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MICROCOFY RESOLUTION TEST CHART

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Railway Electrification

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REPRINT

of an Address to The Engineering Institute of Canada at Toronto on March 28th, 1918

by

JOHN MURPHY

Electrical Engineer of the Department of Railways and Canals, and Board of Railway Commissioners for Canada



Railway Electrification

By JOHN MURPHY, F.A.I.E.E., M.E.I.C.

Note.—The writer wishes to return his thanks to Officials of the Railways and of the Manufacturers of the apparatus referred to below, as well as to the technical press, for much of the following data.

Steam Locomotives consume 25% of all the coal mined every year; Electric Locomotives can save two thirds of that coal when their electrical energy comes from Stationary Steam Plants; Water Power can make them save it all.

Still smarting from the sufferings of two successive winters' fuel shortages, caused primarily by inadequate transportation facilities, we are foregathered to see what can and should be done to prevent, if possible, recurrences of such serious and trying experiences.

No argument is required, I think you will agree, to support the contention that eliminating the need for coal at a considerable distance from the mine *is* a greater measure of relief, and of true conservation, than increasing mine production and thereby adding more load to the all cady overburdened railways. Reducing coal consumption automatically relieves or releases men and apparatus all along the route from the mine to the consumer; it also relieves the route itself from some of its congestion.

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So eminent an authority as Mr. E. W. Rice, the President of the American Institute of Electrical Engineers, addressing that body in New York in February 1918 made the following statement: "It is really terrifying to realize that 25% of the total "amount of coal which we are digging from the earth "is burned to operate our Steam Railroads—and "burned under such idefficient conditions that an aver-"age of at least 6 pounds of coal is required per horse-"power-hour of work performed. The same amount "of coal burned in a modern Central Power Station "would produce an equivalent of three times that "amount of power in the motors of an Electric Loco-"motive, even including all the losses of generation and "transmission from the Power Station to the Loco-"motive."

Mr. Rice went on to say that 150,000,000 tons of coal, nearly 25% as he said, of all the coal mined in the United States, were consumed in Steam Locomotives last year.

Here in Canada Steam Locomotives consumed about 9,000,000 tons-30% of the 30,000.000 tons of coal imported into and mined in this country. Our 9,000,000 tons cover, I believe, wood and oil consumed on Steam Locomotives; some 49,000,000 gallons of oil are covered by the Canadian record. But, in the United States figures, 40,000,000 barrels of oil, 15% of the total oil output, are not included.

The total conservation of—the elimination of the necessity for mining—those great quantities of fuel would be secured if all the Railways were operated electrically and if the electrical energy were generated from water power. Modern Steam Central Stations can save from 50% to 66% of the coal now used in Steam Locomotives if the latter are discarded and Electric Locomotives used instead.

With such possibilities for Fuel Conservation in sight may we not soon expect to learn that the Fuel Controllers in both countries have asked the Railways, and that the Railway Managers have asked their Engineers:—"How many of these millions of tons of coal can you save—when will the good work of Railway Electrification begin?"

It is said our Fuel Shortages were due to a combination of bad weather and inadequate transportation. As we cannot control the *weather* our attention and efforts must be directed to the *transportation* portion of the difficulty. Railway Electrification will reduce coal consumption, coal haulage and the mining of coal; it will also greatly improve traffic conditions; Electrification, therefore, seems to be the solution of the problem. Under these circumstances it may not be out of place to recite in general terms what Electrification has actually accomplished on some notable Railways.

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Railroading in the mountains is the most strenuous kind of Railway work. The examples which I have chosen cover mountain sections. The Butte, Anaconda & Pacific Railroad, by Electrification, is said to have increased its ton-mileage 35% and at the same time decreased the number of trains, and their incidental expenses, 25% The time per trip was decreased 27%. It is said their savings in the first year's operation, after Electrification, amounted to 20% of the total cost of Electrification. That Railway buys power from Water Power Plants.

On the Norfolk & Western Railway power is obtained from their own Steam Station. Twelve Electric Locomotives have replaced 33 Mallets of the most modern and powerful type. The tonnage has been increased 50%. Electrification obviated the necessity for double tracking. The salvage value of the released Steam Engines was 45% of the cost of Electrification. Electric Locomotives make 8 times as many miles per-train-minute-delay as the Steam Engines. Their terminal lay-overs average only 45 minutes and they are double-crewed every 24 hours. Pusher Engine Crews have been reduced from 8 Steam to 4 Electric.

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Pusher Engines or Locomotives have been reduced from 7 Steam to 2 Electric. Steam Locomotives used to "fall down" in cold weather-the Electrics always "stand up," they are really more efficient, in cold weather. At the New York Railroad Club meeting last year their Electrical Engineers stated that:--"coal wharves, spark pits, water "tanks and pumps as well as roundhouses and turntables "have disappeared from the Electric Zone. Our track "capacity has been doubled. Our operating costs have been "reduced. From an engineering, an operating and a finan-"cial viewpoint our electrification has been a success." Speaking of the value of regenerative electric braking they went on to say:-"The use of the air brake is practically "eliminated, it is only used to stop trains; it is regrettable "we are unable to put a dollars and cents value on this great "asset; to appreciate it properly one must have had ex-"perience with the difficulties of handling 90 car trains "with air. Trains of 103 cars are now taken over the sum-"mit, 12 to 20 times every day, down the 2.4% grade with-"out even touching the air. We never broke a train in two "or slid a wheel. It is done so nicely we would'nt spill a "drop of water out of a class in the caboose."

The 440 route miles of the Chicago, Milwaukee & St. Paul Railway which have been electrified will soon be augmented by 450 miles more. Nearly 900 miles of railway and about 33% in addition for passing-tracks, yards, industrial tracks and sidings will soon represent the extent of this great Railway Electrification. Among the advantages secured by this Railway on its Electric Sections are the following:—The "cruising radius" of each Electric Locomotive is twice that of the Steam Engine. Sub-divisional points, where freight crews and Steam Locomotives were formerly housed and changed, have been abolished; the Passenger crews' runs are now 220 miles instead of 110. For Railway purposes, these Stations do not now exist; 7 or 8 miles of track at each old station have been taken up;

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"through freights" do not leave the main line track at all at these points; Shops and Roundhouses have disappeared. along with their staffs, and one electrician replaces the whole old Shop and Roundhouse force. An Electric Locomotive has made 9,052 miles in one month. Although schedules have been reduced the Electrics have "made up" more than $2\frac{1}{2}$ times as many minutes as Steam Engines running on the old schedules-"time" which had been lost on other divisions; 29% of Electric Passenger trains made up "me in this manner. On a mileage basis alone the operating costs of the Electrics are less than one half the Steam Engine costs. Freight traffic increased 40% shortly after Electrification-double-tracking would have been necessary to handle such increased business under Steam operation. An average increase of 22% in freight tonnage, per train, has taken place. One Electric handles about $3\frac{1}{2}$ times as many ton-miles as a Steam Engine; the reduction in time in handling a ton-mile is 30%; faster and heavier trains have accomplished these results; the number of trains has not been increased. About $11\frac{1}{2}$ % of the energy used by the Railway is returned to the line in the process of regenerative braking, and this returned-energy helps to haul other trains. While this is a very important item. and reduces the power bills, it is only regarded by the management as of secondary importance in comparison with the more safe and easy operation of trains on the grades, and the elimination of former delays for changing brake shoes and repairs to brake rigging when operating with Steam Locomotives. The Electrics maintain their schedules much better than Steam Engines. In three months the Electrics only waited for the right of way 254 minutes, while the Steam Engines in a similar period waited 1910 minutes—or $7\frac{1}{2}$ times as long. Extra cars on trains only delayed Electrics 1/9 of the time Steam trains were delayed for a similar reason. Cold weather delayed steam trains 445 minutes in the three months under discussion, but the

Electrics were not delayed a minute; the latter are more efficient in cold weather. Many of the delayed Steam trains were double-headers—but never more than one Electric is hitched to a Passenger train. An entire suspension of Freight service, due to Steam Engines losing their steaming capacity and freezing up was not an uncommon experience. Electrical Energy for the operation of these trains costs considerably less than coal. This latter statement is one of the most interesting in connection with the operation of the C. M. & St. P. Ry. and it is especially interesting because it was made more than one year ago.

The foregoing actual operating experiences on large Railway Electrification projects show what the Electric Locomotive is doing every day. As the Vice-President of the last mentioned Railway said "Electrification has made us forget that there is a continental divide."

The limitations of the Steam Locomotive are due to the fact that it is a mobile Steam Power Plant of limited capacity; it is compelled to carry its own supply of coal and water; and, it is unable to take advantage of many of the economical refinements of the large modern Stationary Steam Plant. On the other hand the Electric Locomotive has no such limitations; it merely acts as a connecting-link between efficient stationary Steam or Water Power Plants of unlimited capacities-because they may be extended indefinitely-and the train to which it is connected. The Electrical World summed up the situation a short time ago when it said:-"Why continue to haul millions of tons of "coal, for and by uneconomical Steam Locomotives, all over "the country, and thus add more loads to the already over-"burdened railways, when the power which they need so "badly can be much more economically and efficiently "transmitted to Electric Locomotives over a wire the size "of one's little finger?"

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The continual increasing cost of Coal and Fuel Oil will force Railway Managers to look more and more carefully into Railway Electrification. Estimates of a few years ago now need revision. Money may be hard to get but if, at times, fuel cannot be obtained at all some substitute must be obtained—if normal life is to be continued in northern latitudes.

A representative of the National City Bank of New York, writing of the period after the war, referred to the stagnation which may ensue, in all the great industries now engaged in war work, as soon as peace is declared; the multitude of the people thus thrown out of work in addition to the men of the returning armies would create unbearable conditions unless suitable employment will have been arranged for them in advance; he referred to the economic advantages of Railway Electrification and was of opinion that this work might solve the whole question if soon taken up with vigor. The Minister of Public Works, Hon. F. B. Carvell, M.P., addressing the Ottawa Branch of the Engineering Institute of Canada a couple of weeks ago, spoke of the necessity for conserving the energy of our Water Powers-instead of letting them run to waste-so that this great store of energy might be employed in assisting to build up our own country and to rebuild other countries when peace comes. How nicely these two ideas, Water Power Development and Railway Electrification, would work together if properly carried out?

With the view of securing something worthy of presentation to this important meeting I wrote to an eminent engineer, a man of international fame and recognized as an authority on Railway Electrification, requesting him to tell me his own views upon this subject. A specialist's opinion, in my opinion, is always very valuable. Here is a short extract from his interesting reply. He said:— "Generalization is always dangerous, especially in con-

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"nection with Electrification of Railways, where so many "factors such as the physical location, character of loads, "the power situation, etc., come in to affect the decision "if applied locally." From this sober statement it may be seen that my correspondent is an Engineer—not a politician. He proceed and follows: ".... with present equipment-"prices the cost is absolutely prohibitive." This opinion, let me point out, is in connection with the proposal to "Electrify Everything." Do not let it dampen our enthusiasm. Listen to this also and kindly keep it in mind; it is another extract from the address of Mr. C. W. Rice above referred to. He said:—"I think we can demonstrate that "there is no other way known to us by which the railroad "problem facing the country can be as quickly and as "cheaply solved as by Electrification."

While the present Fuel Shortage and kindred questions have made us look to Railway Electrification for relief I feel such projects on a large scale can only follow or go hand in hand with Water Power Plant Development and Co-Operative Operation of Power Plants. The location of a number of Plants at different points—large Water Power Plants and Auxiliary Steam Plants—so situated and interconnected that a failure at one Plant, or the connections to it, will not jeopardize the others or completely cut off and isolate an important Railway District is, in my opinion, an essential and a prime necessity in connection with any large Railway Electrification Project.

The 99 year power contract of the C. M. & St. P. Ry. above referred to is worthy of more than a moment's attention and consideration in this discussion. That Railway has a contract with a Power Company which has a series of Plants stretching across the whole country parallel to the Railway. The Railway owns its Sub-Stations and secondary lines but it is not concerned with the high tension lines or Power Plants of the Power Company. A reasonable rate for power arranged between a willing purchaser and a willing seller—a contract, in fact, which each party knows the other will respect—is the basis and the real reason for that great Railway Electrification. Neither party questions the other's integrity or financial soundness. One delivers the Power it has undertaken to supply and the other uses it. The arrangement is ideal in its simplicity and entirely satisfactory to everybody concerned. It will, in my opinion, be necessary to have such attractive Power conditions as those outlined above, backed by abundant supplies of power, in order to foster and encoursge "Railway Electrification" in this country.

Railway Electrification is a truly Economic (Financial and Engineering) Problem—a Problem worthy of the best attention of the most highly trained and experienced Specialists.



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Prince Royal Black Foxes Limited

(Incorporated by Act of the Province of Prince Edward Island)

Authorized Capital, \$75,000.00 Divided into 750 shares (par value \$100.00 each) Issued, \$72,000.00

Directors

Secretary MAJ. CHARLES LEIGH . P. O. Box 225, Charlottetown, P. E. I.

Bankers and References-Bank of Nova Scotia

HARI OTTETOVINI PRINCE EDWARD IN

CHARLOTTETOWN, PRINCE EDWARD ISLAND

1914

INTRODUCTION

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This Company has been formed by the pooling of interests heretofore held privately by the Directorate of this Company and a few other shareholders in the Foxes contained in this prospectus. Of the \$72,000 capital to be issued, the original owners have retained over \$50,000, leaving only about 200 shares to be offered to the public. The present owners believe the prospects for the future in the fur farming industry have never looked so bright as they do at the present time.

MANAGEMENT

The Shareholders can rest assured that everything possible in the best interests of the Company will be carefully looked after by the Directors, as they will retain a very large interest in the stock holdings themselves in the Company.

The Directors have been personally interested in the Fox industry for several years.



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Drince Royal Black Joxes, Ltd.)

FUTURE OF THE FOX INDUSTRY

It is the opinion of the Directors of this Company that "Pure Bred Prince Edward Island" breeding Foxes will be in demand for some years to come, as enquiries are steadily coming in from all parts of the world; and as Prince Edward Island produces the finest grade of foxes in the world, there is no doubt that the main source of supply must be Prince Edward Island, and many fortunes will be made by present-day investors before the supply can exceed the demand. It is practically impossible to-day to purchase any live stock on Prince Edward Island, as everything has been purchased to hold, and the old ranches will not sell at all. Quite a number of options for 1914 pups have already been sold at \$12,500.00 per pair, even at this early date.

The American Consul, Mr. Wealey Frost, in an exhaustive report to his Government respecting the breeding of Black Foxes, points out that not only is our climate peculiarly adapted to this business, but our soil, being of the Triassic formation, contains



Prince Royal Black Joxes, Ltd.)

neither lime nor alkali. The fox loves to burrow and the presence of lime renders the pelt harsh in texture and dull in color. Hence, the pelt of our wild fox, as well as that of the domesticated, especially the latter, is known and prized in the London market. Prince Edward Island has, therefore, become world-wide in its fame as being the home of the Black Fox of superior quality; and it is to this Province the civilized nations are looking for Black Foxes for breeding purposes as well as for the most beautiful ar.d valuable pelts.

CAPITALIZATION

Of the \$75,00.00 capital authorized by the charter of the Company, at present only \$72,000.00 will be issued (including \$1,000.00 for organization expenses) for the purchase and payments of the following, which will form the assets of the Prince Royal Black Foxes, Ltd.

A. One pair of highest grade Pedigreed Foxes Class A, the female being the celebrated "Bluebird,"





View Showing Outside Wire Fence of a Prince Edward Island Fox Ranch. Within this Enclosure are Pens and Dens where the Foxes are Confined



OUR THREE FEMALES

All Highest Registration, Class A



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THE "BLUEBIRD"

Born 1911. Mother of six pups in 1913 (an even three pairs) which were sold for \$46,000 cash.

Born in the original Dalton Ranch, at Tignish. Prince Edward Island.

FEMALE NO. 2

Born 1911. Mother of five pups in 1913.

This vixen is a very fine Tuplin Fox, and of a very prolific strain.

FEMALE NO. 3

Born in 1913. This female is a pure bred Oulton fox, and is a granddaughter of the original Oulton stock that produced the fine grade of pelts which realized the highest prices on the London market.



OUR THREE MALES

All Highest Registration, Class A



"PRINCE ROYAL"

Born 1911. This male fox is a pure bred Oulton, and was born in the original Oulton Ranch at Alberton, P. E. l. He is from the original Oulton family, the pelts of whose progeny sold on the London market for the record prices of $\pounds 540$, $\pounds 530$ and $\pounds 500$ sterling.

MALE NO. 2

Born 1912. A high grade Fox, born in the F. F. Tuplin ranch, New Annan, P. E. l., from best original Island stock.

MALE NO. 3

Borr. in 1911. This is a pure bred Island Fox, Tuplin strain, born in the F. F. Tuplin ranch at New Annan, P. E. l.



Prince Royal Black Joxes, Itb.)

who produced the six pups in 1913. The male is a splendid Silver-Black Fox born in the ranch of F. F. Tuplin, New Annan, from his best stock.

B. One pure-bred Oulton male, mated with purebred Tuplin female, highest grade Pedigreed Foxes, Class A. This pair had five pups last spring.

C. One Tuplin male and one pure-bred Oulton female. Male born 1911 and female born 1913, highest grade Pedigreed Foxes, Grade A.

PEDIGREES

These foxes are all of the very highest grade. They are all Island ranch-bred and eligible for highest registration, and their pedigrees are on file at the President's office.

The female of Pair A is the celebrated "Bluebird," the mother of six pups in 1913 (three males and three females), which were sold and delivered in October for the sum of \$46,000.00 cash, which we believe to be the greatest amount of cash realized from the sale



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Prince Royal Black Joxes, Ltd.)

of one litter the start female in Prince Edward Island. This female is mated with a high grade Tuplin Fox. This pair of foxes are being ranched in the Dinnis Ranch, near Charlottetown; and this ranch has the reputation of producing the largest average of pupe of any ranch on Prince Edward Island.

The pair B are an exceedingly fine pair of high grade foxes. The male is of the Oulton stock, from the griginal Oulton Ranch at Alberton, P. E. I., and his mother lifetid the pups whose pelts sold on the London market in 1910 for the record prices of £500, £530, and £540, respectively, for each pelt.

'a relatives

The female is from the stock of F. Tuplin, whose foxes are noted for their productiveness.

This pair produced in the spring of 1913 five pupe, which is above the average of production.

The Pair C.—The male is a two-year-old fox of the Tuplin strain, and the female is a 1913 fox from the pure Oulton stock, and a relative of the male in pair B, which has the highest quality of fur and best blood on Prince Edward Island.



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Prince Royal Black Foxes, Itd.]

ESTIMATED PROFITS 1914 PRODUCTION

						Produced 1913	Estimated 1914	
Female A			•			6	5	
Female B	•	•			•	5	4	
Female C	•	•	•	•	•	<u> </u>	$\frac{3}{12}$	
12 Pups at	\$5,	50	0 e	acl	h		\$66,000	
Less Ranching Expenses (average 15 per cent)						•	9,900	
							\$56,100	

This would give about 80% profit to the shareholders on the capital issued.

If the production is 10 pups, it would net about 65%; but if they breed in the same ratio as last year, there should be 14 pups.

If deemed advisable, the Directors will gradually increase the number of the foxes in the Company from their own production; as, in the future, when the business gets down to a pelt basis, this company will have the strain of blood which has produced the record pelts in the past.



Prince Royal Black Joxes, Ltd.)

FOX DIVIDENDS DECLARED IN 1913

(Extract from Charlottetown Guardian)

Ranch	Authorized Capital	Total Cash Dividend	% Cash Dividend				
Bunbury	\$ 30,000	\$ 96,000	320				
Spring Park	90,000	40,500	45				
Peerless	20,000	60, 000	300				
Prospect	60,000	60,0 00	100				
Smith	150,000	60,000	40				
Dalton	625,000	250,000	40				
Silver Tip	25,000	23,750	95				
Murray Harbor	50,000	100,000	200				
Magic	100,000	172,000	172				
Eureka	30,000	52,500	175				
Union	190,000	114,000	60				
Riverside Farming Co.	50,000	112,500	225				
Maritime	40,000	13,333	332 -				
Royalty	90,000	216,000	240				
Magnet	50,000	170,000	340				
O'Leary	40,000	8,000	20				
Pioneer	100,000	225,000	225				
North Shore	100,000	25,000	25				
Rosemont	10,000	50,000	500				
Tyne Valley	75,000	37,500	50				
Ranch Bunbury Spring Park Peerless Prospect Smith Dalton Silver Tip Murray Harbor Magic Eureka Union Riverside Farming Co. Maritime Royalty Magnet O'Leary Pioneer North Shore Rosemont Tyne Valley Malpeque Silver Fox Co. * With one fox still for sale.	40,000	30,000	75				
* With one fox still for sale	. t With o	† With one fox still for sale.					

The average cash dividend of these companies is 170 3-7 per cent.







