ Coloured ink (i.e. other than blue or black) / Encre de couleur (i.e. autre que bleue ou noire)
- ☐ Coloured plates and/or illustrations / Planches et/ou illustrations en couleur
- ☐ Bound with other material / Relié avec d'autres documents
- ☐ Only edition available / Seule édition disponible
- ☐ Tight binding may cause shadows or distortion along interior margin / La reliure serrée peut causer de l'ombre ou de la distorsion le long de la marge intérieure.
- ☐ Blank leaves added during restorations may appear within the text. Whenever possible, these have been omitted from filming / Il se peut que certaines pages blanches ajoutées lors d'une restauration apparaissent dans le texte, mais, lorsque cela était possible, ces pages n'ont pas été filmées.
- ☐ Additional comments / Commentaires supplémentaires:

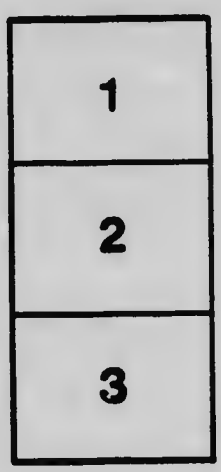
L'Institut a microfilmé le meilleur exemplaire qu'il lui a été possible de se procurer. Les détails de cet exemplaire qui sont peut-être uniques du point de vue bibliographique, qui peuvent modifier une image reproduite, ou qui peuvent exiger une modification dans la méthode normale de filmage sont indiqués ci-dessous.

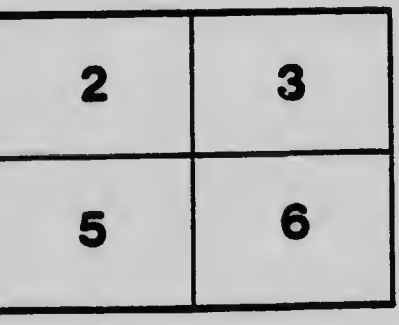
- ☐ Coloured pages / Pages de couleur
- ☐ Pages damaged / Pages endommagées
- ☐ Pages restored and/or laminated / Pages restaurées et/ou pelliculées
- ☑ Pages discoloured, stained or foxed / Pages décolorées, tachetées ou piquées
- ☐ Pages detached / Pages détachées
- ☑ Showthrough / Transparence
- ☐ Quality of print varies / Qualité inégale de l'impression
- ☐ Includes supplementary material / Comprend du matériel supplémentaire
- ☐ Pages wholly or partially obscured by errata slips, tissues, etc., have been refilmed to ensure the best possible image / Les pages totalement ou partiellement obscurcies par un feuillet d'errata, une pelure, etc., ont été filmées à nouveau de façon à obtenir la meilleure image possible.
- ☐ Opposing pages with varying colouration or discolourations are filmed twice to ensure the best possible image / Les pages s'opposant ayant des colorations variables ou des décolorations sont filmées deux fois afin d'obtenir la meilleure image possible.

This item is filmed at the reduction ratio checked below / Ce document est filmé au taux de réduction indiqué ci-dessous.



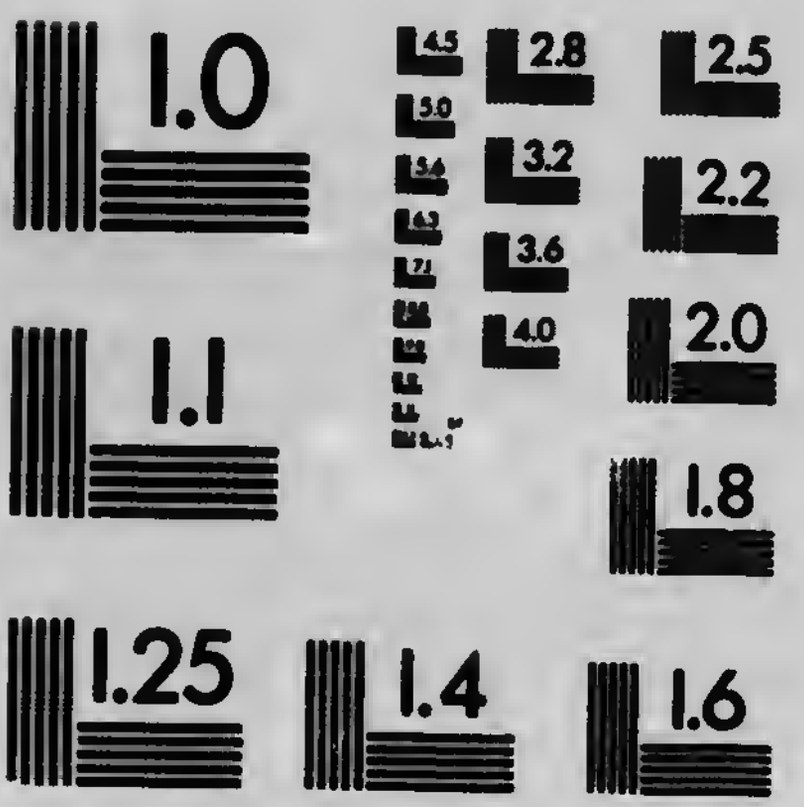






MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



APPLIED IMAGE Inc

1653 East Main Street
Rochester, New York 14609 USA
(716) 482 - 0300 - Phone
(716) 288 - 5989 - Fax

DEVELOPEMENT

OF

ELECTRIC POWER

AND

RAILWAYS

IN THE

PROVINCE OF QUEBEC

ADDRESS
GIVEN BEFORE THE

ROTARY CLUB, QUEBEC

BY

MR. H. E. WEYMAN, A. I. E. E.
MANAGER LEVIS COUNTY RY.

A BADLY NEEDED LESSON OF ECONOMY IS BEING TAUGHT

Present Period of High Costs Has Opened the Eyes of Economists to Great Value of the Intense Development of Water Powers as Sources of Electric Energy for all Daily Requirements, Manager Railway Company Fully Explains Benefits to be Obtained From Hydro-Electric Sources of Motive Power and Energy.

At the Rotary Club lunch last Wednesday Mr. H. E. Weyman, manager of the Levis County Railway, gave an interesting talk upon electric power and railway development in the province of Quebec.

Mr. Weyman's address is here published in full.

Recently we have been treated to several speeches from the new Premier of this Province, in which particularly emphasis has been laid on the "white coal" or "water power" of this Province and its development. Since reference has been made in more than one speech, I think it behooves us to look closely into this matter and endeavor to obtain a clearer vision of what such development would mean to Central Canada and this Province in particular. Canada is one of the young nations of the world and is, therefore, in the fortunate position of being able to take advantage of the experience and mistakes of the older nations, which I believe every Canadian is anxious to do. In Central Canada and this Province there are no coal deposits, but nature has remedied this by providing enormous "water powers" or "white coal," which at present is not being utilized to any great very extent, but wasted, while we pay out huge sums to obtain coal from another country and are dependent on outside sources for almost our very existence.

The period of high costs in which we are living is surely teaching us a lesson of economy, which perhaps is badly needed and which I think our leaders in this Province have already learnt. If we look around

us, we see other nations, even those who have enormous coal deposits, moving rapidly in the development of "water powers" and "super" steam stations.

In France, Norway, Sweden, Italy, England, South Africa, Australia and the United States an evolution is taking place in power generation. The fact that the railways are the first to receive consideration by these other countries, some of them coal bearing, indicates that there is something inherently wrong with our present steam railroad practice. There are probably many who have not realized the advance made during the past few eventful years in electrical engineering, particularly as applied to Railway Electrification.

Many of us are familiar with New-York and know that all trains are hauled into New York city by electric lomotives from a point about twenty-six miles outside and that sections of main trunk lines outside New York are operated Electrically for a made greater distance.

Progress has not stopped there, for in 1916, 440 miles or two main line divisions of the C.M. & St. P. line were changed from steam to electric power—these being the two worst and heaviest grade divisions on that system. This electrification was the direct result of the electrification of the B. A. & P. Ry., primarily a heavy mining line in the mountain which was put in operation in 1912. The results obtained from the 440 miles electrification on the C. M. & St. P. were so favorable that the Cascade mountain division of 216 miles was electrified last year and is now in operation. Electric motive power or "White coal" is now responsible for hauling all the traffic on this road over three mountain ranges and under weather conditions familiar to us in this Province. The topographical conditions and gradients are, of course, similar only to those in existence in the mountains and nothing in this Province can compare with them. Grades of 2½ p.c. for twenty-one miles and 1.7 p.c. for forty-nine miles, with numerous curves are encountered, which with our winter conditions, furnishes the most severe test for electric operation that can be found. As may be expected, very careful records have been kept, both of steam and electric power operation. The comparison obtained is such as to arouse extreme interest among engineers, railway men and government authorities practically all over the world; and has resulted in even further development plans and schemes in the United States. This is of particular interest to Central Canada and this Province, particularly so as the question of coal and power, etc., has become an economic necessity to us. The results, figures and comparisons obtained from the electrification of the C. M. & St. P. furnish us with definite and reliable figures, which we can apply to the development of our Province and show clearly what it means to us, but before applying this comparison, I propose to give you some idea of the results of the C. M. & St. P. line.

The electrification of the main line is almost equal in length to the run from Montreal to Chicago, and longer than Montreal to Halifax. On the first two divisions 112 steam locomotives were replaced by 44 electrics. Many of the steam locomotives replaced were of the latest and most powerful types in existence, being the Mikado type, having 47.000 lbs. tractive effort and the Mallet type, which is really a double Mikado, having 76,000 lbs. tractive effort. The electric ones are 112 feet long and have a tractive effort of 85,000 lbs. or 12 p.c. more than the Mallet. Formerly, under steam operations trains up to 2000 tons were operated as against 4000 tons with electric at present. On an average, electric locomotives haul 30 p.c. more tonnage in 80 p.c. of the time than the steam did the lesser tonnage. Incidentally, instead of having an increase in the number

of trains to take care of the increased traffic there is an actual reduction of 22 p.c. For example on the twenty-one miles 2½ p.c. grade the electric locomotives reduced the running time of the passenger trains from an hour and five minutes to approximately forty minutes, while in freight service the steam required ten to twelve hours to make 115 miles, which is now done by electric operation in seven to eight hours. Those of you familiar with railroading can understand what the saving really is. In addition, one divisional point is now eliminated, only the train crews change. To check this performance, which some may say should not be taken as a criterion, we will refer to the performance on the B. A. & P. Ry. The standard freight train, under steam operation, was fifty cars, totally 3500 tons trailing load, which made the run of twenty miles in one hour and a half without stops. The first electric locomotive took only the standard train making the run in one hour without stops. The eight of the train on this run has since been increased to sixty-five cars, totally 4620 tons trailing load. This performance gives us practically the same ratio of saving as the C. M. & St. P. and the whole cannot be disputed. Further the capacity of a single line of track can be increased by 50 p.c., thus saving the enormous expense o double tracking, which would be necessary for continued steam operation.

Next we will take the cost of coal and electricity and we find that seven lbs of coal on the steam locomotive is equal to a K.W.H. on an electric one and it is principally this comparison that has caused such a stir up in the engineering and railway world, as steam central stations are generating a K.W.H. on 2½ lbs. of coal. This figure is surely a startling one, for it means that the railroads to-day are wasting enormous quantities of coal, the amount in the United States is estimated at to be 122,500,000 tons.

We also have a unique but important feature in the electric locomotive, which is regeneration, being simply the generation of electric power by the locomotive's motors when descending grades instead of using the air brakes, and which power goes back into the power system for use of other trains on any part of the system.

In addition regeneration also effects a large saving in brake shoe wear.

When the C. M. & St. P. road changed over to electricity it was estimated that the cost would pay for itself in the saving made in two years and this has been realized. The cost of electrification of the first two divisions, 440 miles was $12,750,000 against which must be credited the 112 steam locomotives replaced and released for service on other divisions, which required motive power, and amounted to $3,000,000, on the basis of 1917 figures. The above figure does not include the Genera-

As regards maintenance we have the following comparative figures for electric locomotives:—

Electric Locomotive Maintenance Data for 1919

	N.Y.C.	C.M. & St. P.	P.B.A. & P.
Number of locomotives owned.....	73	45	28
Locomotive weight, tons.....	118	290	84
Annual mileage.....1,946,879		2,321,148	566,977
Cost of repairs per mile, cents.....	6.39	14.65	6.48

and the following comparison between electric and steam locomotives:—

Steam and Electric Repairs on Weight Basis

	Steam Mallet	C.M. & St. P. Elec.
Cost of repairs per mile, cents.....	60	14.65
Weight on drivers, tons.....	240	225
Cost of repairs per 100 tons locomotive weight on drivers, cents.....	25	6.52

ting Stations, as the power is purchased from a Hydro Electric Power Company, but includes sub-stations. It will be noticed that the whole electrification receives its power from the water powers in the district.

The first cost of electrification is argued by some who admit the advantage of electrical operation as prohibitive. If however, the cost and maintenance of the formidable facilities required by the steam locomotives, viz.: coaling stations, water stations, shops and machinery, turntables, ash pits, dumps, etc., not required by the Electric Locomotive, is taken into consideration, we will find that approximately 60 p.c. of the cost of the steam locomotives is required to provide these, without counting the cost of the permanent labor involved. This more than covers any difference in the first cost of electrification.

To illustrate the comparison better, I may mention that lately one railroad which is compelled to provide increased facilities on part of their system investigated the question of cost of providing this with steam or electric operation, and it was found that the steam would require $32,000,000, as against $18,000,000, for electric. To provide for 100 p.c. increased traffic to take care of the future normal traffic increase steam would require $84,000,000 as against electric of $38,000,000. One point brought out was that in steam operation an allowance had to be made of 23.2 p.c. for locomotives unserviceable, or under repair, as against 11 p.c. for the electric, which means that the number of electric locomotives required is considerably less than what is required with steam to provide the same service.

Some who are interested in power companies will say that a railway load is unsuitable for a power company, but this has not proved to be so for by an ingenous method the load factor is kept up as high as 60p.c. a figure which no power company could despise. On comparatively level roads with fair traffic density this apparatus would probably not be required.

Now, all these results have been known to many for some time and have resulted in a further development plan which will have far reaching effects and results. This is nothing more or less than a "Super-Power Zone," proposed by our American brethren to take in, not only the railways, but all industries. This zone is to embrace a portion of the Atlantic seaboard taking Washington on the south to Boston on the north and extends 130 miles inland. This covers the most densely located industrial district in the United States and serves to start a plan for the economical operation of all industries and eliminates all industrial, wasteful power plants, transportation of coal, etc., raising the load factor from 15 to 50 or 60 p.c. It is calculated that in this zone a saving of $300,000,000, could be effected, which gives 25 p.c. return on the investment and that the industrial power requirements is 10,000,000 h.p. and for the railroads 700,000 h.p. At present there are 12,000 miles of railway route, 30,000 miles of single track and about 8,000 steam locomotives operating in this zone, consuming 21,000,000 tons of coal annually. By electrification of railways alone 12,000,000 tons of coal would be saved per annum, which gives an idea of the saving to be effected by the application of electric power.

The super power development of our "white coal" and the electrification of the railways fundamentally go hand in hand, as the one helps the other in the results obtained. The electrification of the railways shows enormous savings in itself. The railway load applied to large power development raises the load factor of the power system producing high economical development and operation and reducing the cost of power so that the combination of both is most desirable. It is, of course, not economically possible to scrap all the present steam locomotives, except those which are obsolete and substitute electric lovomotives. It is possible, however, to electrify new roads and sections of the present ones as more motive power is required, selecting the sections, which are the most desirable, from which

the resulting savings would be the largest, thereby providing a gradual evolution without undue financial requirements.

We will now proceed to apply the actual facts to the railways in our own particular province. From actual figures, of our railway operation, starting at Montreal and going east to our eastern boundaries, and figures now available from other electrifications, we can arrive at a comparison, which gives us an accurate idea of what the application of electric power would mean in the province of Quebec. Within our zone we have 15,000,000,000 tons of hauling done by our steam locomotives per annum. To do this requires over two and a quarter million tons of coal per annum, costing at present $8.00 to $10.00 per ton, the total coal bill being from $14,000,000. to $15,000,000. This coal is purchased outside this province and has to be hauled from the mines on an average of 400 miles, which equals about 700,000,000 ten miles of 5 p.c. of the total ton miles of haulage per annum and is, of course, non revenue haulage. To endeavor to make the comparison clear to those not familiar with railroading, I would say that all railway figures and costs are based on the ton mile for freight and train mile for passenger, the former is the number of tons hauled one mile, the latter is the number of miles run by passenger trains, I have here a comparison of several different railway division in this province and the C. M. & St. P., from which I will take the figures of most interest to you as follows:—

Freight service comparison one month:

	C.M. & St. P.	No. 1 Division	No. 2 Division	No. 3 Division	No. 4 Division
Gross ton miles.....					
Gross ton miles....	93,228,000	40,000,000	31,500,000	142,000,000	80,000,000
Train miles.....	58,014	38,000	29,761	128,227	60,904
Ton mile, train mile.....	1,605	1,050	1,040	1,100	1,330
Lbs. of coal per train mile.....	291	170	180	200	185
Cost at $8.00 per ton.....	117.6c	68c	72.0c	80c	74c
K.W.H. per 100 T. M.....	41.5	26	28	31	28
Cost at 1½c per K. W.H.....	52.8c	32.5c	35.0c	39.0c	32.5c

	C.M. & St. P	No. 1 Division	No. 2 Division	No. 3 Division	No. 4 Division
Passenger Service:—					
Train mile.....		19,850	26,564	80,480	21,164
Lbs. of coal per T. M.....	193	192	193	188	186
Cost at $8.00 per ton.....	77.2c	76.8c	77.2c	75.2c	74.4c
* K.W.H. per train mile.....	29.9	28	28	27	27
Cost at 1½c per K. W.H.....	37.4c	35c	35c	33.4c	33.4c
Gross ton mile.....			12,629,936	37,617,820	
Ton mile T.M.....		420	476	470	450

Estimate for Year of all Railways East of Montreal to Provincial Boundaries

Passenger train miles.....	7,000,000
Freight ton miles.....	11,600,000,000
Passenger train coal used at 190 lbs. per train mile—tons.....	670,000
Cost at $8.00 per ton.....	$5,360,000

* Measured at Power Co's. incoming lines at sub-stations.

K.W.H. required at 30 K.W.H. per train mile—K.W.H.	210,000,000
Cost at 1¼c per K.W.H.	$2,625,000
Freight coal used at 186 lbs. per 100 ton miles.....tons	1,080,000
Cost at $8.00 per ton	$8,640,000
K.W.H. required at 32 K.W.H. per 1000 ton miles	371,200,000
Cost at 1¼c per K.W.H.	$4,640,000
Total coal used 1,760,000 at $8.00 per ton	$14,080,000
Total K.W.H. used 716,000,000 at 1¼c per K.W.H.	8,930,000
Saving effected	$6,851,000
Locomotive coal haulage at average of 400 mile haul—ton miles	700,000,000
Power station capacity to handle traffic	100,000
Saving in locomotive maintenance	$4,250,000
Saving effected in eliminating hauling of coal required by locomotives	$1,000,000
Saving in coal	$6,851,000
Saving effected in eliminating locomotive tenders	$986,000

Further a large reduction will be affected by eliminating water pu[illegible] stations at saving of divisional points with their requisite shopping fa[illegible].

In freight service we first notice that our railways are hauling an average of 500 tons less per train than the C. M. & St. P. on a comparative level roadbed as against heavy mountain grades and were hauling under steam operationfor all roads. Under electric operation the C. M. & St. P. are hauling an average of 25 p.c. more tons per train than they did under steam operation, which means we are hauling at least 50 p.c. less tonnage per train than what we could and of course, is reflected in the cost of transportation. With steam and coal at $8.00 per ton it costs 80c for fuel to haul 1000 tons one mile as against electric power at 1¼c per K.W.H. or 39.0c. In passenger service the same ratio exists and to the steam engine has to be added the cost of water required. The amount of power required to operate our railways in the zone mentioned would be about 720,000,000 K.W.H. or at the probable load factor 100,000 K.W. and when it is remembered that there are several water power plants in the province of 300,000 K.W. this figure is insignificant. The total cost of coal for steam operation is $14,080,000, as against $7,265,000, for electric power, besides the saving of 700,000,000 ton miles of non revenue haulage, equal to $1,000,000. These figures are surprising and no doubt our steam engine friends will look questioningly at them, so I will give an illustration.

Take the steam driven air compressor located on one side near the front of the locomotive, which is often at work while the engine is standing in the depot. This supplies air for the brakes of the train and takes 70 to 85 lbs. of steam at 200 lbs. pressure per minute to compress 100 cu. ft. of free air and takes seven to ten times as much power as an electric motor would require to do the same work.

Does no[illegible] the whole question give us much [illegible] for thought. Is it any wonde[illegible] hat our leaders in this province m[illegible]ation "Power and White Coal." Our financiers and engineers are equal to any, and they can carry such projects through. We have at least ten million h.p. in white coal, enormous forests and mineral deposits—why not build our future on the latest and soundest economic principles. We are young and practically undeveloped with a great future. We are told repeatedly to protect and preserve our forests and not to follow the example of wastefulness, which has occurred in the United States and resulted in the removal of pulp and paper plants from there to Canada. Then why not take the first step and eliminate

all damage of bush fire from our steam locomotives, which they have in the past been responsible for. The value of wood lost in the bush fires alone would pay the cost of electrification of the railroads. All new railroads about or to be constructed in the future should and must for their own, if not our national sake, be operated by electricity, as should every other industry. Future development of our white coal also demands that all electric power be standardized so as to permit all power plants to be interconnected, thereby permitting a constant and reliable supply, and that the whole structure be given a solid financial footing, so that the financing, new development, rate of return and individual initiative is assured, no matter what abnormal conditions may come and go. Everyone realizes that the past war resulted in injuring the credit of all public utilities and railroads. The whole question is huge, but as sure as we meet here to-day you will see such a scheme, as outlined, come to pass—you cannot stop it. It has to come and it is up to our financiers, the business men and the workmen of this province to see that we go forward and that we profit by the lessons of others and realize the birthright given to us.

EDITORS NOTE.—As an example of Rly Electrification already decided on the Midi System of France has now announced a ten year programme. By 1925, 1000 miles will be converted and by 1930 the remaining 700 miles of the Co. will be changed over to electric operation.

Twelve water power plants will supply of energy. After exhaustive investigation 1500 volts Direct Currents with overhead catenary line construction has been decided on, as a large number of multiple unit passenger trains will be operated in addition to freight. Had freight traffic been the principal consideration in their care 3000 volts Direct Current would have been adopted identical with the system at present in operation on the 655 route-miles of the C. M. & St. P. R. R.