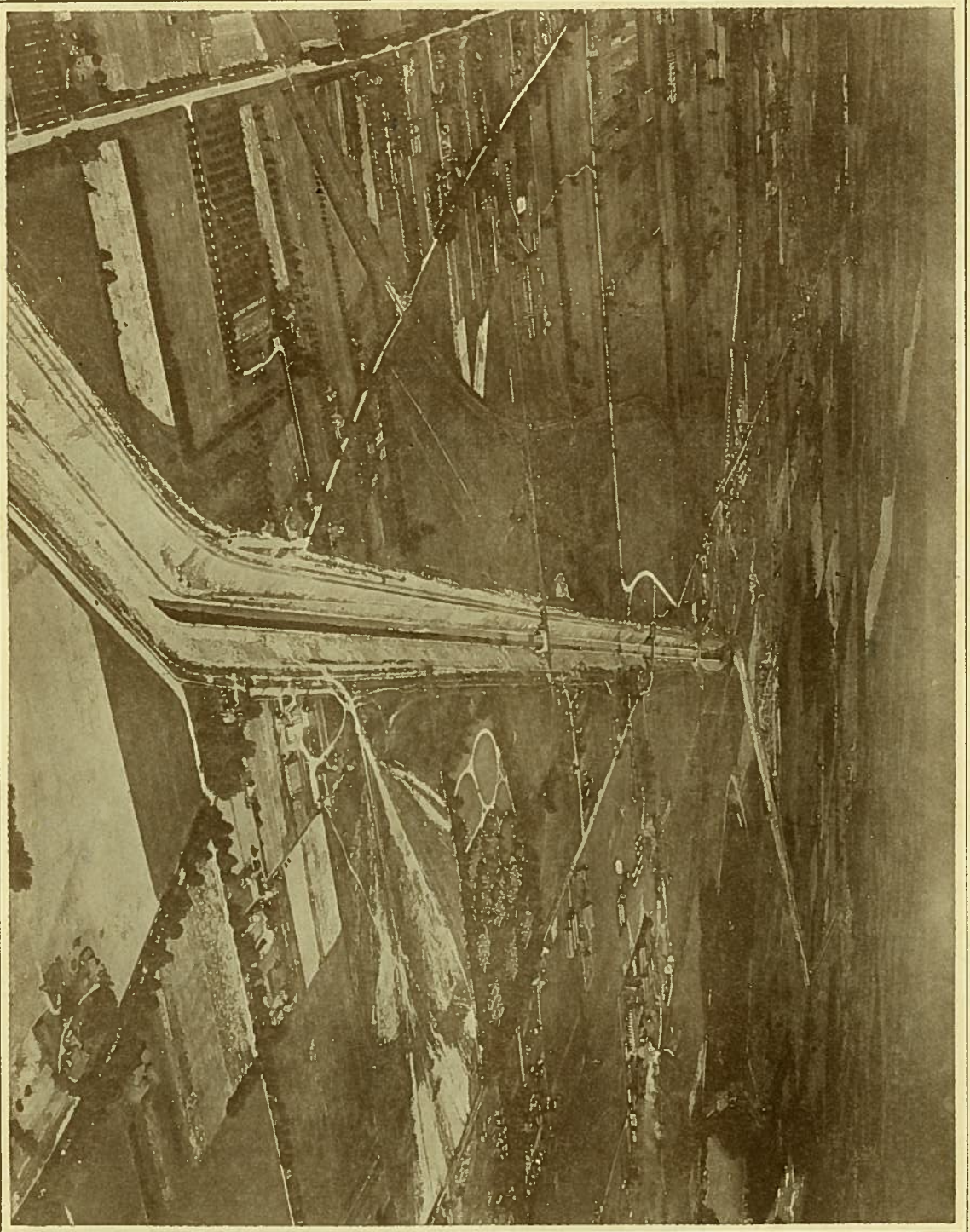


Official Opening  
OF THE  
Queenston-Chippawa Power  
Development

ON THE  
Twenty-eighth Day of December  
MCMXXI



THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO



QUEENSTON—CHIPPAWA DEVELOPMENT.  
FRONTISPIECE—Portion of completed Canal as seen from the air, showing approach to Whirlpool Gully and continuation to Forebay at top of picture.

Official Opening  
OF THE  
Queenston-Chippawa Power  
Development

OWNED BY THE  
Municipalities of the Niagara District  
AND OPERATED ON THEIR BEHALF BY THE  
Hydro-Electric Power Commission of Ontario



COMMISSIONERS

*Col. Sir Adam Beck, Kt., LL. D., Chairman*  
*Lt. Col. Hon. D. Carmichael, D. S. O., M. C.*  
*Fred R. Miller, Esq.*



THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO  
TWENTY-EIGHTH OF DECEMBER  
1921

# The Queenston-Chippawa Power Development



THE consummation of a great public undertaking, such as the Queenston-Chippawa Power Development, is assuredly an event of singular importance, especially to those who will participate most directly in its benefits.

The 28th of December, 1921, will doubtless be a memorable date in the annals of the Province of Ontario, because it marks the attainment of an object long desired. After years of effort

by municipalities, working through the agency of their Hydro-Electric Power Commission, there has now been made available at cost an adequate supply of electrical energy for the service of the public, and from the Queenston-Chippawa Development the municipalities of Ontario will obtain electrical power at rates unparalleled in any similar area in the world.

It is fitting, therefore, on this occasion of the first operation of the power equipment of the Queenston-Chippawa Development, to review some



QUEENSTON—CHIPPAWA DEVELOPMENT

Fig. 2. Bird's eye view showing intake from Niagara River above the Falls with Welland River section in foreground leading water to Control Works at upper end of Canal which stretches to Power House at Queenston where water is returned to the lower Niagara River.

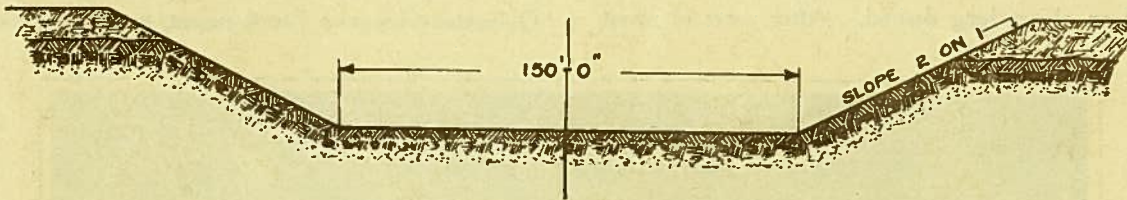
of the prominent circumstances incident to the inception and execution of the project.

Although as early as 1900, a few prominent business men in south-western Ontario commenced agitation looking towards the securing of power from Niagara Falls in order to meet the increasing

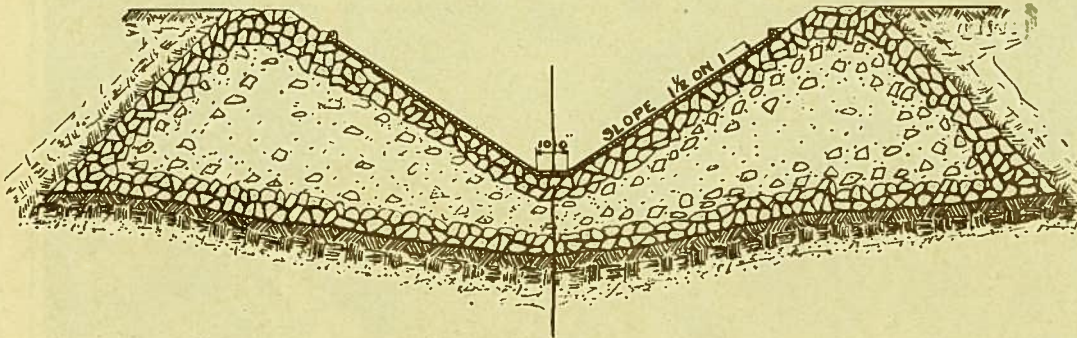
demands for cheaper power of industrial centres at that time chiefly dependent for their power upon imported coal from the United States, it was not until 1903 that the Government of the Province of Ontario authorized the appointment, by the various interested municipalities, of a Commission

## QUEENSTON-CHIPPAWA DEVELOPMENT

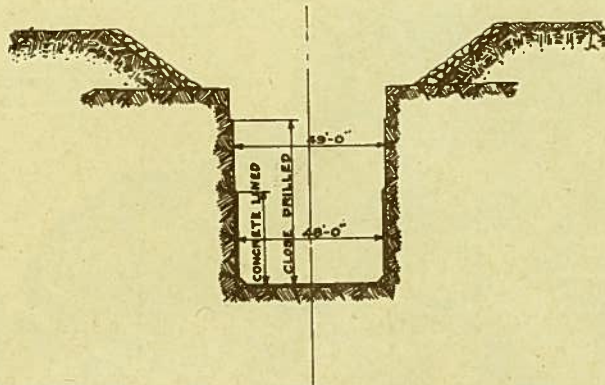
### Typical Cross-Sections of Power Canal



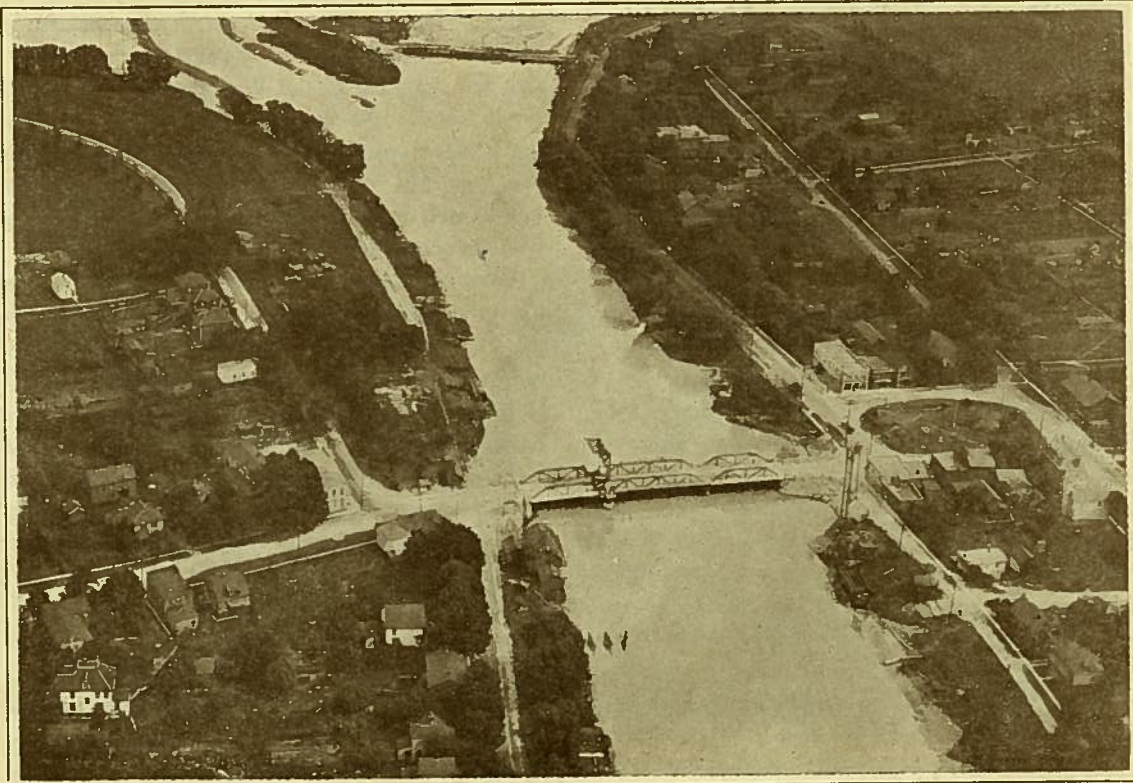
Welland River after enlargement and portion of canal excavated entirely in earth.



Canal crossing the Whirlpool Gully on Rock-fill.

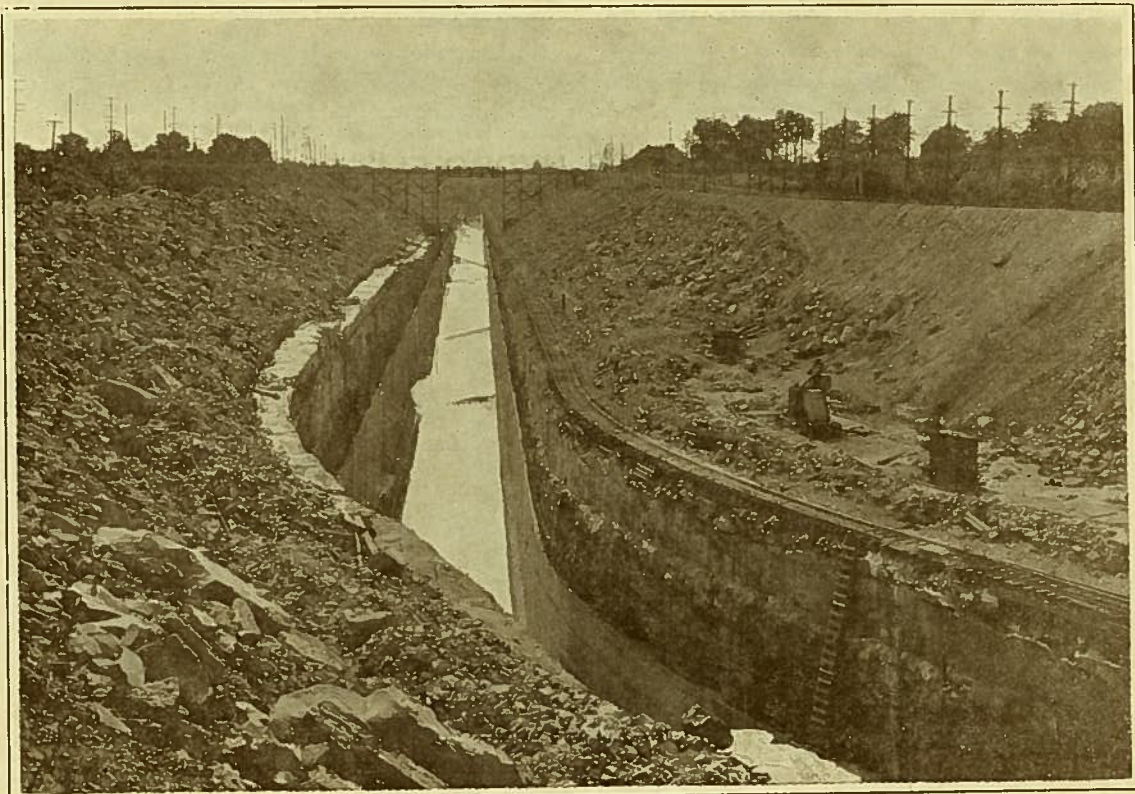


Canal as excavated in Solid Rock showing Concrete Lining at bottom and Earth Slopes above.



QUEENSTON—CHIPPAWA DEVELOPMENT

Fig. 4. Bird's-eye view of Entrance to Canal showing mouth of Welland River with location of Intake at top of picture. Water now flows into the mouth of Welland River, thus reversing the original direction of flow.



QUEENSTON—CHIPPAWA DEVELOPMENT

Fig. 5. Typical section of completed canal through deep rock cut, showing smooth concrete lining in lower portion.

to investigate and report upon the proposal that Niagara Power be supplied for municipal and industrial purposes. The report being duly prepared showed that the proposition promised success. Consequently, in 1906, the Provincial Government created the Hydro-Electric Power Commission of Ontario to act on behalf of the Province as Trustee for municipalities, and in due course legislation was extended empowering the Commission to proceed.

When the Hydro-Electric Power Commission began marketing power to meet the growing municipal and industrial needs of south-western Ontario, the contract it made for the delivery of 100,000 horsepower was referred to as an evidence of ill-advised procedure, but within five years the whole 100,000 horsepower had been marketed. As additional power was provided there were always those—and they were not without influence—who proclaimed that the limits of sound judgment had been exceeded. When the Commission found it desirable to purchase the Ontario Power Company's Niagara Plant and the Central Ontario Water Power System at an outlay involving about thirty-eight million dollars, the cry was raised that such expenditure was improvident and could never be justified. It was challenged, how could such large quantities of power be marketed in the districts available? In 1914, just prior to the War, it was contended that the Commission would be unable, within a reasonable period, to market its unsold power. The vital part which this power subsequently played in the

War does not need to be enlarged upon at this time. After the War, however, it was confidently asserted by parties whose opinion carried weight, that the dropping of the War power loads would surely cripple the operations of the Commission, but it soon transpired that all these dropped loads were quickly re-absorbed and the Commission found itself again wrestling with problems arising from an acute shortage of electrical energy.

Notwithstanding the fact that opposition of this kind was being encountered, the Commission, basing its outlook upon its knowledge of underlying governing factors, felt it necessary as early as 1913 to provide for still larger power demands by preparing plans for a new development at Niagara Falls. These provisions have since taken the form of the Queenston-Chippawa power development, which now commences to supply power and is designed to furnish, ultimately, 550,000 horsepower. This output the Commission expects to see absorbed as it becomes available for commercial use.

#### GROWTH OF COMMISSION'S MARKETS

The growth of the operations of the Hydro-Electric Power Commission has been remarkable. From supplying twelve municipalities in 1910 from a single transmission system, its operations have expanded until now in 1921, from eleven distinct systems, the Commission is supplying under contract 280 municipalities and, in addition, numerous large corporations.

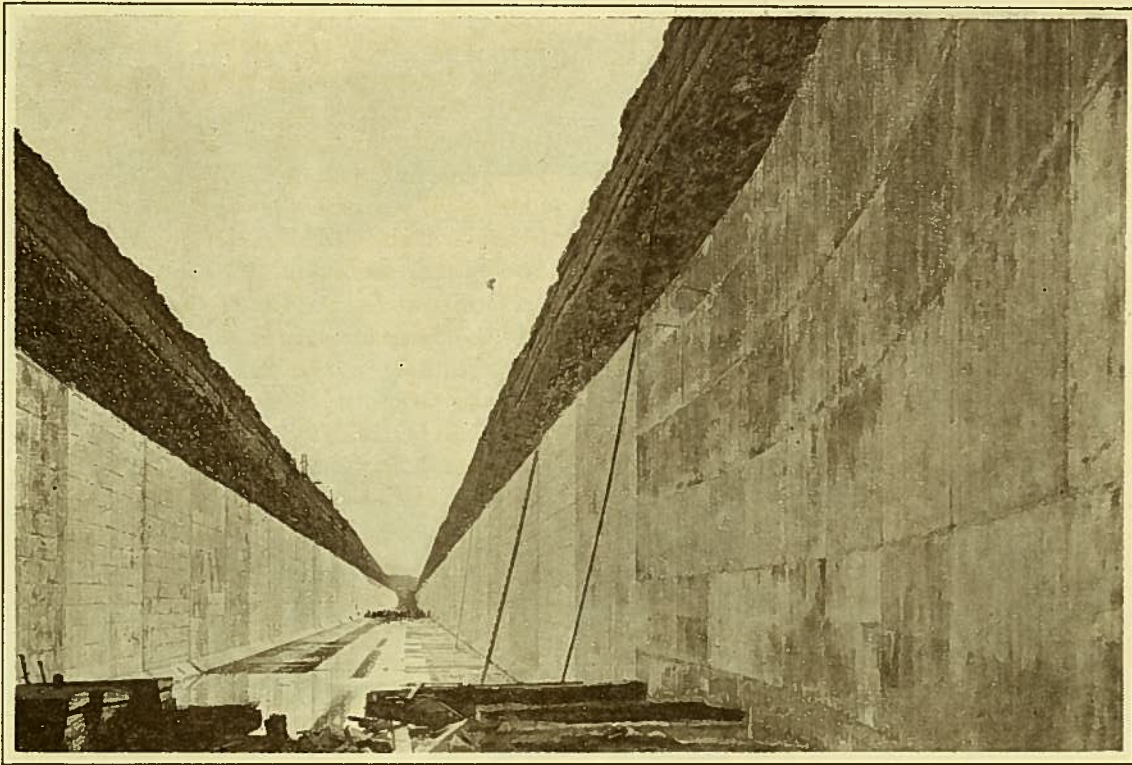
The following table indicates the growth in demand for hydro-electrical energy on the Commission's Systems:

### GROWTH IN DEMAND FOR HYDRO-ELECTRIC ENERGY (Hydro-Electric Power Commission of Ontario)

	NUMBER OF CUSTOMERS			TOTAL LOAD FOR OCTOBER	
	Urban Municipalities	Townships	Total Consumers	Ontario only horsepower	Ontario plus exported power horsepower
1910 .....	10			750	
1911 .....	26			15,214	
1912 .....	36		34,967	31,019	
1913 .....	51	7	65,689	45,502	
1914 .....	82	12	96,844	76,977	
1915* .....	112	18	120,828	103,959	
1916 .....	166	25	148,732	167,661	
1917† .....	179	34	170,916	266,214	333,399
1918 .....	193	41	183,987	253,562	316,592
1919 .....	208	42	216,086	262,281	328,175
1920 .....	217	43	244,388	283,372	355,798
1921 .....	236	44	265,000	305,247	375,010

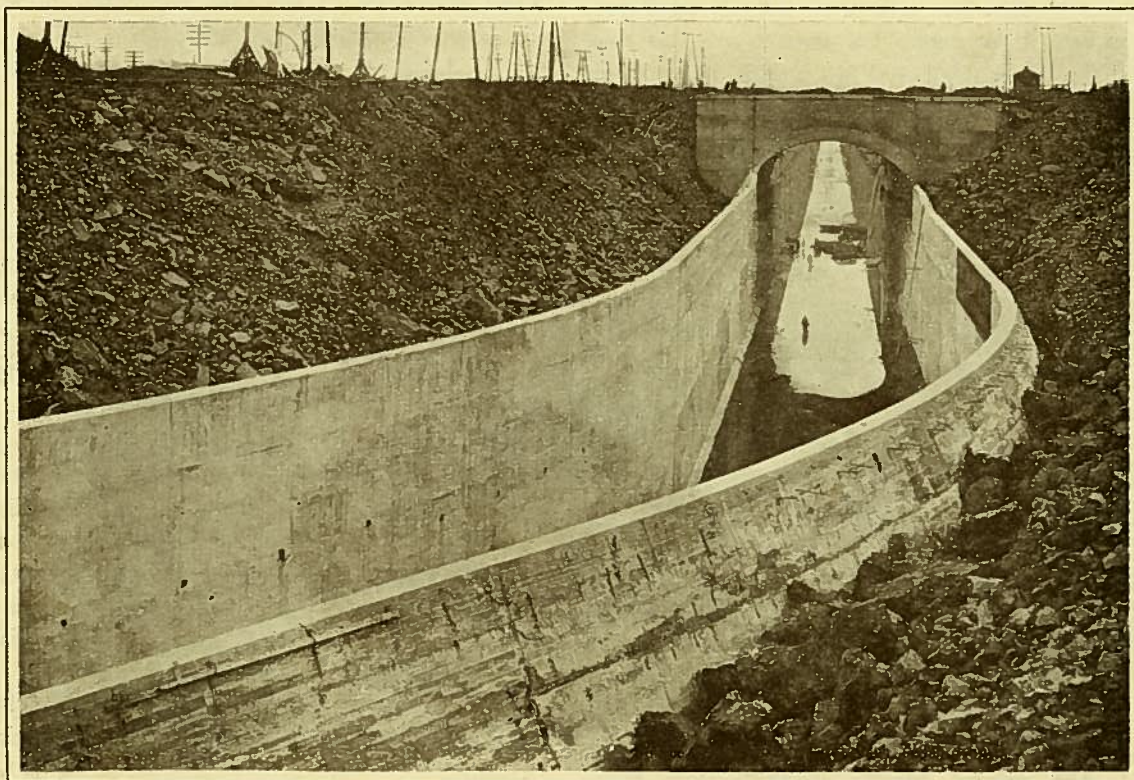
\* Central Ontario System purchased by Provincial Government and operated by the Hydro-Electric Power Commission.

† Ontario Power Company taken over by Hydro-Electric Power Commission.



QUEENSTON—CHIPPAWA DEVELOPMENT

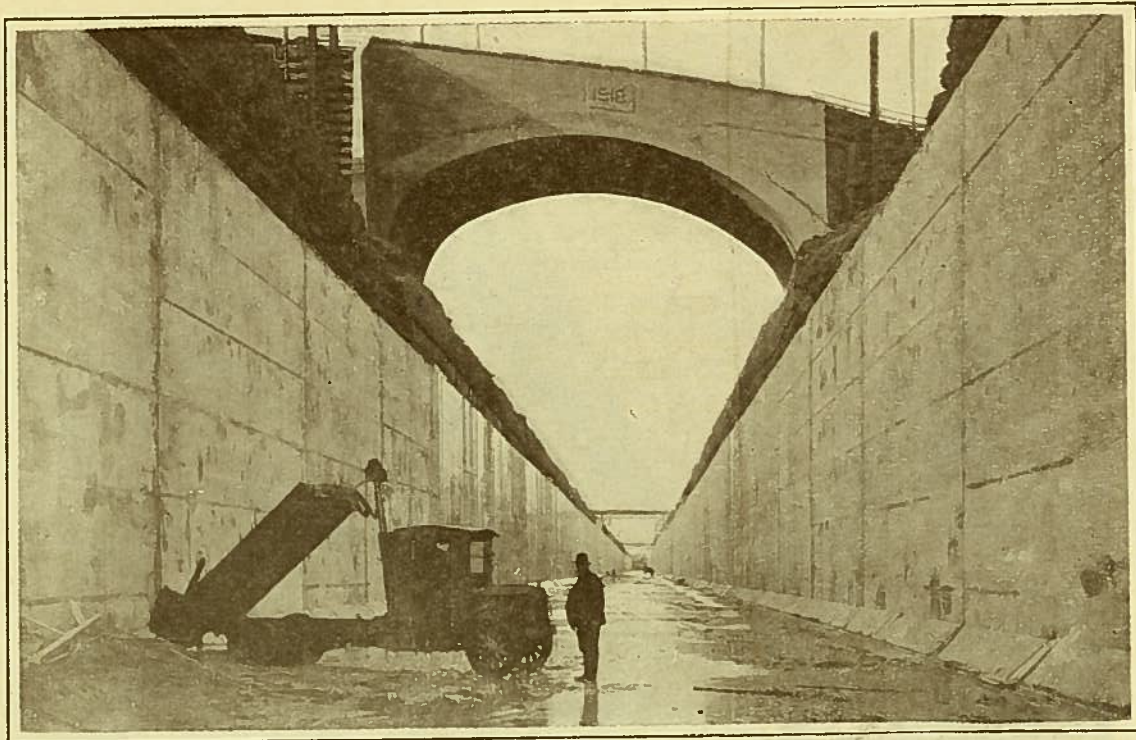
Fig. 6. Looking up a portion of the canal, with Concrete Lining completed. Note group of men in distance.



QUEENSTON—CHIPPAWA DEVELOPMENT

Fig. 7 Curve on canal showing Retaining Walls above concrete lining where natural rock surface lies below water level.





QUEENSTON—CHIPPAWA DEVELOPMENT

Fig. 8 Completed Rock Section of Canal as seen from the bottom, with Concrete Lining and showing Niagara, St. Catharines & Toronto Railway Bridge.

#### USE OF ELECTRICITY RAPIDLY INCREASING

It is only a few years since electricity was a luxury within the reach of a relatively small proportion of the public, but since its cost has been reduced from about 10 or 12 cents per kilowatt hour to about 2 or 3 cents per kilowatt-hour, electricity has become a common commodity of the people. Upon the part of the general public there is a greatly increased demand for electrical energy. Electrical devices for domestic service, which even a few years ago were a novelty, have now become staple articles of every-day use. New applications for electricity in the mechanical and industrial arts are constantly being discovered.

In Ontario the use of electrical appliances is greatly promoted by the low cost of energy. In most of the Hydro Municipalities, and for less than \$1.00 per month, the average family may take full advantage of the cleanliness, convenience and safety of electric lighting, while for a small additional cost, electric fans, irons, vacuum cleaners, toasters and certain classes of light cooking appliances may be utilized. Cooking by electricity, although not yet in very general use, is becoming increasingly popular.

The indirect benefits derivable from cheap power, however, are far in excess of what may be styled the immediate and more direct benefits as

reflected by low bills for electric light or for electric power. For instance, the manufacture, sale and installation of electrical appliances, provide employment and profit for many.

It would be impossible here to make anything like a complete enumeration of the vast number of electrical appliances, devices, and machinery which are in every day service. Suffice it to say that electricity in its manifold applications lightens the labors of all classes of the community, contributes more than any other agency to raising the standard of living and saves money for manufacturers, business men and householders.

#### POWER ACTUALLY AVAILABLE ATTRACTS LARGE INDUSTRIES

It has been the experience that abundant supplies of cheap power *actually available* undoubtedly attract large basic industries, and the establishment of these, as in the case of Niagara and other large power centres, inevitably results in the establishment also of new by-product industries—which in turn give rise to increase in population, transportation, and general prosperity such as would not have been created without there first being available large supplies of cheap electrical energy.

The Hydro-Electric Power Commission has been handicapped hitherto, in not having had readily

available sufficiently large blocks of electrical energy—apart from those required for municipal and general industrial purposes—after the manner in which electricity has been available in certain other developing centres. This state of affairs has now been remedied by the great Queenston-Chippawa Development.

#### DESCRIPTION OF THE DEVELOPMENT

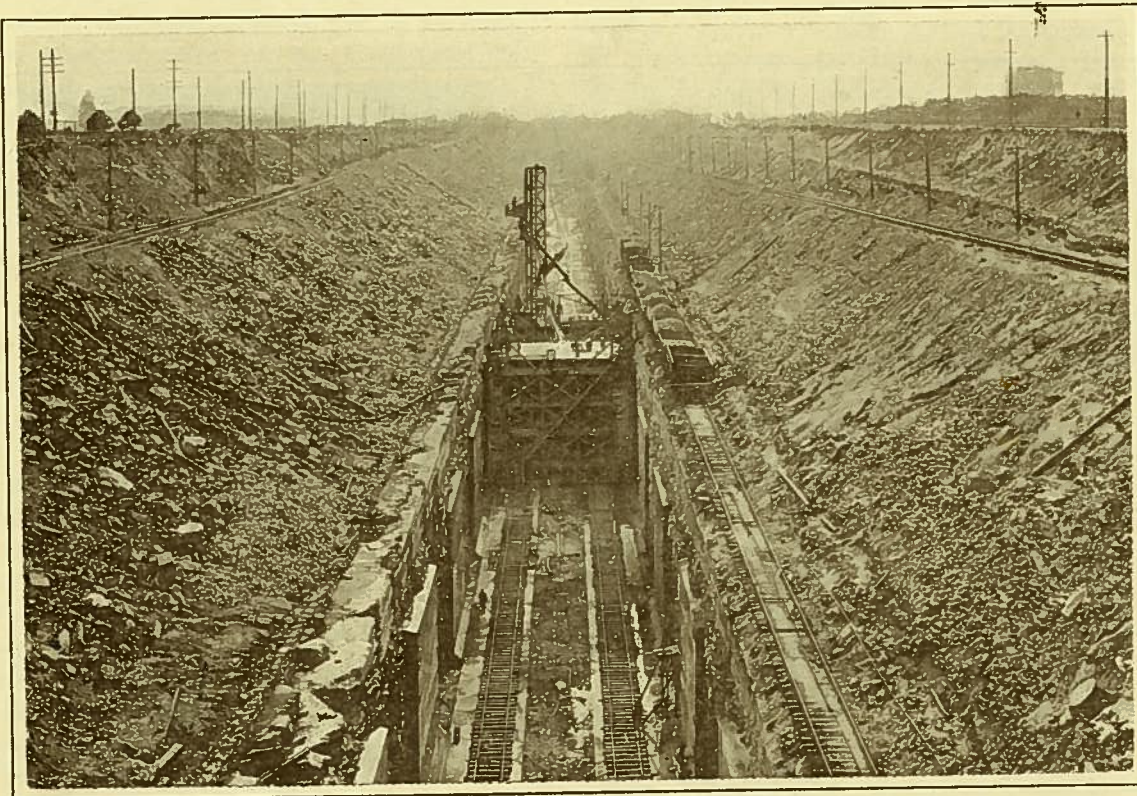
Let us now consider the outstanding characteristics of the Queenston-Chippawa Development, every feature of which has been designed with the express object of producing power most efficiently from the available water at the lowest possible cost.

Before proceeding, it should be clearly understood that the Queenston-Chippawa Development, in its present condition is a much larger installation than that contemplated in 1915 when, under the exigencies of war conditions, it was proposed to construct a power development and canal with an initial capacity of only 100,000 horsepower and an ultimate capacity of 300,000 horsepower at a cost, for the initial development, of \$10,500,000—a figure which, however, under the conditions which soon afterwards prevailed, owing to the War, would have become \$29,000,000.

When the crisis of the war passed in July of 1918, and peace came in the following autumn, it became necessary to reconsider the status of the project, and transform it as far as possible from a war measure, designed to meet an urgent and immediate need, to a commercial scheme embracing the elements both of true conservation and of ultimate maximum economy in the production of power. Space is not available to cover the steps of this transformation in detail, but it resulted in the final development as it stands to-day, with permanent works designed for the installation of plant up to an aggregate capacity of at least 550,000 horsepower, the initial development being 275,000 horsepower.

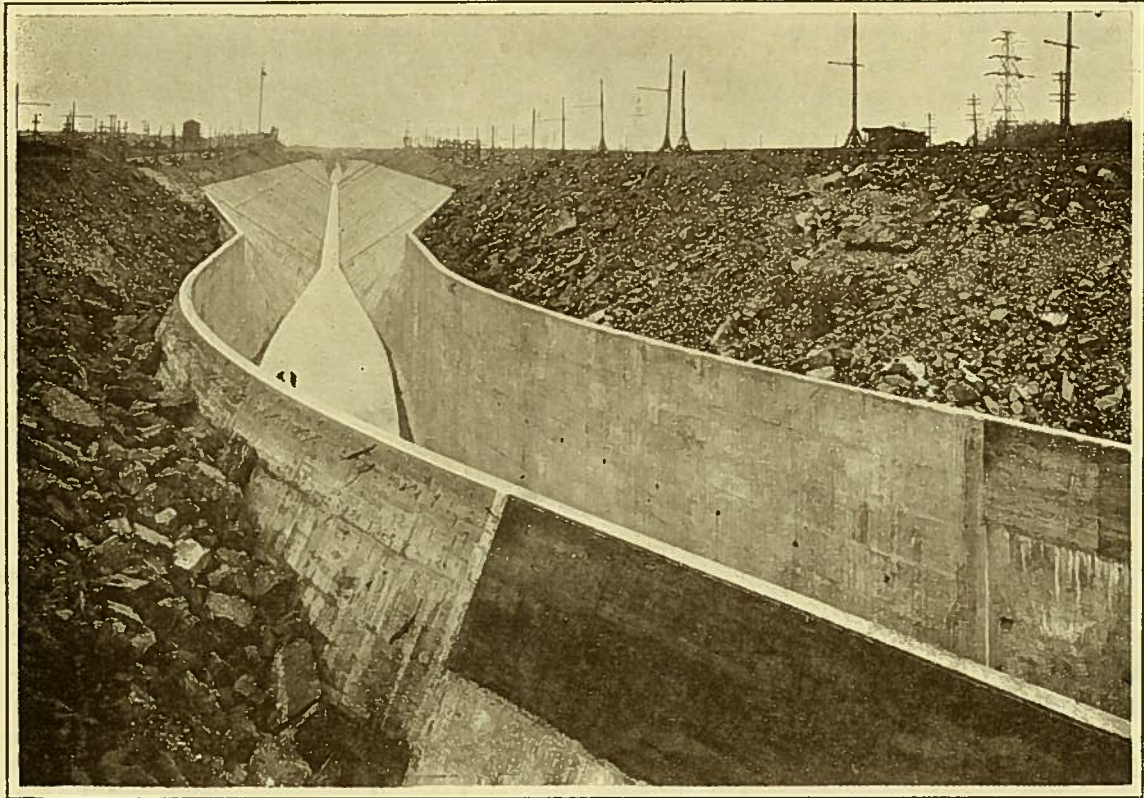
#### THE SCHEME AS A WHOLE

The general scheme of development comprises an intake structure in the Niagara River at Chippawa; the deepening and widening of the Welland River between Chippawa and Montrose, a distance of  $4\frac{1}{2}$  miles; the construction of a canal  $8\frac{1}{2}$  miles long from Montrose to the forebay and screenhouse at a point on the cliff about a mile south of the village of Queenston; and the construction and equipment of a power house in the gorge immediately below the forebay.



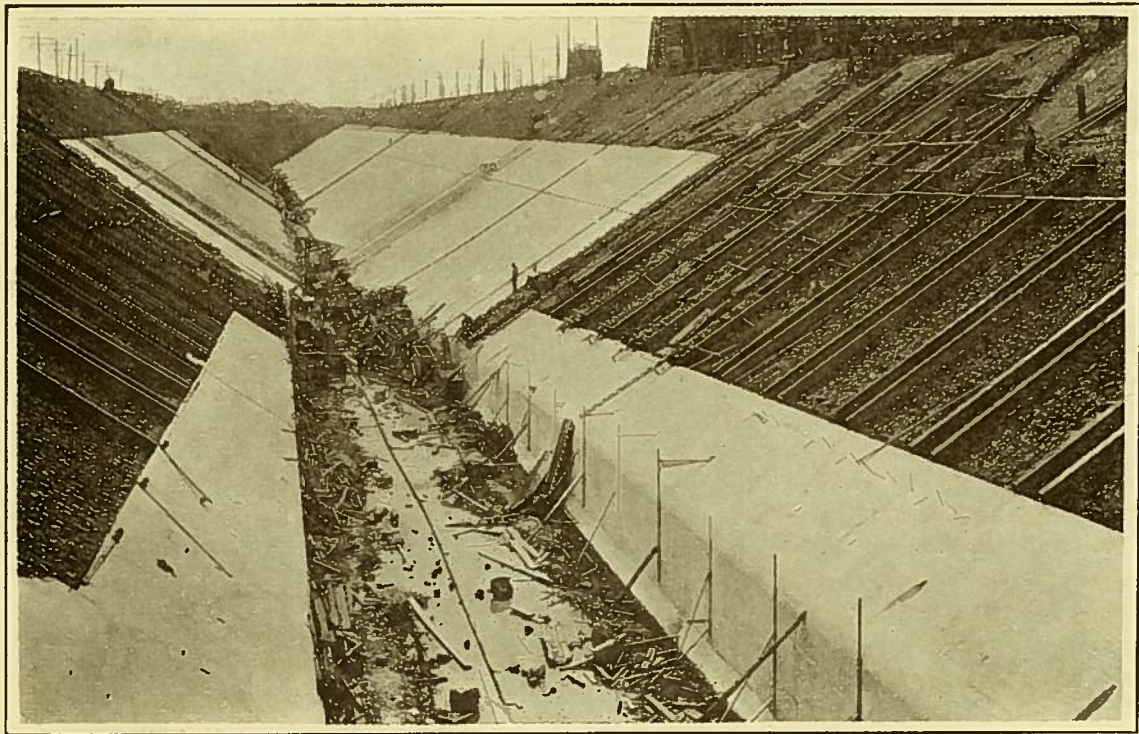
QUEENSTON—CHIPPAWA DEVELOPMENT

Fig. 9 Placing concrete lining on rock sides of canal. Completed sections 40 feet in length in foreground with mixing plant and forms in distance.



QUEENSTON—CHIPPAWA DEVELOPMENT

Fig. 10 Power Canal showing change in shape of the canal as it passes from vertical faces of rock cut to sloping sides of Whirlpool section.



QUEENSTON—CHIPPAWA DEVELOPMENT

Fig. 11 Placing concrete lining in the Whirlpool section of the canal, showing various stages of construction.

## INTAKE

The vital requirement of a power development supplying the needs of a large community is continuity of service, and one of the most frequently recurring obstacles to securing this end in Canada is the annual formation and flow of ice. This is a particularly aggravated form of trouble in the case of the Niagara River because the large fields of ice which form along the shores of the comparatively shallow Lake Erie are all discharged through the river each spring. It was only after a long series of tests and experiments on large-sized models had been made, that a design of intake was evolved which will operate satisfactorily to keep the plant absolutely free from this ice menace.

At the present time a large area of the river bed has been unwatered by the construction of coffer-dams, but the actual building of the intake structure within this area has been deferred until next season. In the meantime, water to operate the plant will enter the Welland River portion of the canal through the North Channel between Hog Island and the shore.

## CANAL

The cross section of the canal was fixed only after a long series of calculations had been made in order to determine the lowest cost for the maximum amount of power. In the present canal the total loss of head from Chippawa to Queenston when operating at full capacity will not exceed 12 feet.

Existing power developments on the Niagara River have only utilized that portion of the total fall of the river which occurs in the vicinity of the Falls and, for the most part, even this amount of head has been inefficiently utilized; but the basic conception of the Queenston-Chippawa Development is the utilization of the greatest possible amount of the total fall of the Niagara River between Lake Erie and Lake Ontario at the highest possible efficiency. Of this total fall of 327 feet, about 10 feet occurs in the upper Niagara River from Lake Erie to Chippawa and in the lower river from Queenston to Lake Ontario; these 10 feet it is impossible to reclaim for power purposes. Of the remaining head, about 12 feet are required to convey the water through the canal.

From the foregoing it will be seen that the average head actually available at the power house is 305 feet, which means that for every cubic foot of water that flows through the canal per second 30 horsepower will be developed. That this is a great forward step in economy is apparent from

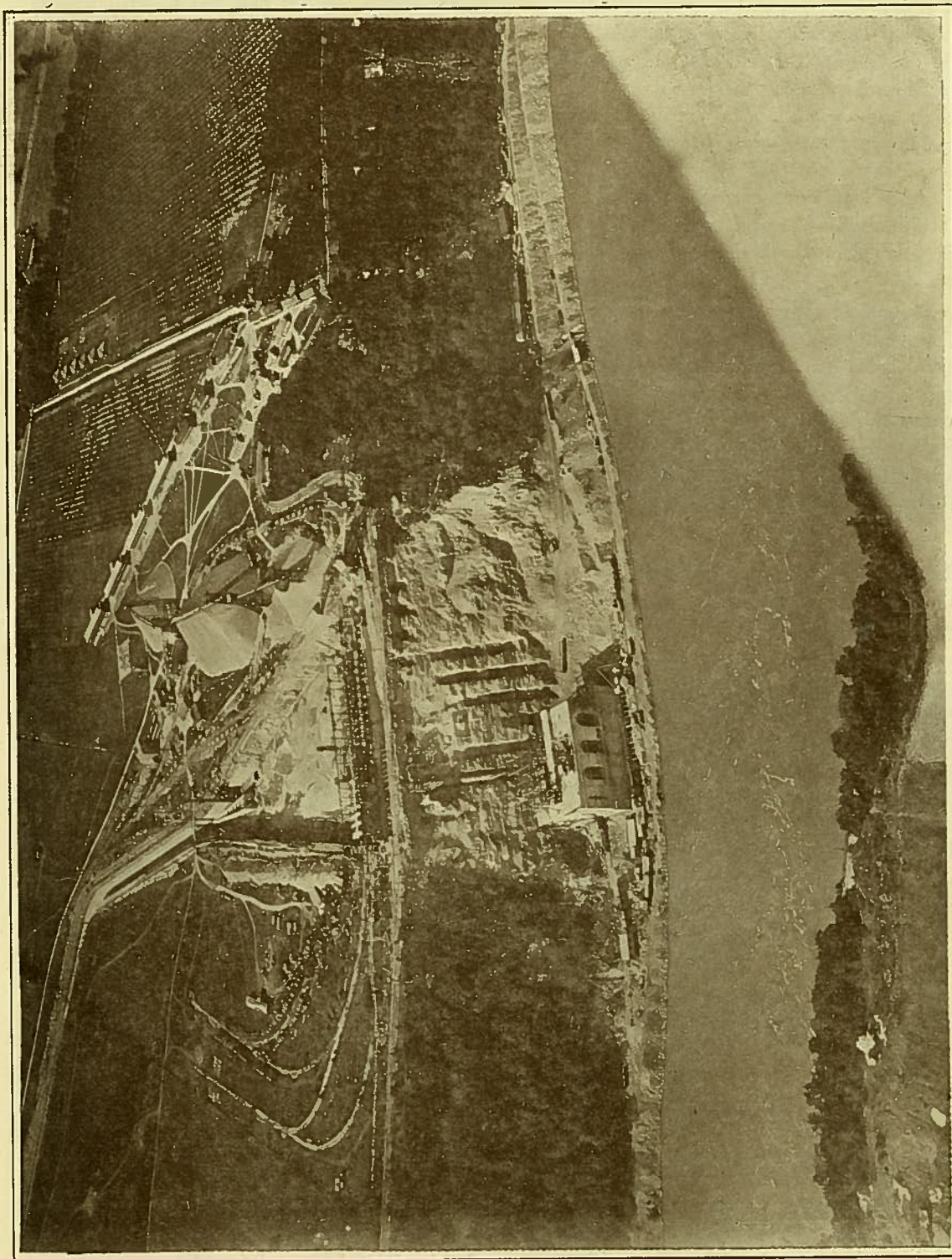
the fact that only 16 horsepower is obtained from each cubic foot of water flowing per second in the most efficient of the present three plants on the Canadian side of the river at Niagara Falls. From Montrose, on the Welland River, where the canal proper begins, the first mile was dredged through earth and is similar in section to the Welland River cut; from this point the canal, which runs in a general northerly and easterly direction, is all in rock with the exception of the built-up, rock-filled section, 2,500 feet long, adjacent to the Niagara Whirlpool. The lower end of the canal opens up into a triangle-shaped forebay cut into the rock at the top of the cliff. Where the canal is in rock the sides and bottom are lined with concrete for the purpose of increasing its carrying capacity by virtue of the smooth surface thus obtained. It was estimated that the capacity of the canal will be increased 20 per cent. by means of the lining, but in view of the exceptionally fine quality of the work as actually constructed, it is now evident that an even greater increase in flow will be obtained.

Among the special features of the canal may be mentioned the massive electrically-operated Control Gate located near Montrose, for controlling the flow in the Canal; the deep excavation at Lundy's Lane crossing, where the bottom of the canal is 143 feet below the level of the ground; the various railroad and highway crossings over the canal; and the "Whirlpool Section." The last named is that part of the canal which crosses over an old gorge, the bottom of which was largely composed of quicksand. The construction of the canal across the valley was accomplished by first filling the whole gorge with rock, excavated from other parts of the canal, and then allowing this rock-fill to come to a final settlement; after this it was excavated for the canal section and faced with a heavy reinforced concrete lining.

Where the canal enlarges into the forebay a triangular concrete structure has been erected which acts as a diffuser to smooth out any turbulence of the water as it enters the forebay. The dimensions and shape of this diffuser were only determined after an involved study and a series of experiments.

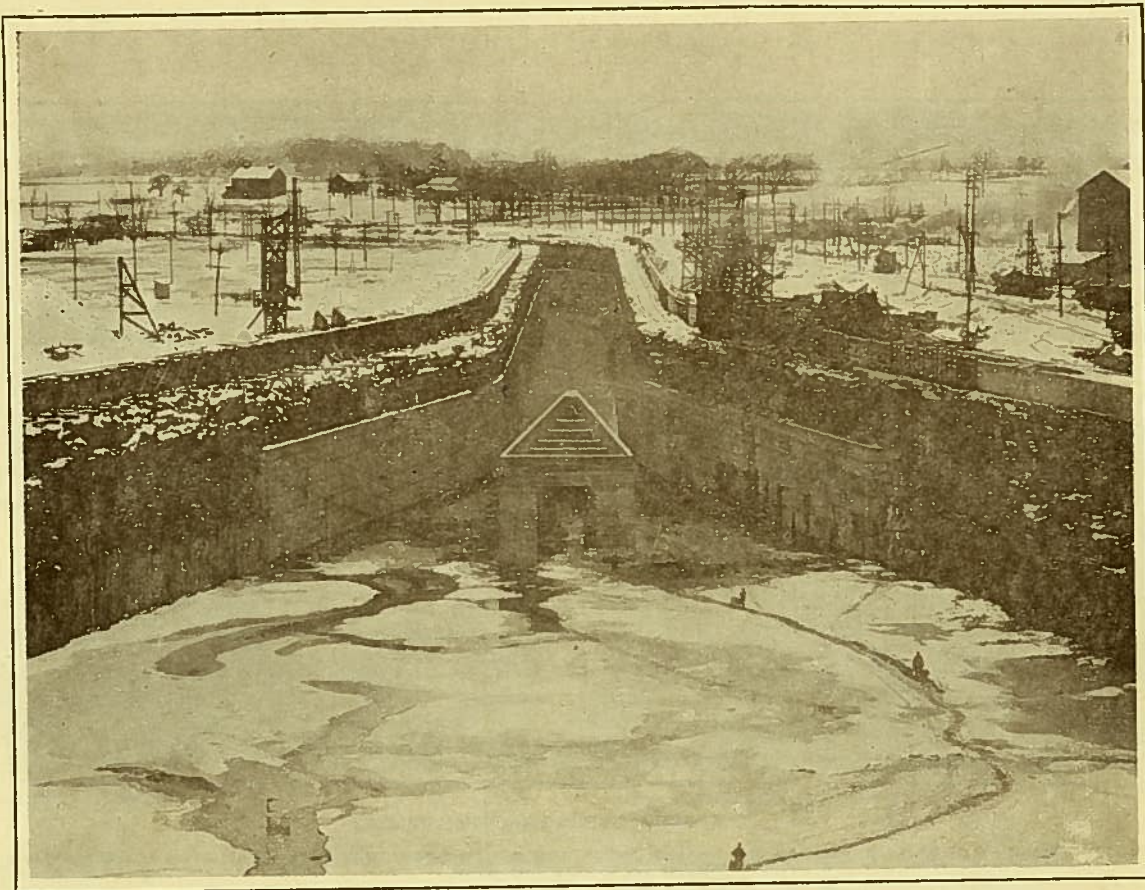
## SCREEN HOUSE

The permanent screen-house substructure, to accommodate nine generating units, which extends across the lower end of the forebay, is completed. This heavy reinforced-concrete structure forms a dam at the end of the forebay and contains the moulded entrances to the penstocks or pipes which convey the water down the cliff to the



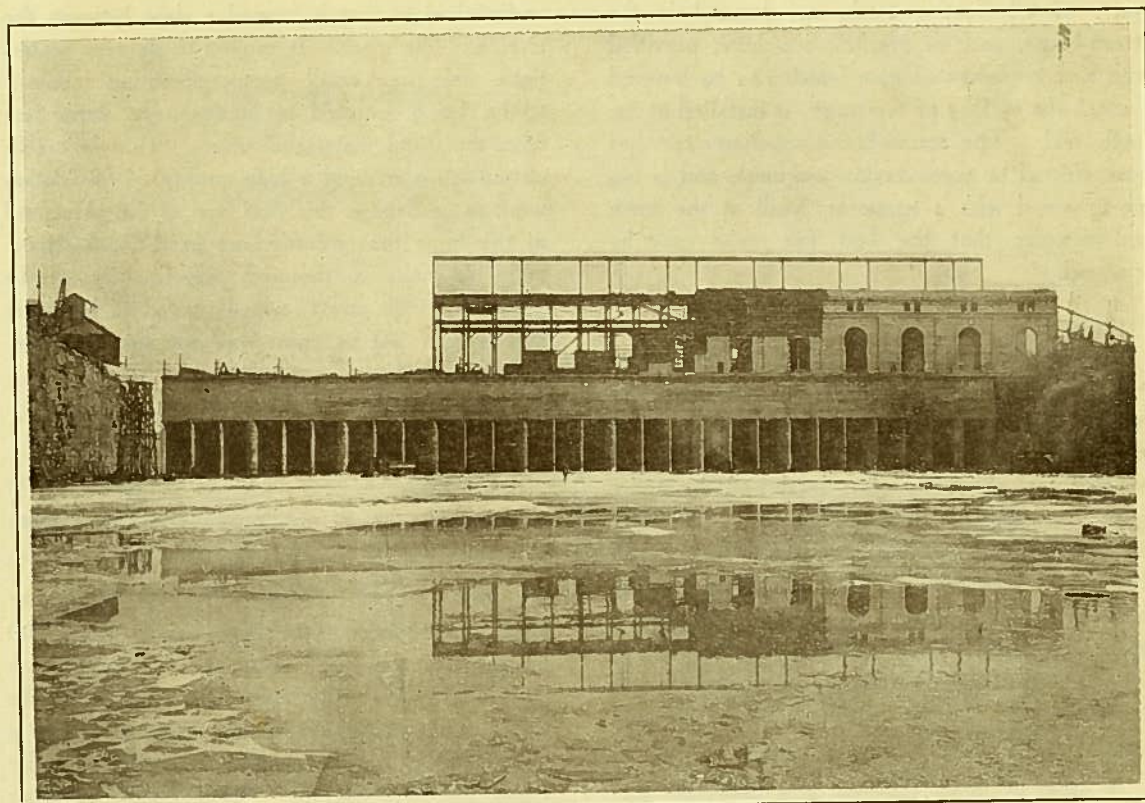
QUEENSTON—CHIPPAWA DEVELOPMENT

Fig. 12 Canal, Forebay, Screen House and Power House at Queenston, as seen from the air. Piles of crushed stone and sand to right of Forebay.



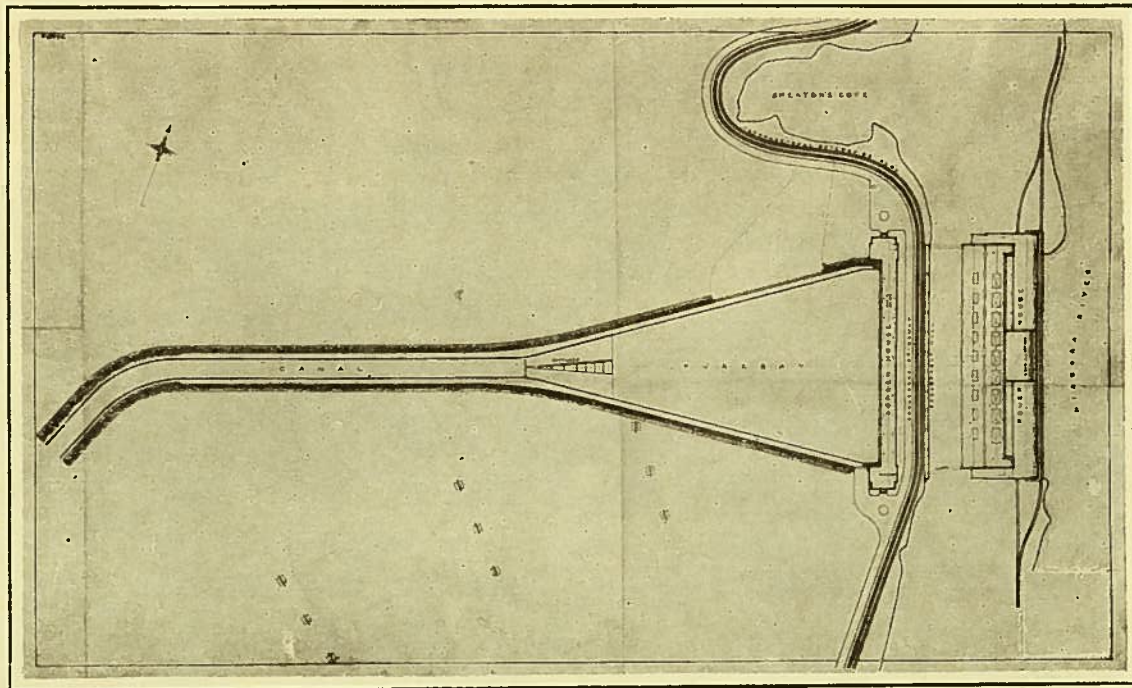
QUEENSTON—CHIPPAWA DEVELOPMENT

Fig. 13 View of Forebay from Screen House Roof showing lower end of Canal with Diffuser at entrance to Forebay.



QUEENSTON—CHIPPAWA DEVELOPMENT

Fig. 14 Screen House at end of Forebay showing entrances to pipe-lines. The racks for screening the water and the gates for closing off the entrances to the pipe-lines are supported between the piers. There are three openings to each pipe-line.



#### QUEENSTON—CHIPPAWA DEVELOPMENT

Fig. 15 Plan of Power Works at Queenston showing lower end of Canal entering Forebay with Screen House on top of cliff and Power House and Niagara River below.

turbines. The sectional drop-gates for closing off each penstock, and the screens for clearing the water of all floating trash, are located in the screen-house, and an overflow ice-chute, provided with a motor-operated gate which can be lowered beneath the surface of the water, is installed at the south end. The screen-house superstructure has been erected to accommodate six units, and is being provided with a temporary wall at the north end in order that the first five units may be operated.

#### POWER HOUSE

The building required to house the generating and transforming equipment for the completed development will be of majestic proportions — the total length will be 650 feet, while the roof will be 160 feet above the river level and the entire height from the bottom of the tail-race to the highest portion of the building is only slightly less than 200 feet. The whole structure is composed entirely of fire-proof materials—concrete, brick and steel. Inasmuch as the whole of the building is not required at present, the superstructure as constructed to-day is only one-fourth of the ultimate length.

In order to obtain sufficient area under the turbines to permit the spent water to discharge into the river, it has been necessary to excavate the rock for a depth of 25 feet below the surface of the

river. To enable this work to be done "in the dry," the rock shore adjacent to the river was left undisturbed so that it formed a dam between the river and the work. It proved to be very watertight, only one small pump, operating intermittently, being required to maintain the work free from the usual water difficulties. This favorable circumstance enabled a high quality of foundation work to be done in this vital part of the plant and at the same time afforded an exceptional opportunity to make a thorough examination of the underlying rock strata, which proved to be dense and sound. At no point was any sign of settlement apparent.

#### HYDRAULIC EQUIPMENT

Each penstock after it enters the power house is provided with an automatically-operated Johnson valve, which controls the flow of water to the turbine. The turbines, which are of the vertical, single-runner type, each being of 60,000 horsepower, are the largest in capacity of any hydraulic turbines ever built. Before they left the works of the manufacturers they were subjected to an hydraulic test of double the pressure under which they will operate. An hydraulic governor system is installed, which will maintain constant speed on each turbine regardless of the variations in the demand for power.

## ELECTRICAL EQUIPMENT

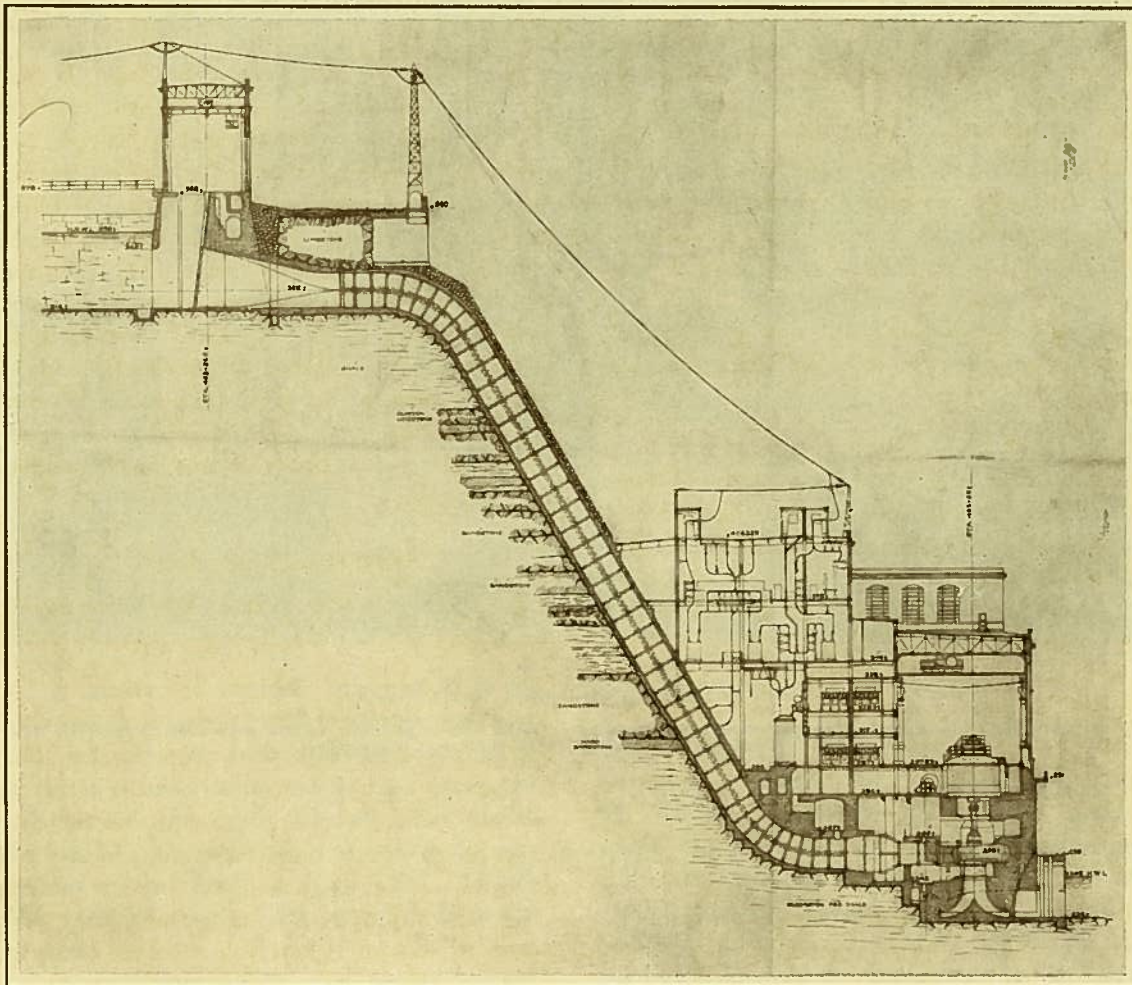
The generators, of which there are two installed at present, and of which three more are in process of manufacture, are the largest and heaviest in the world. The entire weight of the revolving parts of each generator and turbine is carried on a thrust-bearing mounted in a housing above the generator proper, the bearing being designed to sustain a weight of one million pounds. The heaviest part of a generator weighs 300 tons, and its removal requires the joint use of the two 150-ton cranes which have been installed in the power-house.

Every generator is cooled by air, which may be obtained either from outside or from inside the generator room, as desired, and it is a point of interest to note that the weight of air required by each generator within the brief space of two and a half hours, is 690 tons—equal to the total weight of the generator itself. The speed at which each generator is designed to run is  $187\frac{1}{2}$  revolutions per minute.

An exciter, direct connected to the shaft of each generator, is mounted over the thrust-bearing mentioned above.

Electric power is generated at 12,000 volts, the frequency being 25 cycles. The power from each generating unit passes through 12,000-volt oil circuit-breakers and busses to a bank of 3-15,000 kilovolt-ampere transformers, by which the voltage is increased from 12,000 to 110,000. The high-voltage power then passes through the oil circuit-breakers and busses, located in the upper rear section of the building, to the roof, where the station circuits are connected to the transmission lines, which, on leaving the station, pass up the face of the cliff over the screen-house and forebay and radiate thence in different directions.

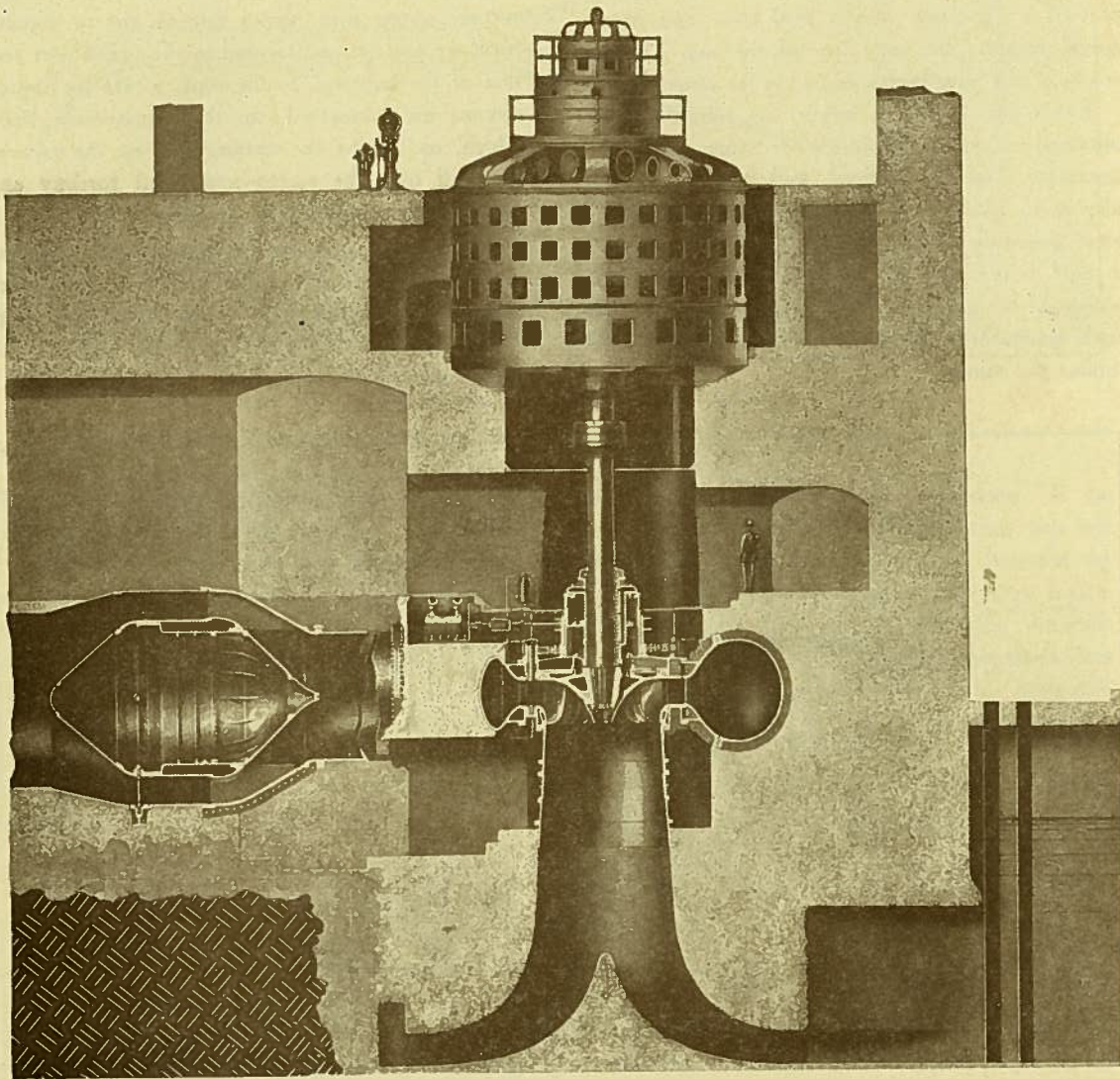
Power for operating the station lights, pumps, cranes, elevators, etc., is obtained from two service generators, each having a capacity of 2,500 horsepower; either of these is capable of supplying the entire demand of the station.



QUEENSTON—CHIPPAWA DEVELOPMENT

Fig. 16 Cross-section through Screen House and Power House, showing pipe-line down face of cliff with transmission lines above.





QUEENSTON—CHIPPAWA DEVELOPMENT

Fig. 17 Cross-section through 55,000 horsepower unit, the largest in the world, showing generator, turbine, water supply pipes, valve and draft tube. The enormous size may be judged by the man in the gallery.

The control room will eventually be located above the generator room over Units Nos. 4, 5 and 6, but as this portion of the building is not yet erected, it has been necessary to provide a temporary control room in the service section for present needs.

Access to the power house will be provided by means of a high-speed elevator running from the screen house, and by a tunnel which will enter the power house near the top. A second elevator in the station will give access to all floors.

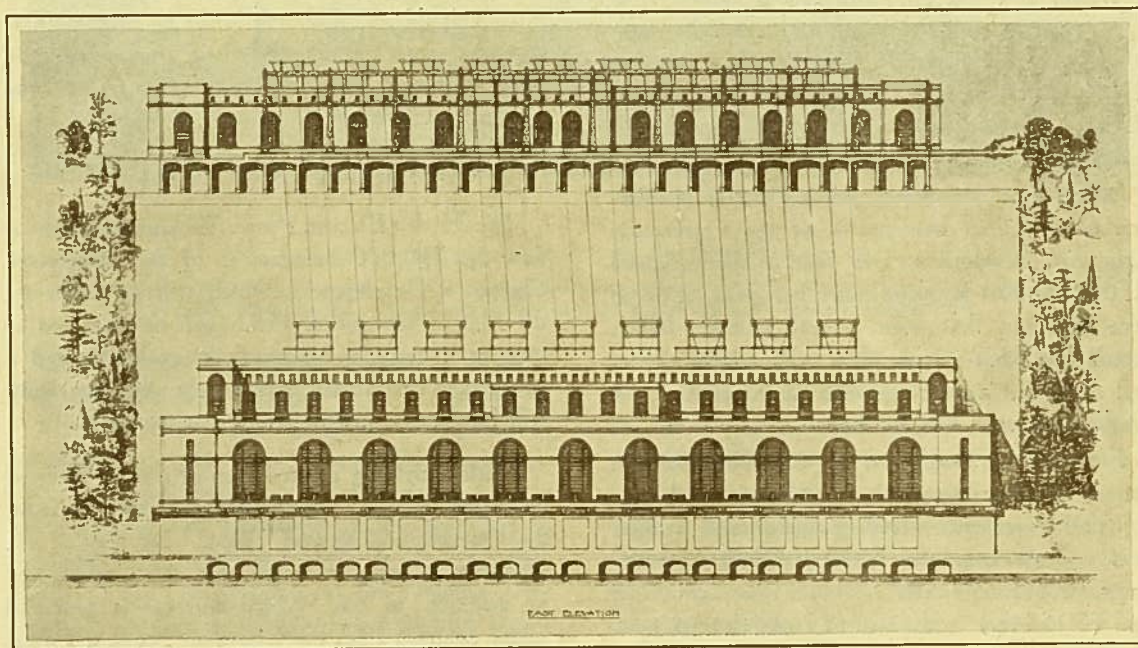
#### SOME STRIKING FEATURES

The total length of the canal is  $12\frac{3}{4}$  miles. At one point the bottom of the canal is 145 feet below the original ground level. The maximum depth of cutting in earth was 80 feet and in rock,

pleted in December, 1921. At one time 8,100 men were employed on the construction work.

The carrying out of operations of such magnitude necessitated the creation of new engineering appliances, such as large shovels and special concrete forms. To handle excavated material 82 miles of standard gauge railroad track were laid. Trains were hauled by 50 locomotives, the majority being electrically driven. The excavation was carried out with the aid of 14 shovels, most of which were electrically operated, and 5 of which are larger than any heretofore built; each of the large shovels was capable of loading a car of 20 cubic yards capacity, standing 60 feet above the shovel, in  $1\frac{1}{2}$  minutes; it could excavate a cellar for an average house in 4 minutes.

During the construction of the canal, which



QUEENSTON—CHIPPAWA DEVELOPMENT

Fig. 18 Power House at the bottom of the 320 foot Escarpment at Queenston, as it will appear when completed.

85 feet. The width of the finished rock-cut portion of the canal is 48 feet and the depth of water is from 35 to 40 feet.

The amount of material excavated from the canal proper is over 17,000,000 cubic yards of earth and rock; the earth excavation amounts to 13,200,000 cubic yards, and the rock excavation to 4,182,000 cubic yards. Concrete to the amount of 450,000 cubic yards has been used in the construction of the canal; in June, 1921, 62,000 cubic yards of concrete were poured in 25 working days.

Preliminary work on the canal was commenced in May, 1917, active excavation with the large shovels in March, 1918, and the canal was com-

passes beneath many of the main trunk railways on the Niagara frontier, the work of excavation was carried on and bridges were built, without any delay to traffic.

#### WAR CONDITIONS INCREASE COSTS

It will be recalled that the original project for the Queenston-Chippawa Development contemplated the production of 100,000 horsepower. Later on, when the necessities of the war were making increased demands upon the power supply, and when, at the same time, it became evident that the future demands for electrical energy for widespread use for municipal, industrial and commercial purposes would be heavy, the whole Queens-

ton-Chippawa project was reviewed in the light of the altered conditions.

In view of all the facts, it was found best to provide for an initial development of 275,000 horsepower, a complete canal installation for a continuous capacity of 550,000 horsepower, and an ultimate capacity of 650,000 horsepower. When completed, this project will have cost about \$30,000,000 more than it would have cost had it been carried out under the conditions of low costs of labor and materials prevailing in 1913 and 1914. It may be asserted, therefore, that as a result of conditions brought about by the War the Queenston-Chippawa Plant has actually cost at least \$30,000,000 more than it would have cost if constructed under the prevailing market conditions of 1913-1914.

When, however, this extra cost is viewed from a proper business standpoint and carefully analyzed, it becomes evident that, after all, the net result to the consumer is not of serious moment, although the sum itself at first sight appears formidable.

When it is considered that the initial installation of 275,000 horsepower of the Queenston-Chippawa Development will yield in round figures 1,500,000,000 kilowatt-hours per year, it is at once apparent that even several million dollars spread over such a large number of kilowatt-hours will cause but a small increase in the price to be charged for each kilowatt-hour.

For this increased cost of \$30,000,000 the annual carrying charges to cover interest and sinking fund—and even including depreciation charges—if spread over the 1,500,000,000 kilowatt-hours, would only add less than one-sixth of a cent (0.1544c.) to the cost of each kilowatt-hour.

The electric departments of practically all the Hydro municipalities have been accumulating substantial yearly surpluses from the beginning of their operation. In fact, of the municipalities comprised in the Niagara System in 1920, those which accumulated surpluses included about 90 per cent. of all the consumers. These surpluses ranged from a few dollars to about twenty dollars per horsepower per year. In these municipalities it would be possible to meet the additional cost of one-sixth of a cent per kilowatt-hour out of present revenues, without in any degree raising the existing local rates to consumers.

If the development were fully completed and the balance of the work could be executed under normal business conditions, then the increased cost of one-sixth of a cent per kilowatt-hour would im-

mediately be halved. The extra cost, however, has here been considered in its most unfavorable aspects.

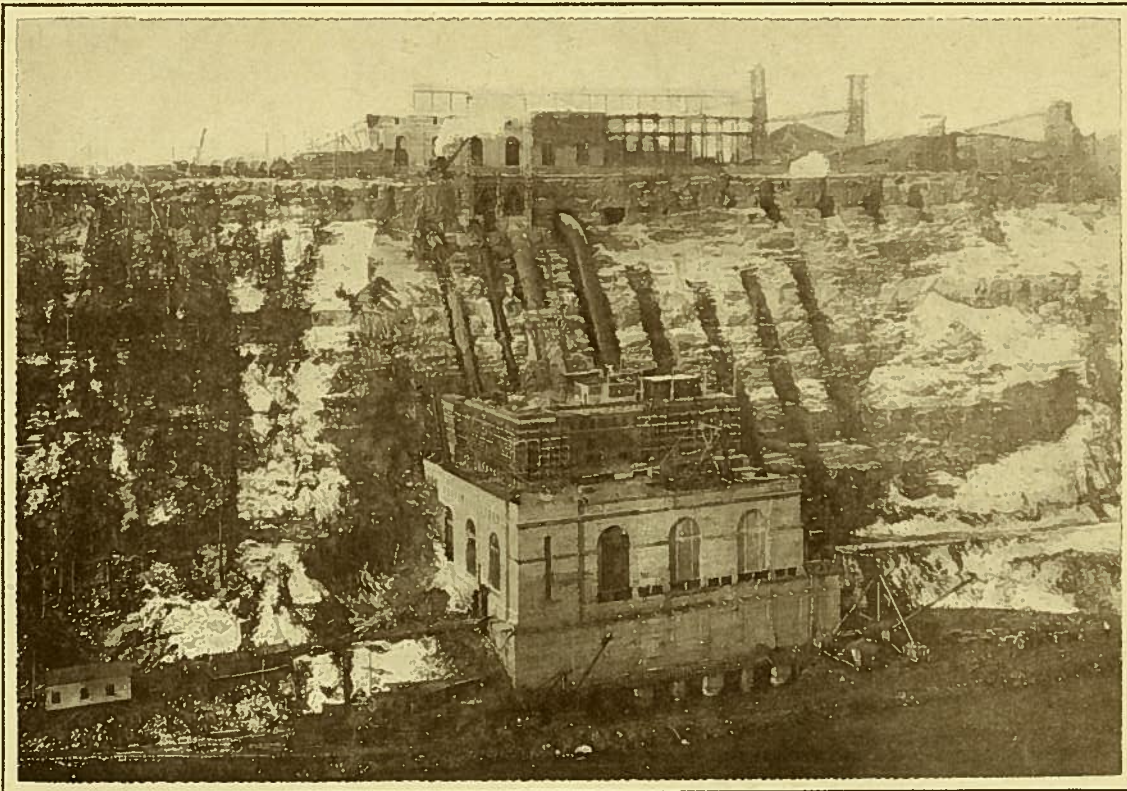
Disregarding the sinking fund charges of the Queenston-Chippawa Development only, it may be stated that when the delivery of 250,000 horsepower from the Queenston-Chippawa Plant is reached, then the average cost of Niagara power at the generating plants at Niagara will be approximately \$15.00 per horsepower-year. Due to the fact that certain low-priced power contracts were necessarily acquired in the taking over of the Ontario Power Company, the cost of power at Niagara to the municipalities will be increased over this figure by about \$1.00 per horsepower-year.

It should be remembered that, under no circumstances, is this extra charge borne by anybody except the municipalities and their consumers, who have assumed the full responsibility for the Queenston-Chippawa Development.

#### PROSPECTIVE MARKETS

The Hydro-Electric Power Commission believes that the 250,000 horsepower of the Queenston-Chippawa Development, which will be ready by the 31st of December, 1922, will be marketed as soon as it becomes commercially available, and it is expected that almost immediately additional units will have to be ordered for the power house.

Under anything like a return of normal business conditions there is a large electrical load awaiting the Queenston-Chippawa Plant. By way of explanation it may be stated that the Commission, in addition to the 50,000 horsepower procured under contract from the Canadian Niagara Power Company, is now obtaining under temporary agreement from outside sources in the Niagara District, 91,000 horsepower. The Hydro-Electric Power Commission is under contract to supply when demanded by municipalities and other customers, 80,000 horsepower. The increased power demands for the year 1922 over the year 1921, may conservatively be estimated at 25,000 horsepower, in view of the fact that the demand of the year 1921 over 1920 was between 60,000 and 70,000 horsepower. It is manifest, therefore, that with the purchased 91,000 horsepower, plus the customers' 80,000 horsepower, plus the 1922 estimated 25,000 horsepower, there awaits under normal conditions a load of over 200,000 horsepower to be carried by the Queenston-Chippawa Development by the close of 1922.



#### QUEENSTON—CHIPPAWA DEVELOPMENT

Fig. 19 Power House as it appeared on Dec. 20th, 1921, showing two main pipe-lines to the right, with service pipe-line and ice chute in course of construction on the left. The cuttings on the face of the cliff for future pipe-lines may also be noted.

When one contemplates the unanimous decision given by the municipalities at the polls of 1917, to assume—under the Ontario Niagara Development Act—the direct responsibility for acquiring and developing power at Niagara, and moreover, when present circumstances are regarded in the light of the comments made in the foregoing statement, the municipalities of the Niagara District are to be highly congratulated on their enterprise and courage in initiating and carrying to completion this Queenston-Chippawa Development.

The Hydro-Electric Power Commission of Ontario, as trustee for the municipalities, believes that the future will more than justify the municipalities in the course they have taken, and the Commission further believes that no single factor will contribute more to the wholesome growth of the Province of Ontario than the economical usage of the power which will now become available as a result of the great municipal undertaking which has this day been officially opened.