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ELECTRIC POWER IN CANADIAN INDUSTRY.

By

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Electricity maintains its commercial supremacy as a source of energy, to the general public, as a convenience; to the manufacturer requiring a source of power, on account of its adaptability to his respective needs and by its economy in application; in the field of traction, by its operative simplicity, cleanliness and comparative silence and suitability to frequent short haul; to the electrometallurgist and electrochemist, by permitting of concentration of energy, simplification of processes and equipment, for its uniformity and control of results, and from its application in the production of materials unavailable from any other source. In communication and in therapeutics its field is absolute. Dominating all these elements of industrial power supremacy, cheapness of electrical energy is paramount.

In the study, from the Canadian standpoint, of the use of electric power and its generation and supply, it is necessary to analyse the make-up of the typical power load, such as may be found to comprise the greater portion of the aggregate loads throughout the Dominion.

In general, a mixed power load consists of domestic, industrial or power load, municipal service, commercial lighting and street lighting. The domestic load has, by energetic campaigning by the power distributing companies, been constructed into one involving no mean figures; the former incandescent-

lighting load, generally to be found in meagre quantities, even ten or fifteen years ago, has been greatly amplified, so that the unequipped and unlighted residence, anywhere throughout the Dominion within reach of electrical sources, has become the exception; the day load of the many household electrical accessories and conveniences has appreciably added to the consumed power, tending to flatten out the peaked curve of this load and extend the service hours of the distribution system and transformers over a longer remunerative period and, further, get fuller advantage of power purchased on a peak load basis. The non-load night hours, are now engaging the attention of the central station, with the hope of commercially establishing electric heating accumulators for charging during such hours. As yet, it is the experience that lighting and domestic loads create a peak in early evening, unapproached by any other loads on domestic service transformers.

While the domestic service loads cannot be termed industrial loads, the subject this paper is more properly confined to, examples of loads to be quoted herein are appreciably composed of domestic loads, and, in most cases, the present power service originated many years ago from the immediate prospect of this market alone. Today, it is usually the personal aspect and home convenience of electrical power that carries the great weight in the establishment of a publicly-owned system or in the granting of service franchises. Directly and indirectly, domestic electrical-power service bears a most important relationship to electricity in industry.

For municipal uses such as pumping and street lighting electricity is universal. Off-peak-hour pumping into water reservoirs has proven an economical system when operated as a component of a mixed power load. The enormous strides in application and design of street-lighting units and the great efficiency to be obtained has placed electrical street lighting far beyond the reach of any other illuminating source.

Electric power in industry has a wide and practically limitless field. As a motive power available in any capacity, conveniently and economically applicable in every class of service, it out-ranks all its competitors, from the rolling-mill steam engine, reversing its ponderous thousands of horsepower, to the

infinitesimal foot-power of a sewing machine. In the heating and welding of materials, as a part of the process of manufacture, electricity, by its control, speed and concentration or distribution, enjoys a peculiar field, distinct from either coal or gas.

Electric railways have not reached beyond the industrial, urban, interurban and terminal use. The electrification of trunk lines, which awaits the supply of economic electric power at frequent intervals along the route and the overcoming of the many necessary minor changes in trunk line operation, besides the enormous capital outlay required, comprise a combination of requirements not considered economically attractive as yet.

Electrometallurgy and electrochemistry have been responsible for the handling of materials not workable by any other means, have made available new materials and have greatly cheapened the production of many important materials of wide use. Aluminum, calcium carbide, chromium, cyanamid, silicon, etc., are products only from electrical processes. Alkalies, hypochlorite, phosphorous, magnesium, sodium, nitrates, etc., are produced electrically at the lowest cost.

Telephony and telegraphy; radio-telephony and radio-telegraphy; radiography and therapeutics, electricity, while possibly providing the greatest conveniences and aids afforded to mankind by electricity, are not of such power-consuming magnitude as to require further mention.

The source of electric power for commercial purposes is motive power produced by steam, oil, gas or water. In Canada, it is notable that, without exception, all cities are now supplied by or are within the economic distribution zone of hydro-electric sources, and, further, commercial conditions are such that power from these sources is available to the customer at very attractive rates and it is apparent that the future of power-consuming industries has its foundation in the bountiful and wide-spread water power resources of the country.

The Dominion of Canada has an area of 3,745,574 square miles, stretching from the Atlantic to the Pacific and from the northern boundary of the United States to the Arctic Ocean.

The Northwest Territories, the vast northern portion of

Quebec and the greater part of the Yukon cannot be considered, within our generation, to be factors in the industrial field. The possibilities in these districts, from the standpoint of natural resources, are not as yet, with the incomplete investigations made up to the present, capable of appreciation; water power is plentiful, but so remote from any present market that the capacities of the thousands of known water powers are not included in statistics; within a limited area, the Yukon is an exception. In the Provinces of Nova Scotia, New Brunswick, Prince Edward Island, Quebec, Ontario, Manitoba, Saskatchewan, Alberta and British Columbia, power is available in great abundance.

Nova Scotia water powers are, in general, of small dimension, as a result of the limited drainage areas and the low available heads on the various rivers, due to the general topography of the country. New Brunswick has many rivers of magnitude, but with gradual drop and small facilities for storage. Prince Edward Island is very limited in water powers, there being no site capable of the development of over one hundred horsepower. Quebec and Ontario and the eastern and northern portions of Manitoba have enormous possibilities in power production, while the southwestern part of Manitoba, southern Saskatchewan and southeastern Alberta are quite limited in capacities, being the prairie, wheat-growing "West" of Canada. The Rocky Mountains and eastern foothills in Alberta provide a notable source of power and the Province of British Columbia, comprising the western slope of the Rocky Mountains to the Pacific Ocean, is capable of enormous waterpower development.

Within the provinces of the Dominion of Canada, and excluding the Northwest Territories, practically all of the Yukon, and the northern and eastern portions of Quebec, it is estimated that 17,764,000 horsepower are available, this amount being inclusive, in the case of Niagara Falls, Fort Francis and the St. Mary's River at Sault Ste. Marie, of only the development permitted by International treaties, and, further, does not contemplate the full possibilities of storage for the improvement of capacities. The developed powers, which are inclusive of all water powers, whether for electrical production, pulp grinders,

for milling or for the great many other uses, aggregate 1,712,193 horsepower, as developed by turbines, and this amount is distributed over the Provinces as shown in the following table:

Province	Horsepower Developed
Nova Scotia	21,412
New Brunswick	13,390
Prince Edward Island	500
Quebec	520,000
Ontario	789,466
Manitoba	56,730
Saskatchewan	45
Alberta	33,305
British Columbia	265,345
Yukon	12,000
Total	1,712,193

The relation between population and water power developed makes a very interesting study. It cannot be said that a definite relation exists or should exist, although it is possible that in the future, as the rapidly changing commercial conditions assume a permanent stability from established markets and universal demand, a constant may be deduced for the equation, the variables being environment, government policy, inherent commercial instinct, natural resources of materials, accessibility of market and, above all, available sources of low-cost electric power.

Horsepower per capita of the various manufacturing countries may be compared on the present standing, and while the contemporary industrial conditions may not readily admit of the projection of these values to the next few years to come, in the commercial future of the world it must be recognized that cheap power will be the keynote of industrial advancement.

As statements from official sources, or as computed from all accessible sources of information, the amounts of water power available and developed and the horsepower per capita have been compiled and are here presented for the various industrial countries of Europe and America.

Country	Area Square Miles	Population (Latest available figures)	Horsepower Available (1915 estimate)	Horsepower Developed, (1915 estimate)	Per Cent Utilized	Horsepower Per Square Mile of Area		Horsepower Per Capita	
						Available	Developed	Available	Developed
United States	3,026,600*	92,019,900	28,100,000	7,000,000	24.9	9.3	2.31	0.31	0.076
Canada A	2,000,000	8,033,500†	17,820,000	1,710,843	9.6	8.91	0.86	2.22	0.21
Populated B	927,800	8,000,000	8,094,000	1,700,000	21.0	8.74	1.83	1.01	0.21
Austria-Hungary	241,330	49,418,600	6,460,000	566,000	8.8	26.8	2.34	0.13	0.011
France	207,100	39,601,500	5,587,000	650,000	11.6	27.0	3.14	0.14	0.016
Norway	124,130	2,302,700	5,500,000	1,120,000	20.4	44.3	9.02	2.39	0.487
Spain	194,700	18,618,100	5,000,000	440,000	8.8	25.7	2.27	0.27	0.024
Sweden	172,900	5,521,900	4,500,000	704,500	15.6	26.0	4.08	0.81	0.127
Italy	91,280	28,601,600	4,000,000	976,300	24.4	43.8	10.7	0.14	0.034
Switzerland	15,976	3,742,000	2,000,000	511,000	25.5	125.2	32.0	0.53	0.137
Germany	208,800	64,903,400	1,425,000	618,100	43.4	6.8	2.96	0.02	0.010
Great Britain	88,120	38,802,500	963,000	80,000	8.3	10.9	0.91	0.02	0.002

Canada "A", 2,000,000 square miles taken as the area treated in the Conservation Commission's Estimate of available water power, and the area which we may expect to see fairly thickly settled during the next few decades; 3,729,700 square miles = area of whole Dominion.

† 1911 Census + 12%.

* Excluding Alaska (area about half million square miles).

The comparison of the above figures is shown diagrammatically in Figure No. 1.

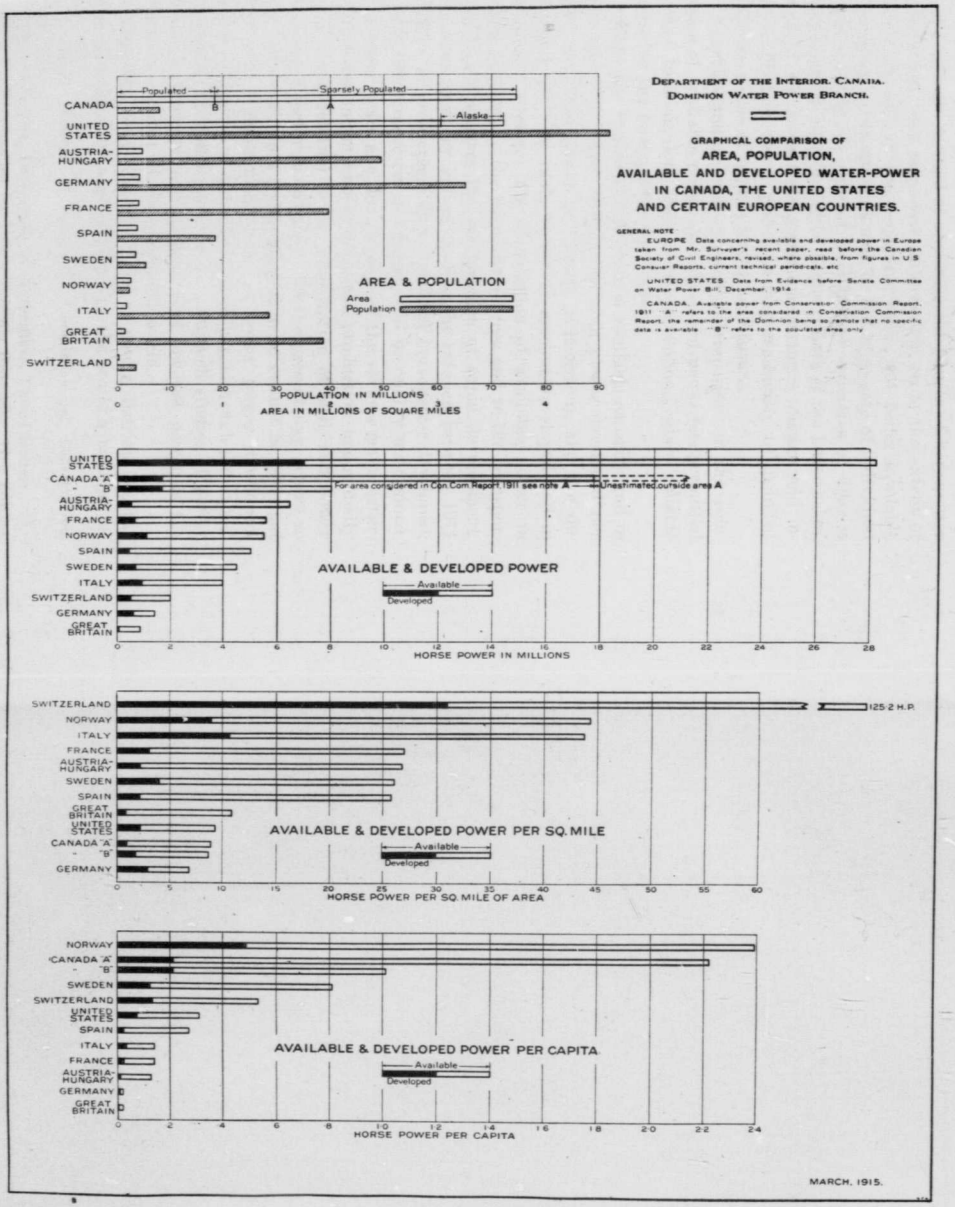
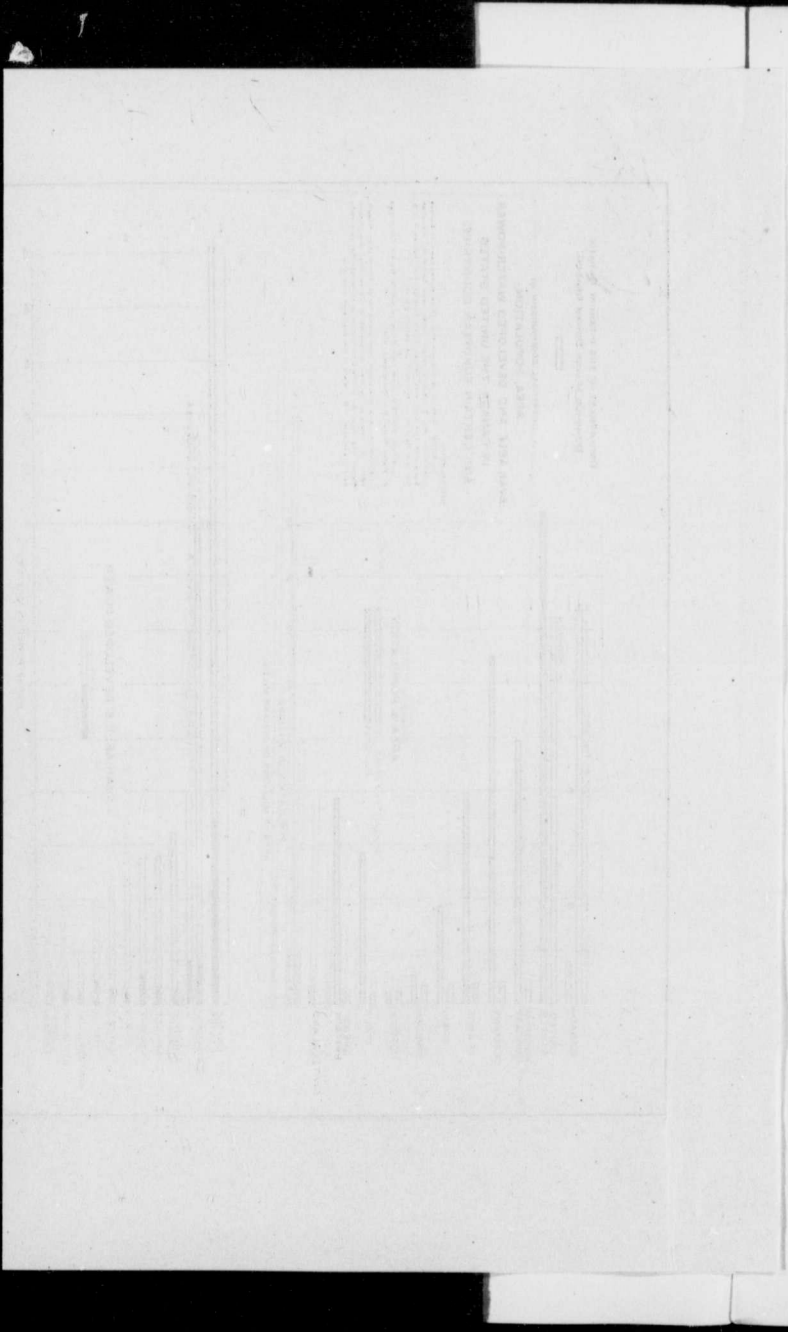

DEPARTMENT OF THE INTERIOR. CANADA.
DOMINION WATER POWER BRANCH.
GRAPHICAL COMPARISON OF
AREA, POPULATION,
AVAILABLE AND DEVELOPED WATER-POWER
IN CANADA, THE UNITED STATES
AND CERTAIN EUROPEAN COUNTRIES.
GENERAL NOTE
EUROPE. Data concerning available and developed power in Europe taken from Mr. Surveyer's recent paper, read before the Canadian Society of Civil Engineers, revised, where possible, from figures in U.S. Consular Reports, current technical periodicals, etc.
UNITED STATES. Data from Evidence before Senate Committee on Water Power Bill, December, 1914.
CANADA. Available power from Conservation Commission Report, 1911. "A" refers to the area considered in Conservation Commission Report, the remainder of the Dominion being so remote that no specific data is available. "B" refers to the equivalent area only.
Populated
Sparsely Populated
B
A
Alaska
CANADA
UNITED STATES
AUSTRIA-HUNGARY
GERMANY
FRANCE
SPAIN
SWEDEN
NORWAY
ITALY
GREAT BRITAIN
SWITZERLAND
AREA & POPULATION
Area
Population
POPULATION IN MILLIONS
AREA IN MILLIONS OF SQUARE MILES
For area considered in Con. Com. Report 1911 see note A
Unestimated outside area A
AVAILABLE & DEVELOPED POWER
Available
Developed
HORSE POWER IN MILLIONS
125.2 H.P.
AVAILABLE & DEVELOPED POWER PER SQ. MILE
HORSE POWER PER SQ. MILE OF AREA
AVAILABLE & DEVELOPED POWER PER CAPITA
HORSE POWER PER CAPITA
MARCH, 1915.

Fig. 1.



No uniform method of obtaining the figures of horsepower available has been employed; information as to the extent of possible storage, in the respective cases, not being available and, further, these amounts may be the aggregate of individual estimates, as in the case of Canada,* or estimates of district totals, as in the case of United States;† both of the latter cases, moreover, do not include maximum economic storage and include only such power plants as may reasonably be included within the range of market in the near future.

Notwithstanding such possible discrepancies in the compilation of available power, the developed power has permitted of close totaling, and thus, with population,‡ gives reliable figures for the horsepower per capita.

While the United States leads in available capacity and in power developed, and Norway leads in power developed per capita, available power in Canada is enormous, and the developed power now ranks second in amount developed and in amount per capita. The distribution of available power in Canada adjacent to the natural resources and to the transportation routes ensures the continuation of rapid development, there existing every indication that the rate set between 1911 and 1914, of an increase from 1,016,521 horsepower developed, to 1,711,188 horsepower developed, will be readily maintained.

Twenty years ago, the position of the various manufacturing countries, in the scale of industrial production, undoubtedly bore a direct relation to the consumption of coal, and power was a major factor in industry. In the present day, where so many factors are in a transitional stage, it cannot be said that either coal consumption, alone, or water power developed, alone, is indicative of commercial standing, although the aggregate power equivalent may be so. All such studies of power economies, however, will disclose that low-cost power is the underlying element of the industrial world.

Fortunate as is Canada in water power distribution, the added advantage of a great share in the world's mineral re-

*"Water Powers of Canada", Commission of Conservation, Ottawa, 1911.

† Forest Service, Department of Agriculture, United States.

‡ Population compiled from Encyclopaedia Brittanica, 11th Edition.

sources, with, moreover, the proximity of power to the mines, will by their interdependence provide a great stimulus to the development of both. Coal, iron, copper, nickel, gold, silver, cobalt, lead, asbestos, mica and corundum are the principal minerals, and the output value of these, aggregating $186,802,406, in 1910, is one of the chief elements in the commerce of the Dominion.

The appreciation of low cost of power is relative only; relative, in the first place, to our ideas of absolute cost of commercial power as produced, possibly, by the steam engine, and secondly, when cost of power as a major factor in production is lower than the critical power cost at which manufacture becomes commercially feasible. We are apt to think of low cost of power as something tangible and absolute. Under certain conditions, steam power at $100.00 per horsepower per year is low-cost power, and under certain conditions, power at $6.00 per horsepower per year is high-cost power; $6.00 power may show a loss in an extensive electrochemical plant, while $5.00 power may show an attractive profit.

In general, low-cost power is considered by the majority to be synonymous with hydro-electric power. The constituents of power cost may be readily analysed. In a hydro-electric generating plant, charges against capital—the aggregate of interest, sinking fund to retire bonds, depreciation fund, taxes and insurance, etc.—go to make up the greatest portion of the total cost; water charge (if any), operation, maintenance and supplies, are, in general, the minor items. In the steam plant, the cost of fuel alone will generally greatly exceed capital charges, while capital cost of a steam plant may readily compare with the capital cost of an electrical generating plant. In the steam plant, the greater the capital cost properly expended, the greater the over-all efficiency; and thus the increase in the minor factor of capital charge may provide a more than proportionate decrease in the major item of fuel. In the hydraulic plant, efficiencies are practically standardized and fixed; capital charges, however, vary greatly, from many causes, within the wide limits of a low-cost plant with a head of several hundred feet, with small headworks and a small number of large capacity generating units, to the high-cost

plant with low head, with extensive construction and a multitude of small units.

Quality of power is an element in the cost of an hydro-electric plant. In the supply of industrial power, continuity of service and more or less adherence to a definite standard of electrical characteristics of the supply are the essentials of quality. Absolute continuity is impractical, and the safeguards required in securing even an approximation of continuity in generating plants and transmission and distribution systems is usually so costly as to prohibit cheap power. The electrical characteristics of voltage and frequency, as representing the factors of greatest appeal to the consumer, are dependent on design and operation, and their maintenance is readily to be obtained.

In the electrochemical and electrometallurgical field, the lowest cost power, only, can be entertained, and such is available only from the largest of plants; power at from $6.00 to $10.00 per horsepower per year must be the aim, to secure such a market.

While abundance of water powers exist in Canada, today only the most cautious governmental administration policies can provide for the anticipated requirements of the future. The majority of water powers within market range will undoubtedly be developed, and the future is one of vital importance.

It has been fortunate that, in Canada, the water power rights have mostly remained under the control of the Dominion or Provincial Governments. The Dominion Government controls navigable streams, and their water powers, throughout the Dominion and the water powers of the Provinces of Manitoba, Saskatchewan and Alberta; the Yukon and the Northwest Territories, Quebec and New Brunswick have granted powers, heretofore, on broad leases, while Nova Scotia has many of its water powers privately owned outright from eighteenth century Government land grants; these provinces are now planning much more efficient control. In the Province of Ontario, the administration has become of such exceptional nature that it is worthy of a very complete study, as being, possibly, the greatest of municipal power undertakings.

The Dominion Government's administrative policy affords

every reasonable protection to the public, as to rentals, periodic revisions, control of rates, limited grants, etc., and, at the same time, fosters legitimate private enterprise to return reasonable profits. Regulations are in force affording all possible assistance to the development of water powers which have every reasonable assurance of economic utilization, and, further, before the authorization to proceed with development is given, complete investigations are undertaken to prove the economic features of design, capacities and costs, and, eventually, supervision is carried out during construction. Proper government supervision and control of the construction and maintenance of all developments is the only safe method of intelligently initiating construction and maintaining an adequate system of river improvement for power purposes.

The Hydro-Electric Commission of Ontario has created a world-wide interest as an experiment in publicly owned power. The history and results of the undertaking deserve fullest consideration in dealing with electric power in Canadian industry.

For some years previous to 1906, several of the energetic and leading citizens of central southwestern Ontario had endeavoured to secure a working basis for a comprehensive scheme of supplying power to the various municipalities, the City of Toronto comprising the largest interests in the matter. In 1906, the Provincial Government created a Commission empowered to investigate power conditions everywhere in the Province, and a further Commission was established after the rendering of the preliminary reports on the situation, which resulted in by-laws on the question of power supply being voted upon by the interested municipalities; and an agreement was entered into by the cities and towns of Toronto, Hamilton, London, Brantford, Guelph, Stratford, St. Thomas, Woodstock, Ingersoll, Berlin, Galt, Toronto Junction, Hespeler, St. Mary's, Preston, Paris, Waterloo, New Hamburg and Weston with the Hydro-Electric Power Commission of Ontario for a supply of electric power to be transmitted from Niagara Falls. The Commission is empowered, by Act of Parliament, to make expenditures for the carrying out of the necessary work, and these expenditures are repayable to the Commission by the municipal corporations which have entered into contracts. The price per

horsepower per year that each municipality has to pay for the respective block of power is the cost to the Commission and, in addition, (a) interest at the rate of 4 percent upon the moneys expended by the Commission on capital account in the construction or purchase of works; (b) an annual sum sufficient to form in thirty years a sinking fund for the retirement of the securities issued by the Province, under the Act, for the payment of the cost of the works; and (c) line loss and the cost of operating, maintaining, repairing, renewing and insuring the works. The amounts payable are annually adjusted and apportioned.

Tenders were called for the supply of electrical power from the producing companies at Niagara Falls, Ontario, and in March, 1908 the Commission entered into a contract with the Ontario Power Company for amounts up to 100,000 horsepower. Power was obtained from this source at the price of $9.40 per horsepower per annum for amounts up to 25,000 horsepower, and when the power demand exceeded 25,000 horsepower, the price became $9.00 per horsepower per annum. This price is for 12,000-volt, three-phase, 25-cycle power delivered in the Commission's transformer station at Niagara Falls.

In addition to the district served in the Niagara System, the Commission buys power from the Kaministiquia Power Company, of Fort William, Ontario, and sells to the City of Port Arthur; from the Ottawa and Hull Light and Power Company, selling to the City of Ottawa; from the Auburn Power Company, selling to the City of Peterborough; and from the York and Ontario Power Company for selling to the group of towns in the St. Lawrence System. Further, the Commission purchased the generating and distributing system of the Simcoe Railway & Power Company, at Big Chute, on the Severn River, and made considerable extensions to the distribution system, this plant being arranged to tie in with a generating plant being built by the Commission at Eugenia Falls, where a 542-head is to be obtained, and which is to supply power on June 1, 1915. A generating station and distribution system has just been completed at Wasdell's Falls, on the Severn River, at the outlet of Lake Couchiching, to supply power to the Wasdell's Falls system. The Commission is at present engaged on the

preliminaries to construction of radial electric railroads in the vicinity of Toronto and has undertaken the engineering and construction of the electrification works of the London and Port Stanley Railway.

A reference to the map (Figure 2) will well show the extent of the distribution area served by the Commission, excluding the Port Arthur, Ottawa and St. Lawrence systems. The transmission lines today aggregate 395.7 miles of double-circuit 110,000-volt line; 37 miles of single-circuit 110,000-volt line; 722 miles of single- and double-circuit pole lines of voltage from 13,200 up to 46,000; and 77 miles of low-voltage circuits. All the 110,000-volt lines, and the greater portion of the others, are included in the Niagara system.

On December 31, 1914, the number of customers served by the system was 96,744. On February 28, 1915, the power purchased by the Commission was over 100,000 horsepower.

Three features are outstanding: First, the power is intended to be available for every class of consumer, rural or urban; second, the equipment and general design are selected for most permanent and effective service; third, the power is supplied to the municipalities at cost.

Being assisted by complete, effective legislation from both Provincial and municipal standpoints, these operations of the Hydro-Electric Power Commission are the broadest examples of municipal ownership. The field entered by the Commission, wherever established municipal plants did not previously exist, was quite fully covered by private companies.

The adverse criticism which a publicly owned, electrical power system must expect when entering an established commercial market was based, at the inception of the Commission's plans, on the monopolistic tendency; on the possible effects of the introduction of Provincial party politics; and on the experimental nature of the scheme. The entire success as a commercial system, as an engineering work, and as a popular undertaking has entirely vindicated the situation.

The sale of power at cost eliminates much competition. This cannot be said to be creating a monopoly, as several of the established companies were able to reduce their rates to a corresponding amount, and with the decidedly less remunerative

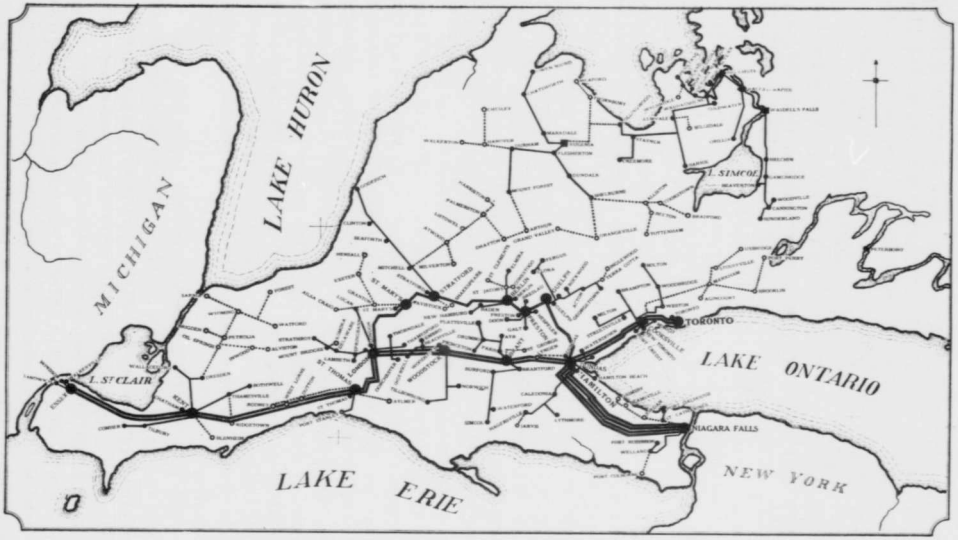


Fig. 2. Ontario Hydro-Electric Commission's Systems, Southwestern Ontario.

rates, have been able, by a much increased activity in the handling of business, to maintain a sound financial existence. The popular idea of the effect of a monopoly is that the public pays more and gets less in return, a condition certainly not comparable with the Commission's enterprise.

The selection of the personnel of the Commission has been a very judicious one, quite beyond criticism from the party standpoint, and to these men, of whom Sir Adam Beck, K. B., has been the chairman from the beginning, must belong much of the credit for the present position.

The experimental features of the engineering and commercial problems, involved, particularly, long distances, it being 233 miles from Niagara Falls to Windsor; the fact that 110,000-volt transmission at the time designs were commenced was in its earliest stages; that power was to be available to the municipalities at 25 cycles, for use in established markets using 60 cycles and 133 cycles; the necessary duplication in many cases of distribution systems; published power prices were based on estimates, only, of cost of construction and distribution; large blocks of power, with corresponding prices, were apportioned to the respective municipalities considerably in excess of their needs at the time, and in reality, in most cases, in excess of the power consumption from all sources of steam, water, gas and oil; an appreciably leavening factor was to be introduced into the industrial rivalry of the various communities; the consideration of an aggregate load of 100,000 horsepower, as was anticipated and which was to be an element in the ultimate success, was beyond the comprehension of the great majority; and possibly, lastly, no apparent provision was made for the development period in acquiring the load contracted for.

The analysis of the foregoing is quite beyond the capabilities of this paper. In 1908, the municipalities entering into the agreement subscribed for 29,335 horsepower; distribution of power was commenced in 1910; in 1915, the power will be in excess of 100,000 horsepower in the Niagara system alone. These figures may broadly suffice in place of a complete analysis, as each of the problems enumerated was eventually met by a successful solution. The rate of this growth in the Niagara system is shown in Figure 3, from 1910 to 1915.

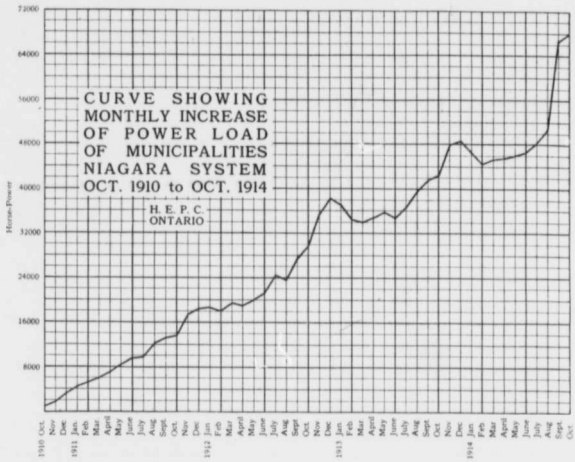


Fig. 3.

The municipalities originally included in the power agreements numbered fifteen; on February 28, 1915, this number had increased to 82, and the growth in the number of consumers is well shown in the following table:

Approximate Number of Consumers (to December 31, 1914).

	1912	1913	1914
Light	33,568	63,157	93,179
Power	1,399	2,532	3,565
Total	34,967	65,689	96,744

The total cost of the Niagara System of the Commission to October 31, 1914, is as follows:

Transmission Lines		
Right-of-way	$ 574,806.67	
Steel Tower Lines	2,095,050.23	
Telephone	129,706.69	
Relay System Lines	54,537.32	
Conduit Systems, Ontario Power Co. to Niagara Station	66,844.67	$2,920,945.58

Windsor Extension (Operating 1915)		
Right-of-way	195,060.87	
Steel Tower and Telephone Lines	835,734.97	$1,030,795.84
Duplication of Transmission Lines, Niagara to Dundas (Operating 1915)		
Right-of-way	47,264.25	
Steel Tower and Telephone Lines	258,305.92	$ 305,570.17
Wood Pole Line in operation	1,047,924.46	
Wood Pole Lines in course of construction	191,572.20	$1,239,496.66
Welland and St. Catharines District Lines		8,239.20
Rural Line Construction		159,382.23
Transformer Stations		
Stations in operation	$1,905,352.25	
Stations and extensions in course of construction	342,080.83	$2,247,433.08
Distribution stations in operation	86,674.65	
Distribution stations in course of construction	5,138.18	$ 91,812.83
Total		$8,003,675.59

The aggregate of the annual cost of operation, capital charges, up-keep, etc., of the municipal systems is as follows, for the years 1912, 1913 and 1914:

	Dec. 31, 1912	Dec. 31, 1913	Dec. 31, 1914
Number of municipalities included in report	28	45	69
Operating and maintenance expenses	$1,086,135.00	$ 1,511,048.00	$ 2,012,754.07
Debenture charges and interest	291,033.00	479,995.00	661,949.23
Total annual expense	1,377,168.00	1,991,043.00	2,674,703.30
Total revenue	1,617,674.00	2,611,918.00	3,433,936.16
Gross surplus for year	240,506.00	620,875.00	759,232.86
Depreciation charge	179,847.00	230,480.00	357,883.31
Net balance, profits in excess of depreciation	60,659.00	390,395.00	401,349.55
Total plant value	6,349,711.00	9,196,483.00	12,901,125.43
Net debenture debt and overdraft	5,882,156.00	10,468,351.78	12,702,689.81
Accumulated gross receipts invested in plant extension		861,381.00	1,601,167.42
Accumulated depreciation reserve		410,327.00	850,618.07
Net surplus from operation		451,054.00	750,549.35

St. Thomas	28 00	4	2.5	6	2.5	20	1 00	2.5	1.7	0.2	10	[illegible] $10.00	75 w.	"
Stayner	43 57	4	4.5	9	4.5	10	1 00	4.2	2.8	0.3	10	$53.00 $12.00	Arc 100 w.	"
Stratford	30 00	4	4	8	4	20	1 00	3.6	2.4	0.3	10	$ 9.00	60 w.	"
Sunderland..	Note A	3	6	12	6	10	1 00	4.5	3.0	0.4	10			
Thamesford .	45 00	4	6	12	6	10	1 00	5.6	3.8	0.5	10	$14.00	100 w.	"
Thorndale....	45 00	4	6	12	6	10	1 00	5.6	3.8	0.5	10	$14.00	"	"
Tillsonburg...	32 00	4	4	8	4	10	1 00	3.8	2.5	0.3	10	$11.00	"	"
Toronto	15 00	4	3	8	3	10 to 20	1.35 1st 10 h.p. 1.00 all add'l	1.5	1	0.5	10 to 20	$ 9.00	"	"
Walkerville...	38 00	3	4	8c. 1st 30 hr. 4c. next 70 hr.	0.8	10	1 00	3.6	2.4	0.3	10	$10.50	60 w.	"
Waterdown...	26 00	4	5	10	5	10	1 00	3.5	2.4	0.3	10	$10.00	100 w.	"
Waterloo	22 50	4	4	8	4	25	1 00	2.5	1.7	0.2	25	$ 8.75	100 w. mult. or 75 w. series Incandescent	
												$10.00	100 w. series Incan.	
												$10.50	150 w. mult. "	
												$25.00	3 lt. standard, 1-100 w. and 2-60 w.	
												$40.00	5 lt. standard, 1-100 w. and 4-60 w.	
Welland	14 00	4	3	6	3	25	1 00	1.8	1.2	0.15	25	$18.00	250 w. Incandescent	
West Hamilton	Served by Dundas	4	4	8	4	10	1 00	2.8	1.8	0.2	10	$ 9.00 $14.00	100 w. "	"
Weston.....	30 00	4	3	6	3	10	1 00	3	2	0.2	10	$12.00	"	"
												$40.00	5 lt. stand., 4-100 w.	
Winchester ..	43 77	4	4	8	4	10	1 00	3.1	2.0	0.25	10	$15.00	100 w. Incandescent	
Windsor.....	38 00	3	4	8c. 1st 30 hr. 4c. next 70 hr.	0.8	10	1 00	3.6	2.4	0.3	10			
Woodbridge...	33 83	4	4.5	9	4.5	10	1 00	3.9	2.6	0.3	10			
Woodstock ...	23 00	4	3	6	3	20	1 00	2	1.5	0.2	10	$25.00	250 w.	
Woodville	Note A	3	6	12	6	10	1 00	4.5	3.0	0.3	10	$10.00	60 or 100 w.	

Note A.—Service commenced during October, 1914.

Fig. 4. Ontario Hydro-Electric Power Commission, Power Rates, 1914.

Municipal Rates

1914

Municipality	Cost of Power to Municipality per h.p. per year	Lighting Rates					Power Rates					Street Lighting
		Domestic		Commercial		Prompt payment discount	Per h.p. per month	1st 50 hrs. per month per Kw-hr.	2nd 50 hrs. per month per Kw-hr.	All add'l per Kw-hr.	Prompt payment discount	
		Per 100 sq. ft.	Per Kw-hr.	1st 30 hrs. per Kw-hr.	All add'l per Kw-hr.							
	$ c.	c.	c.	c.	c.	%	$ c.	c.	c.	c.	%	
Acton	36 00	4	5	10	5	10	1 00	4.3	2.9	0.4	10	$15.00 per 100 w. Incandescent
Ancaster	Served by Dundas											
Baden	32 00	4	4.5	9	4.5	10	1 00	3.8	2.5	0.3	10	$14.00 " "
Barrie	33 70	4	4.5	9	4.5	10	1 00	3.6	2.4	0.3	10	$12.00 " "
Beachville	31 00	4	5	10	5	10	1 00	3	2	0.25	10	$10.00 " "
Beaverton	Note A	3	4	8	4	10	1 00	3.6	2.4	0.3	10	$13.00 " "
Berlin	21 50	4	3.5	7	3.5	25	1 00	2.1	1.4	0.2	10	$ 9.00 " "
Brampton	25 00	4	3	6	3	20	1 00	2.8	1.8	0.2	10	$ 8.00 " "
Brantford	19 50	4	3	6c. 1st 30 hr. 3c. next 70 hr.	0.15	10	1 00	1.9	1.3	0.15	10	$ 8.00 " "
												$40.00 Magnetite arc.
Bullock's Corn. and Greensville	Served by Dundas	4	4	8	4	10	1 00	2.8	1.8	0.25	10	$12.00 100 w. Incandescent
Caledonia	24 00	4	4	8	4	10	1 00	3.7	2.5	0.3	10	$12.00 100 w. "
Cannington	Note A	3	4	8	4	10	1 00	3.6	2.4	0.3	10	$13.00 " "
Chesterville	44 43	4	5	10	5	10	1 00	4.2	2.8	0.3	10	$13.00 " "
Clinton	41 00	4	5	10	5	10	1 00	4.9	3.3	0.4	10	$12.50 40 c.p. "
Coldwater	28 00	4	4	8	4	10	1 00	3.2	2.1	0.3	10	$12.00 100 w. "
Collingwood	33 97	4	4.5	9	4.5	10	1 00	3.6	2.4	0.3	10	$12.00 " "
Creemore	54 00	4	7	14	7	10	1 00	6.4	4.3	0.5	10	$12.50 " "
Dundas	15 00	4	3	6c. 1st 25 hr. 3c. next 75 hr.	0.15	10	1 00	1.6	1.1	0.15	15	$ 9.00 " "
Elmira	38 00	4	5	10	5	10	1 00	4.7	3.1	0.4	10	$12.00 " "
Elmvale	31 00	4	4.5	9	4.5	10	1 00	3.6	2.4	0.3	10	$12.00 " "
Elora	33 97	4	4.5	9	4.5	10	1 00	3.9	2.6	0.3	10	$12.50 " "
Fergus	33 97	4	4.5	9	4.5	10	1 00	3.9	2.6	0.3	10	$12.50 " "
Galt	21 50	3	2.5	6	2.5	10	1 00	1.9	1.3	0.15	25	$ 8.50 " "
Georgetown	36 00	4	5	10	5	10	1 00	4	2.7	0.3	10	$12.50 " "
Glen Williams	Served by Georget'n	4	6	12	6	10	1 00	4.3	2.9	0.4	10	$14.00 100 w. "
Goderich	37 00	4	4.5	9	4.5	10	1 00	4.8	3.2	0.4	10	$15.00 80 c.p. "
												$55.00 3 lt. standard
												$40.00 1 "
												$25.00 1 "
Guelph	21 00	4	4	8	4	25	1 00	2	1.5	0.2	25	$ 9.00 100 w. Incandescent
Hagersville	33 21	4	4.5	9	4.5	10	1 00	3.9	2.6	0.3	10	$12.00 " "
Hamilton	15 00	4	3	6c. 1st 25 hr. 3c. next 75 hr.	0.2	20	1 00	2.1	1.4	0.2	25 & 10	$ 8.00 " "
												$13.75 250 w. "
												$50.00 500 w. Nitrogen filled on standards
Hespeler	23 00	4	4.5	9	4.5	10	1 00	3	2	0.25	10	$12.00 100 w. Incandescent
Ingersoll	26 50	4	4	8	4	10	1 00	2.8	1.8	0.2	10	$12.00 80 w. "
												$12.50 100 w. "
London	23 00	4	3	6c. 1st 30 hr. 3c. next 70 hr.	0.6	25	1 00	2.5	1.7	0.2	10	$11.00 75 w. "
												$12.85 100 w. "
Midland	19 45	4	3	6	3	10	1 00	1.7	1.1	0.15	10	$13.50 " "
												$35.00 500 w. arc.
Milton	28 00	4	4	8	4	10	1 00	3	2	0.25	10	$ 9.00 100 w. "
Mimico	30 00	4	4	8	4	10	1 00	3.3	2.2	0.3	10	$11.00 " "
Mitchell	37 00	4	4	8	4	10	1 00	4.2	2.8	0.3	10	$12.00 " "
New Hamburg	32 00	4	4	8	4	10	1 00	3.8	2.5	0.3	10	$ 9.00 " "
New Toronto	28 00	4	4	8	4	10	1 00	3	2	0.25	10	$12.00 " "
Norwich	32 00	4	4	8	4	15	1 00	3	2	0.25	10	$12.00 " "
												$ 9.00 60 w. "
												$10.00 100 w. "
Ottawa	15 00	4	2.5	6	2.5	20	1 00	1.8	1.2	0.15	20	$45.00 Arc
Paris	21 00	4	3.5	7	3.5	10	1 00	2.5	1.7	0.2	10	$11.00 100 c.p. "
Penetang	26 50	4	3	6	3	10	1 00	1.7	1.1	0.15	10	$12.00 100 w. "
Peterboro	18 00	3	2.5	6	2.5	10	1 00	1.3	0.8	0.1	10 & 10	$12.00 16 and 32 c.p. "
												$50.00 500 w. arc.
												$50.50 Magnetite arc.
Petersburg and St. Agatha	Served by Baden	4	6	12	6	10	1 00	5.1	3.4	0.4	10	
Port Arthur	22 25	4	2.5	6	2.5	10	1 00	2	1.3	0.15	10	$ 5.00 60 w. "
												$ 8.30 100 w. "
Port Credit	28 00	4	4	8	4	10	1 00	3	2	0.25	10	$11.00 " "
Port Dalhousie	21 50	4	3	6	3	10	1 00	2.1	1.4	0.2	10	
Port Robinson	Served by Welland	4	3	6	3	10	1 00	1.8	1.2	0.15	10	
Port Stanley	42 70	4	4.5	9	4.5	10	1 00	5	3	0.4	10	$16.00 " "
Prescott	34 05	4	4	8	4	10	1 00	2.8	1.8	0.2	10	
Preston	21 00	4	4	8	4	20	1 00	2.3	1.6	0.2	20	$11.00 60 w. "
												$12.00 100 w. "
Rockwood	38 00	4	5.5	11	5.5	10	1 00	4.7	3.1	0.4	10	$13.00 " "
Seaforth	40 00	4	4	8	4	10	1 00	4.3	2.9	0.4	10	$15.00 " "
												$12.00 75 w. "
Sebringville	Served by Stratford	4	5	10	5	10	1 00	5.4	5.6	0.4	10	
St. Catharines	14 00	4	3	6c. 1st 30 hr. 3c. next 70 hr.	0.6	25	1 00	1.8	1.2	0.15	25	$ 8.00 100 w. "
St. Mary's	29 50	4	5	10	5	10	1 00	3.6	2.4	0.3	10	$13.00 100 w. "
												$25.00 250 w. Nitrogen
												$65.00 Arc
St. Thomas	28 00	4	2.5	6	2.5	20	1 00	2.5	1.7	0.2	10	$10.00 75 w. "
												$53.00 Arc
Stayner	43 57	4	4.5	9	4.5	10	1 00	4.2	2.8	0.3	10	$12.00 100 w. "
												$ 9.00 60 w. "
Stratford	30 00	4	4	8	4	20	1 00	3.6	2.4	0.3	10	
Sunderland	Note A	3	6	12	6	10	1 00	4.5	3.0	0.4	10	
Thamesford	45 00	4	6	12	6	10	1 00	5.6	3.8	0.5	10	$14.00 100 w. "
Thorndale	45 00	4	6	12	6	10	1 00	5.6	3.8	0.5	10	$14.00 " "
Tillsonburg	32 00	4	4	8	4	10	1 00	3.8	2.5	0.3	10	$11.00 " "
Toronto	15 00	4	3	8	3	10 to 20	1.35 1st 10 h.p. 1.00 all add'l	1.5	1	0.5	10 to 20	$ 9.00 " "
Walkerville	38 00	3	4	8c. 1st 30 hr. 4c. next 70 hr.	0.8	10	1 00	3.6	2.4	0.3	10	$10.50 60 w. "
Waterdown	26 00	4	5	10	5	10	1 00	3.5	2.4	0.3	10	$10.00 100 w. "
Waterloo	22 50	4	4	8	4	25	1 00	2.5	1.7	0.2	25	$ 8.75 100 w. mult. or 75 w. series Incandescent
												$10.00 100 w. series Incan.
												$10.50 150 w. mult. "
												$25.00 3 lt. standard, 1-100 w. and 2-60 w.
												$40.00 5 lt. standard, 1-100 w. and 4-60 w.
Welland	14 00	4	3	6	3	25	1 00	1.8	1.2	0.15	25	$18.00 250 w. Incandescent
												$ 9.00 100 w. "
West Hamilton	Served by Dundas	4	4	8	4	10	1 00	2.8	1.8	0.2	10	$14.00 " "
Weston	30 00	4	3	6	3	10	1 00	3	2	0.2	10	$12.00 " "
												$40.00 5 lt. stand., 4-100 w.
Winchester	43 77	4	4	8	4	10	1 00	3.1	2.0	0.25	10	$15.00 100 w. Incandescent
Windsor	38 00	3	4	8c. 1st 30 hr. 4c. next 70 hr.	0.8	10	1 00	3.6	2.4	0.3	10	
Woodbridge	33 83	4	4.5	9	4.5	10	1 00	3.9	2.6	0.3	10	
Woodstock	23 00	4	3	6	3	20	1 00	2	1.5	0.2	10	$25.00 250 w.
												$10.00 60 or 100 w.
Woodville	Note A	3	6	12	6	10	1 00	4.5	3.0	0.3	10	

Note A.—Service commenced during October, 1914.

Fig. 4. Ontario Hydro-Electric Power Commission, Power Rates, 1914.

The assets of the 69 municipalities in the systems up to December 31, 1914, were:

Lands and buildings	$ 791,732.20
Sub-station equipment	1,476,087.84
Distribution system, overhead	3,422,763.93
" " underground	807,153.53
Line transformers	787,613.52
Meters	1,172,475.11
Street lighting equipment, regular	1,071,255.37
" " " ornamental	270,386.55
Miscellaneous equipment and construction equipment	2,062,035.90
Steam or hydraulic plant	420,108.33
Old plant	478,881.56
Other miscellaneous assets	140,631.56
	$12,901,125.40

The table in Figure 4 shows municipal power rates for the year 1914 and covers cost to municipality per horsepower per year, power rates, domestic and commercial lighting and street lighting.

The rates at which the Commission sells to the municipality consider the distance from the Niagara or other generating source, cost of 110,000-volt and 13,000-volt local systems of supply, and the amount and load factor of power consumed. The Commission recommends the rates to be applied by the municipality for the consumers, and the municipalities, in general, adopt them. The rates for sale are now on a uniform basis and involve a service charge, which, in case of power, consists of a flat rate of $1.00, a special rate of approximately 12 times the standard rate for the first fifty hours of service each month, and of approximately 8 times the standard rate for the second fifty hours of service each month, the balance being at a standard rate per kilowatt hour. Domestic lighting rates bear a service charge of 3 or 4 cents per 100 square feet of floor area per month, and a standard rate of from 2.5 to 7 cents per kilowatt hour. Commercial lighting rates, in general, have a service charge involving the first 30 hours per month, and a standard rate for all additional time. Discounts for prompt payment apply throughout. The average rate paid for domestic

service is calculated to be 3.7 cents per kilowatt hour. Street lighting rates are, in general, flat rates applied to the particular type of street lighting units used by each respective municipality.

Power is brought from the Ontario Power Company on a 20-minute peak basis and is taken by the municipalities in a similar manner. The oversale of power, by the Commission, resulting from the time distribution of the respective superimposing pay peaks is quite an appreciable amount, and is in excess of the line and transformer losses, etc., which has justified the Commission in excluding loss costs from power rates; the flattening of the load curve, however, over the 24-hour period is gradually reducing the oversale.

As examples of the nature of daily load curves, typical summer and winter loads are shown in Figure 5. The individual loads are typical commercial, domestic and municipal loads and do not include any electrochemical or electrometallurgical loads. The municipal nature of practically all the loads concerned has shown the possibilities of flattening the 24-hour load curve. Pumping to reservoirs is undertaken on off-peak hours and is responsible, to a great extent, for the magnitude of night loads, as shown; and again, the pumping equipment usually includes synchronous motors, which, when necessarily operating as day loads, have a power-factor corrective value favourably comparative with their energy consumption. The load factor on the Niagara system is said to average about 80%.

The Ontario Power Company, at Niagara Falls, the source of power for the Niagara system, has an installed capacity of 160,000 horsepower in 14 generator units, and, in addition to the Hydro-Electric Commission of Ontario, has a very large market established in New York State, through the Niagara, Lockport and Ontario Power Company, and a considerable market in Ontario adjacent to the generating plant*.

The big Chute generating station, owned by the Hydro-Electric Commission and which serves the Severn system, is shown in plan in Figure 6.

Previous to the use of the Commission's power, the industrial market for steam-generating central electric stations was

* See Publications issued by the Ontario Power Company.

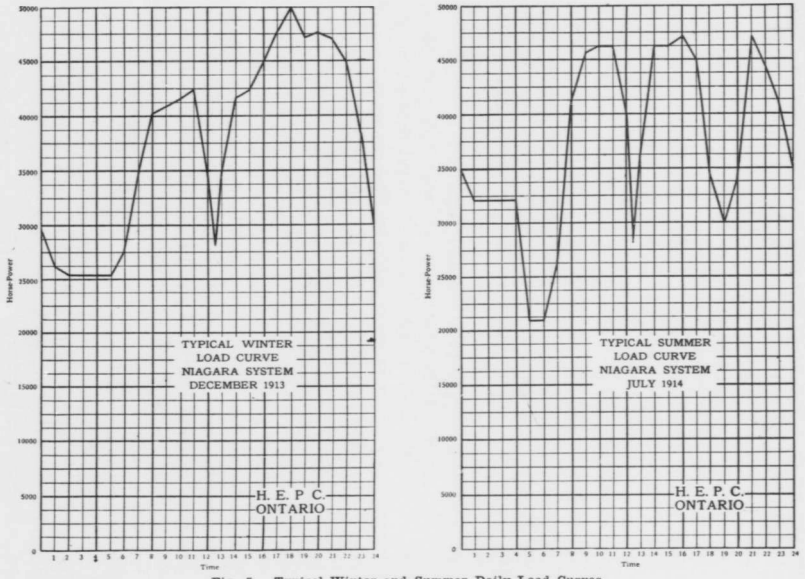


Fig. 5. Typical Winter and Summer Daily Load Curves.

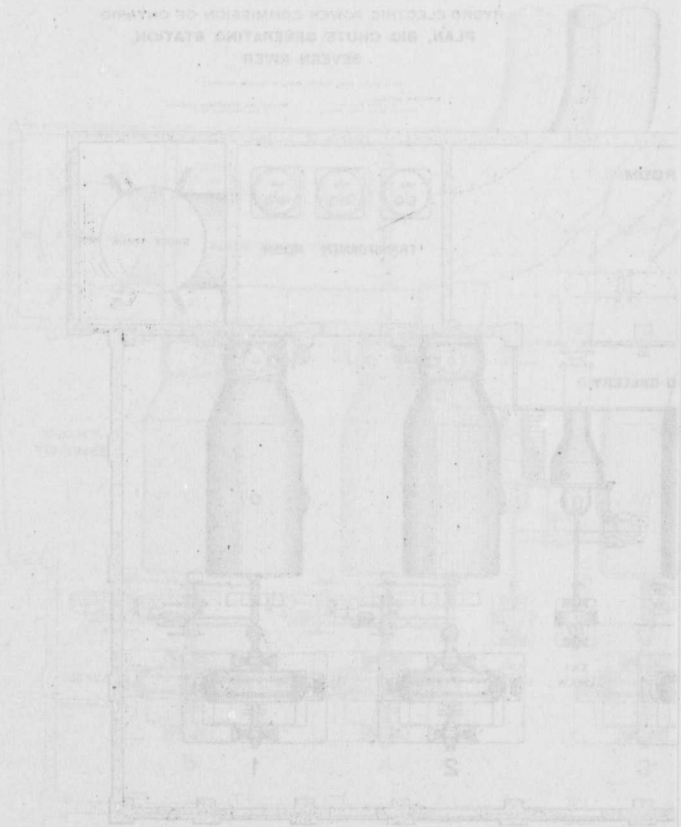
limited, as the rate for power from the water power companies bore a recognizable relation to cost of power from isolated steam power-plants of corresponding capacities. The municipalities served by the Commission represent the major portion of the industrial centres of the Province, and amongst these, considerable rivalry has existed as to their industrial growth.

The practice of granting of municipal bonuses—of fixed taxation or water rates, debenture or bond guarantees, free sites, money grants, etc., greatly in vogue several years ago—is gradually disappearing, and aside from these inducements the individuality of the community was chiefly based upon transportation facilities, labor economies and cost of power. The elimination of cost of power as a selective factor, by the application of comparatively similar rates over a wide area, and the discouragement of bonusing has led to a more fruitful and substantial competition among the municipalities; the active improvement of all public services directly influencing the conditions of transportation and labor.

The powers of the Commission are very wide and extend far beyond the distribution of power. Rates throughout the Province may be investigated and controlled on application of any municipality; existing systems and undeveloped sites may be bought or expropriated; systems, in part or complete, may be designed, financed and constructed; rivers may be improved for storage purposes, and so forth. These are particularly mentioned, as they have been included in the actual work of the Commission to date. Further, by its administration, conjointly with the Provincial Department of Lands, Forests and Mines, of all water-power matters under Provincial jurisdiction—that is, excluding only such affairs as arise under the Dominion Government's rights on navigable streams—the interests of the municipalities are fully guarded.

The existing competitors, in such portions of the Province as are not directly served by the Commission's system, either by influence of the Commission or by respect for its powers sell at quite comparable rates.

As examples of two conditions of development quite different in aspect to the Hydro-Electric Commission, but which, also, are well worth study, reference is made herein to the



DEPARTMENT OF THE INTERIOR, CANADA.
DOMINION WATER POWER BRANCH.

HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO
PLAN, BIG CHUTE GENERATING STATION,
SEVERN RIVER

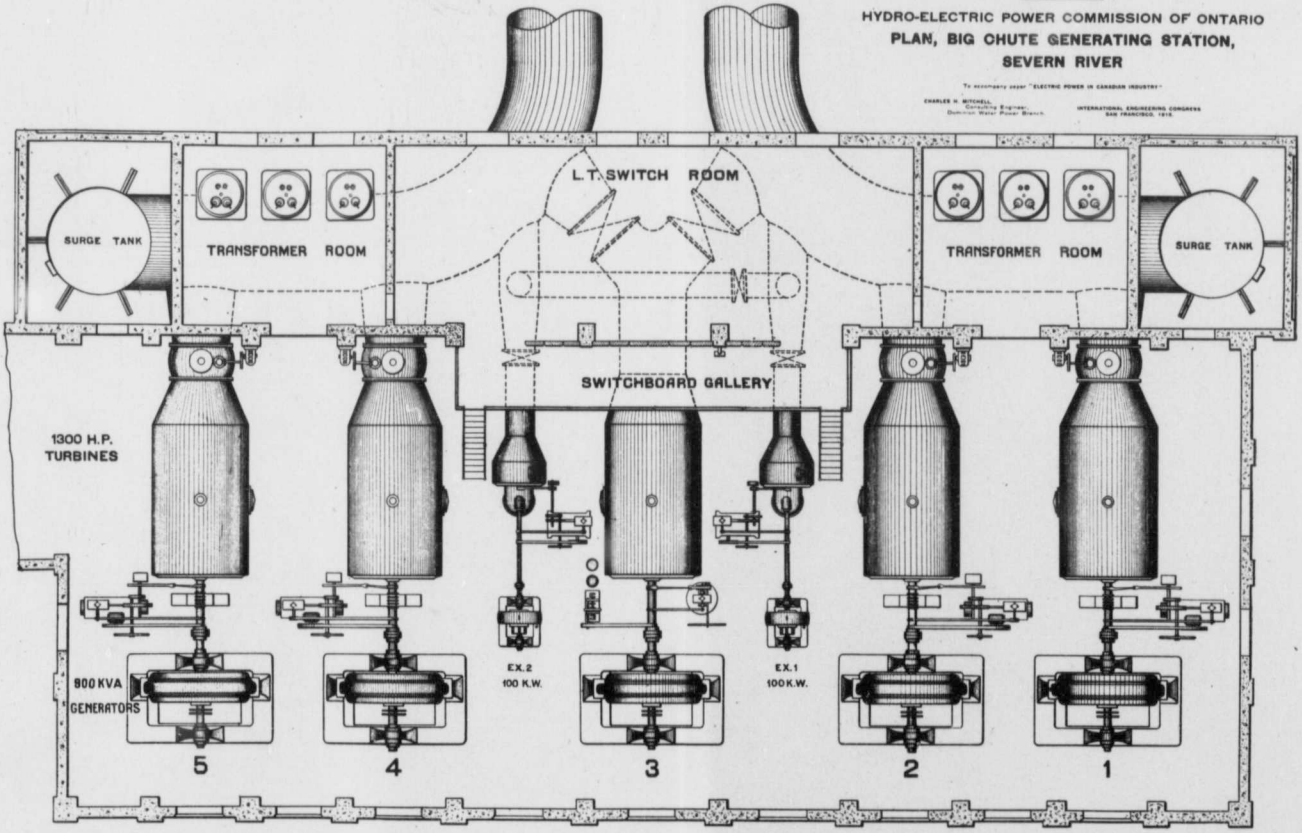
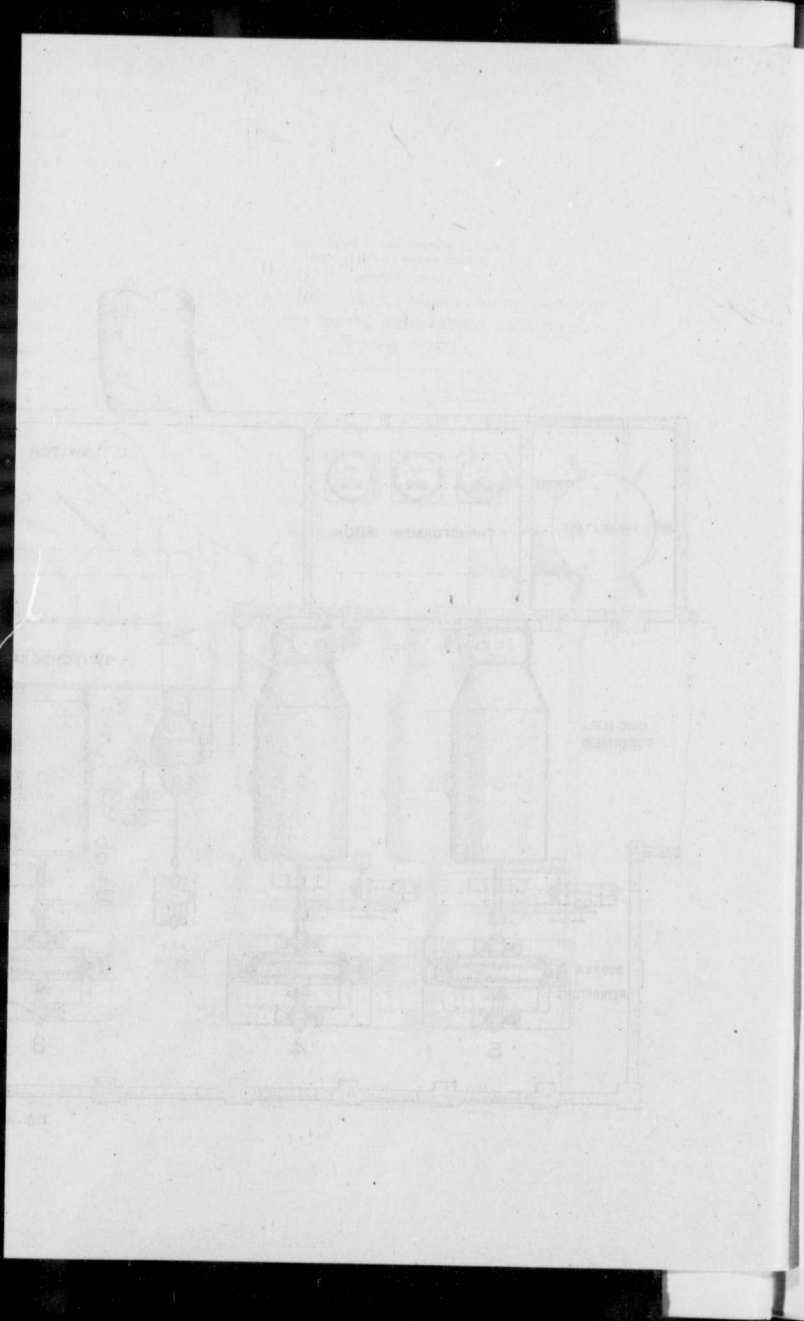
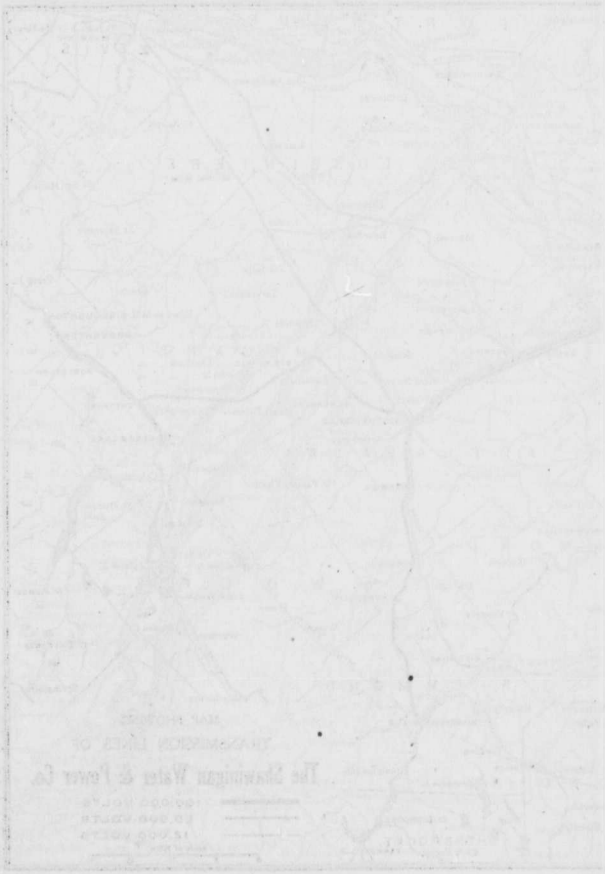


Fig. 6.





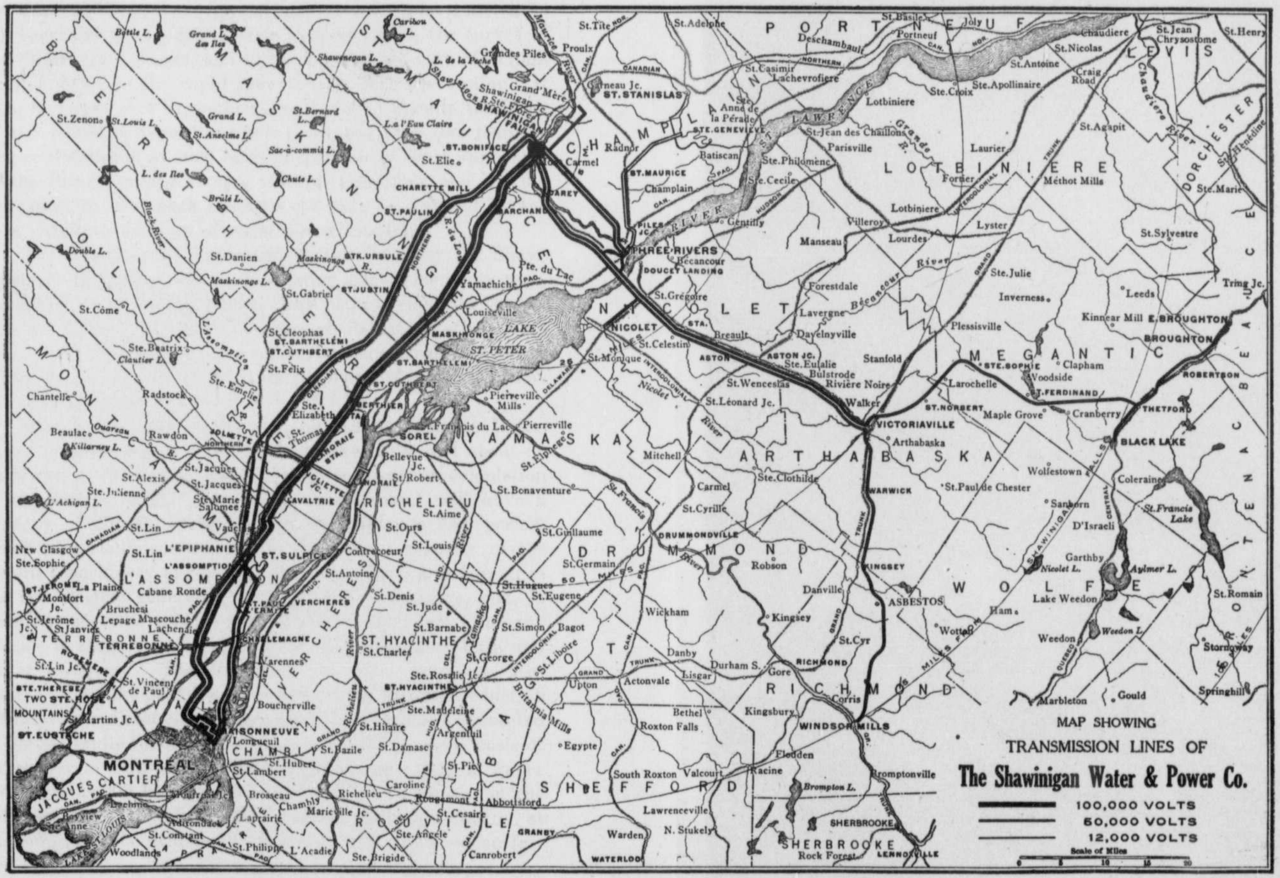
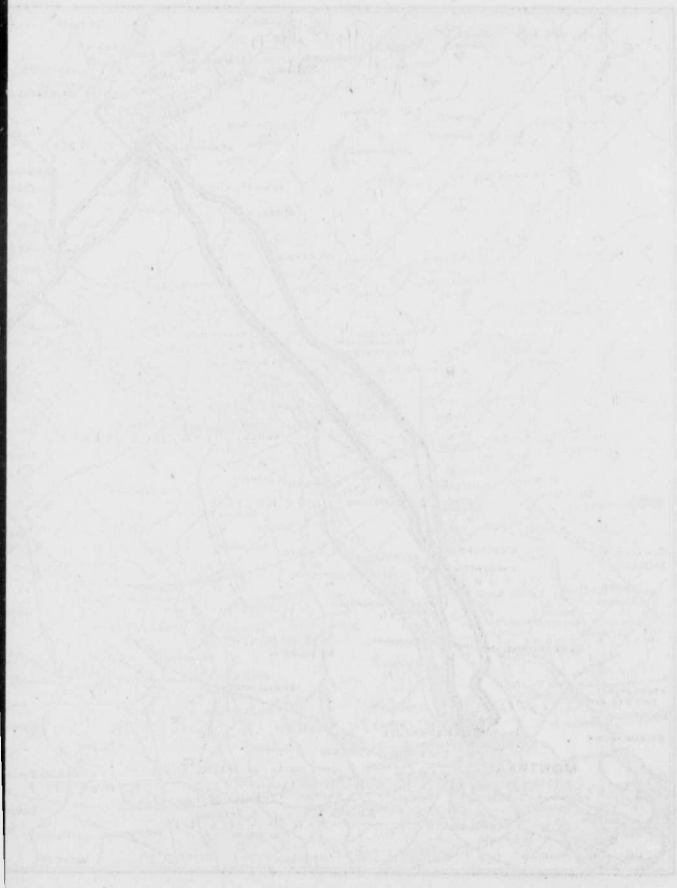

MAP SHOWING
TRANSMISSION LINES OF
The Shawinigan Water & Power Co.
100,000 VOLTS
60,000 VOLTS
12,000 VOLTS
Scale of Miles
PORTNEUF
CHAMPLAIN
LOTBINIERE
DORCHESTER
LEVIS
NICOLET
MEGANTIC
ARTHABASKA
YAMASKA
RICHELIEU
DRUMMOND
WOLFE
RICHMOND
SHEFFORD
ROUVILLE
CHAMBLY
BAGOT
ST. HYACINTHE
VERCHERES
L'ASSOMPTION
TERREBONNE
LAVAL
JACQUES CARTIER
MONTREAL
MASKINONGE
ST. MAURICE
BERTHIER
JOLIETTE
MONTCALM
SHERBROOKE
THREE RIVERS
SHAWINIGAN FALLS
LAKE ST. PETER
VICTORIAVILLE
ST. LAWRENCE RIVER
Grand'Mère
Sorel
Joliette
Drummondville
Danville
Asbestos
Thetford
Black Lake
Windsor Mills
Lennoxville
Maisonneuve

Fig. 7.



Shawinigan system, in the Province of Quebec, and to the developed and undeveloped sites on the Winnipeg River, in the Province of Manitoba. Special attention must be directed to the curves of the Hydro-Electric Commission, to the curves of the Shawinigan system, and to the loads in the City of Winnipeg, as denoting the rapid growth in power consumption. It is to be found that throughout the whole of Canada the loads of the power systems have been increased in a like manner. The consideration of such rates of increase as being applicable to the future, creates a most striking condition, and the development to meet such demands can only be supplied by the most careful utilization of water power sources.

The Shawinigan Water and Power Company, at Shawinigan Falls, Quebec, has an interesting system for study as to industrial use of electric power. This plant is noted for several reasons: First, its magnitude; second, its extent of distribution; third, its creation of an industrial centre from the power standpoint alone; and fourth, its supplying of power for several electro-chemical plants.

Shawinigan Falls is situated on the St. Maurice River, about 20 miles north of the St. Lawrence River and about 80 miles east of Montreal. The St. Maurice River, on completion of the storage works now under construction,* will have a capacity of 204,000 horsepower at the minimum flow period, which practically corresponds to the present capacity of the installed machinery at Shawinigan Falls. The water is used in the two electric generating stations of the Company, and, in addition, water is sold to the Northern Aluminum Company for use in their turbines and to the Belgo-Canadian Pulp and Paper Company. The Northern Aluminum Company uses water to generate 33,000 horsepower for use in their reduction furnaces; the direct-current generators are installed connected to the hydraulic turbines, the water rates being on the basis of direct-current output. In the Belgo-Canadian Pulp & Paper Company, 14,000 horsepower is delivered by turbines on the pulp grinders. In addition, the Canadian Carbide Company, at Shawinigan Falls, utilizes 12,000 horsepower, and a cotton fac-

* See "Canadian Hydraulic Power Development", Mechanical Section, International Engineering Congress, 1915.

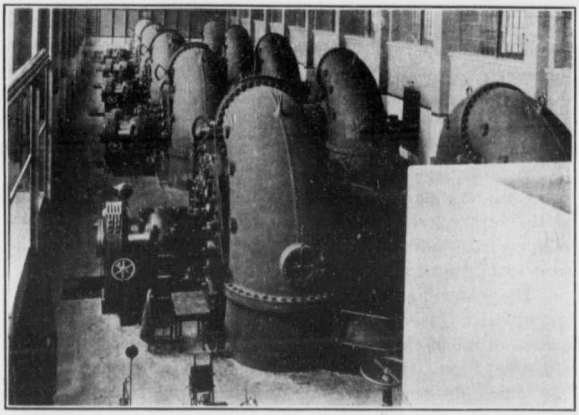


Fig. 8. Hydraulic Units, No. 2 Power Station, Shawinigan Falls, Quebec.

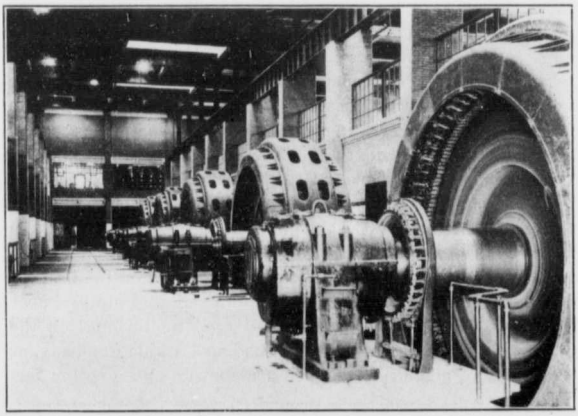


Fig. 9. Electrical Units, No. 2 Power Station, Shawinigan Falls, Quebec.

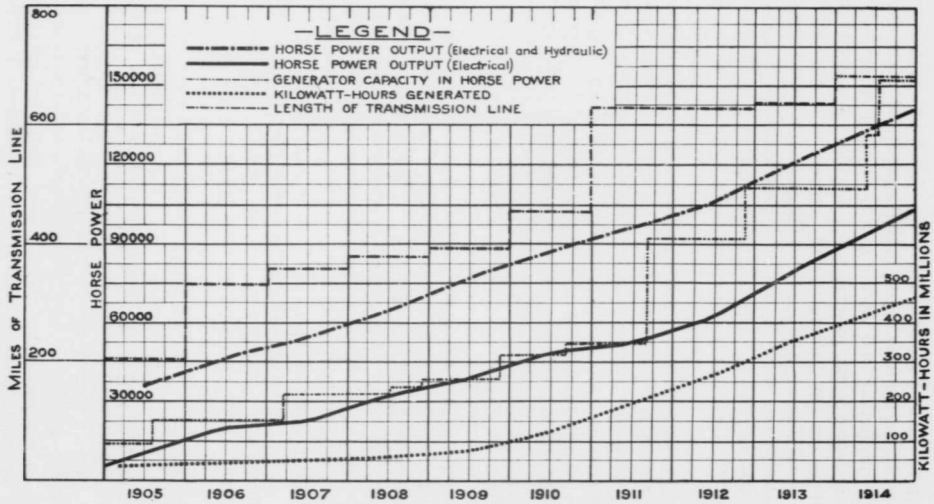


Fig. 10. Growth of Load and System, Shawinigan Water and Power Company, Shawinigan Falls, Quebec.

tory, 550 horsepower; so that, besides a miscellaneous local load, industries have been created, consuming nearly 60,000 horsepower, at a site where but a few years ago no community existed and transportation was entirely absent.

Figure 7 shows the large field which this Company serves with its 675 miles of high-voltage lines and 105,000 horsepower transmitted.

The Shawinigan Power Plants are two in number, aggregating approximately 150,000-horsepower capacity. No. 2 Plant* contains 5 units, each of 20,000-horsepower capacity. The hydraulic bay and electrical bay of No. 2 generating station are shown on Figures 8 and 9 respectively.

The greatest load of the power transmitted is at the City of Montreal, which is served with four direct transmission circuits, direct from Shawinigan Falls; this being but one source of the horsepower consumed in that city. A market for 6000 horsepower has been built up at the City of Three Rivers, on the St. Lawrence River, a location which affords excellent facilities for transcontinental railway service and lake and ocean transportation. The asbestos district in southern Quebec consumes several thousand horsepower, and the many municipalities in the various districts are also supplied.

The growth of power load and equipment of the Shawinigan Company affords an excellent example of the industrial growth of the country. Figure 10 shows the comparative values of generating capacity, length of transmission lines, horsepower output and kilowatt hours generated. Optimism as to the future of the industrial situation is indicated by the excess of generator capacity over the present load.

On the Winnipeg River, in Manitoba, two generating plants have been built to deliver power to the City of Winnipeg. The city itself has constructed a generating plant and transmission system, having a present capacity of 51,500 horsepower, at Point du Bois, 77 miles distant from Winnipeg, and the Winnipeg Street Railway Company has a plant of 28,200-horsepower capacity on the Pinawa Channel, near Lac du Bonnet. These plants have developed a large market in what is at present a non-manufacturing city (for other than local needs) of 210,000

* See "Electrical World", Vol. 59, p. 953.

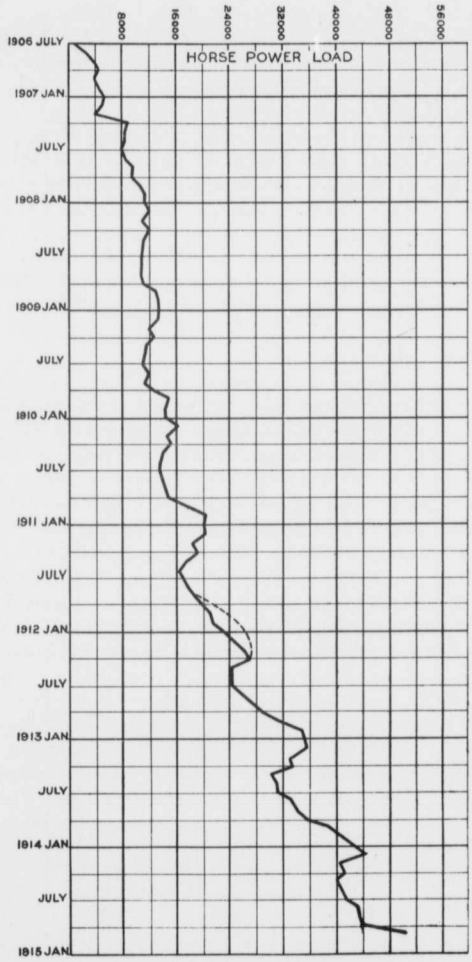


Fig. 11. Growth of Power Loads in the City of Winnipeg.

population. The magnitude and character of these loads may be realized from the curves shown in Figure 11, which shows the curve of growth of the combined loads from year to year.

On the Winnipeg River, within easy reach of three transcontinental railways and at the gateway to the agricultural West, is a series of power sites, which are being the subject of considerable study on the part of the Dominion Government as to the storage facilities and the economic possibilities in the development and market. Storage regulation is feasible to increase the minimum flow from 12,000 second-feet to 20,000 second-feet, which will result in several sites being well adapted for power purposes, the aggregate capacity of electrical power being 262,000 horsepower, in addition to 76,800 horsepower available at Point du Bois and 28,200 horsepower at the Winnipeg Electric Railway Company's site.

Western Canada is the granary for a world-wide market and the artificial replenishing of the notably fertile prairie soil is a problem for the future, to be solved only by abundant water supply. The communities, rapidly increasing in number and population, and the manufacturing now commencing for the local market will demand enormous quantities of power. The water powers must be developed for this purpose.

As companion curves to those included herein which show the growths in the loads of the Shawinigan Power Company, the Hydro-Electric Commission and the plants supplying the City of Winnipeg, the curves of the Calgary Power Company (Figure 12) and the British Columbia Electric Railway Company (Figure 13) are shown herewith. The latter companies serve the cities of Calgary and Vancouver respectively, the British Columbia Electric Railway Company representing but one of the hydro-electric systems supplying Vancouver.

In these curves, the record of the principal cities across a continent, it is remarkable that the growth of each has proceeded under such paralleling circumstances; truly this is the electrical age.

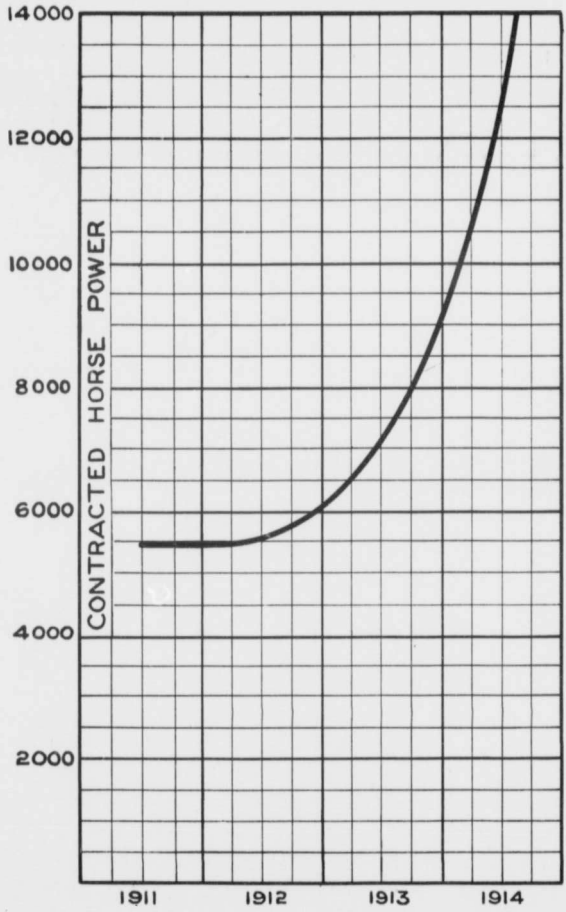


Fig 12. Growth of Power Loads, Calgary Power Company, Calgary, Alberta.

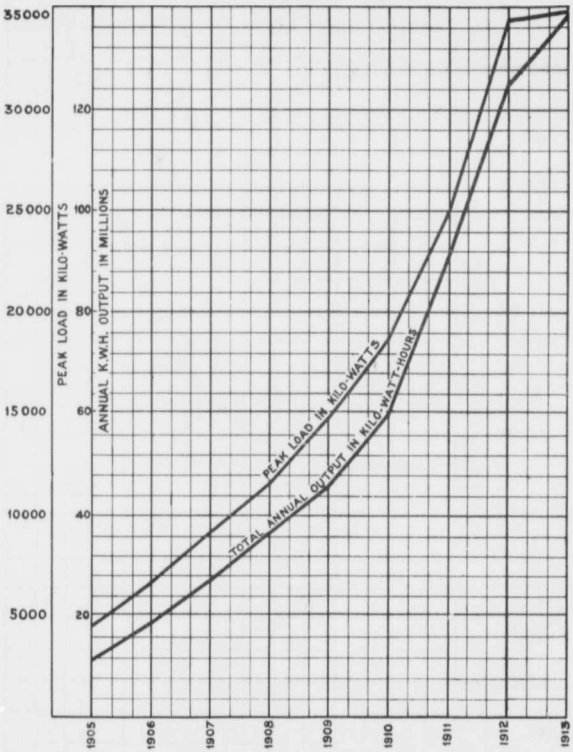


Fig. 13. Growth of Power Loads, British Columbia Elec. Rwy. Co., Vancouver, B. C.