is avoided. The penstocks are so short that they can be designed to withstand the stresses due to pressure surge. Valves may not be required on the penstocks; regulation will be effected by the gates at the gatehouse and by the wicket gates on the turbines.

About 30 h.p. will be obtained from each second-foot of water, compared with about 14 h.p. obtained by the existing plants. With 36,000 c.f.s., over 1,000,000 h.p. could be developed at this plant, compared with less than half that amount at the heads under which the present plants are operating.

Most of the excavated section of the canal will be in rock, but at the Whirlpool there is a stretch which is in earth; and the initial portion of the excavated section, adjacent to the Welland River, will also be in earth.

Canal Mostly in Rock

Starting at the point of diversion from the Welland River, near Montrose, as station 0, the earth section extends to station 80, a distance of 8,000 ft. Then the canal is in rock all the way to the gatehouse excepting at the Whirlpool, where it is in earth from station 332 to station 351. At station 351 it is in the full rock section again, but the sub-base of rock crops up gradually far ahead of station 351, with the result that only about 1,000 feet, or from station 332 to about station 342, is entirely in earth at this part of the canal. The station at the gatehouse site is 462, a distance of 46,200 ft. from the diversion at Montrose.

The stations on the Welland River section are separately numbered, beginning at Hog Island as station 36, allowing 3,600 ft. for future allotment to plans for the intake works that will be constructed in the Niagara River. The diversion at Montrose is at station 222+40, a distance of 18,640 ft. from Hog Island. The total length of the Hydro Power Canal from Hog Island to the gatehouse location is 64,840 ft., or 12.28 miles.

The gradient and the section adopted for the canal are the most economical for the amount of water which it is desired to pass through the canal. The canal is nominally designed for 10,000 c.f.s. at minimum low water. The rock is mostly very good limestone, and as all the rock will be channelled, and may be lined with concrete where it is too poor to channel smoothly, the friction will not be great. Ten Sullivan channellers, each having a 20-ft. cut, will be used on each side of the canal.

Earth Sections Will Be Lined

The earth sections will be lined in some manner not yet finally decided. The sides of the wetted section will be sloped 1½ to 1 and they will either be "gunited" over light reinforcing, by the Cement-Gun method, or else a heavier reinforcing will be used and the walls will be poured. This detail of design and many other details of the scheme are in a state of flux and will be decided only from time to time as the work progresses. As the commission is both the buyer and the contractor, there is no necessity for rigid decision in advance in regard to details of this sort, the commission being able to leave them for disposal as circumstances may dictate. The entire construction programme is liable to change in any detail at any time should conditions, as the work progresses, suggest changes.

The rock section is 48 ft. wide at the bottom, with perpendicular sides, the average wetted section being 35 ft. deep. The velocity in the rock section will be about 6 ft. per second when the plant is under maximum load. The banks of the overburden will be sloped 1½ to 1 unless local conditions in certain places require a flatter slope or other treatment.

The earth section will be 34.6 ft. wide at the bottom and 162 ft. at the top, the sides having a 1½ to 1 slope, the average wetted section being about 26 ft. deep. The width at the mean water line will be about 84 ft.

The commission has purchased a wide tract of land as a right-of-way, and has enough acreage to be able to build two more canals should they be required in the future. These canals would be located a few hundred feet to the west of the first canal and would be almost parallel to it. They would draw water from the Welland River just as the first canal will do. The capacity of these additional canals would, of course, depend upon the section and the gradient assumed, but could be built readily and economically to handle all of the water which both Canada and the United States are now diverting from Niagara Falls, should the people of the United States ever desire to merge their water allotment with Canada's, in one big plant, for the sake of higher efficiency. The cost of all this property is being charged against the present scheme. About $1,000,000 worth of land will have been acquired when the expropriations are complete. This includes the vast disposal area at St. David's, which can accommodate about 20,000,000 cubic yards of dumped material.

The canal's designed capacity of 10,000 c.f.s. at minimum low water refers to the absolute minimum during a period of about sixty years. The records for the Niagara River had been kept for fourteen years, and the records for Lake Erie had been kept for about sixty years, and from the Lake Erie levels the Niagara River levels were estimated for the period prior to the fourteen years for which direct records were kept for the Niagara River. This minimum low water has occurred only about once in fourteen years; the average monthly minimum is much higher; so, in assuming the absolute minimum, the

CHIPPAWA-QUEENSTON SCHEME IN TABLOID

Horse-Power Developed	300,000
Capacity of Units	50,000 H.P.
Number of Units	6
Diameter of Main Penstocks	13 ft. 6 ins.
Gross Head	316 ft.
Net Effective Head	305 ft.
Water Required	10,000 c.f.s.
Length of Canal	12¾ Miles
River Section	4¼ Miles
Excavated Canal	8½ Miles
Gradient in Ex. Canal, per mile	1 ft.
Width of Rock Section	48 ft.
Width of Earth Section	162 ft.
Earth Excavation	11,000,000 Cu. Yds.
Rock Excavation	4,000,000 Cu. Yds.
Deepest Cut	145 ft.
Surveys Started	1914
Construction Commenced	1917
Completion of Work	1921
Estimated Cost, about	$25,000,000