PAGES

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The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Progress of Queenston-Chippawa Power Canal

Nearly Five Million Cubic Yards of Earth and Rock Removed—Huge Shovel Establishes Record in Loading 8,500 Cubic Yards on Cars in 20 Hours—Extensive Construction Railway Handling 200 Trains Daily—Payroll Only 1,000 Men Per Shift—Construction Equipment Worth Several Million Dollars

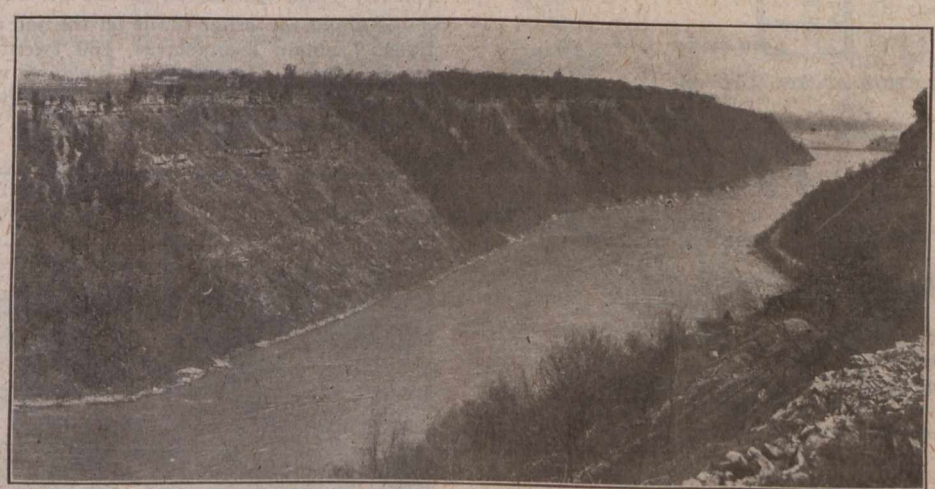
WITH several million dollars' worth of equipment on the job, and a pay roll of 2,000 men, the Hydro-Electric Power Commission of Ontario is making rapid progress on the Queenston-Chippawa power development. The construction organization has been perfected, any probable difficulties in excavation have been adequately met, the overburden has been stripped from nearly half the length of the canal, considerable rock has been taken out, the forebay is nearing completion, the power house site has been cleared, the construction railway into the power house site is being graded, the hydraulic turbines and the generators are under construction; in brief, it is now almost solely a matter of digging, channeling, drilling and blasting to complete what will probably be the largest and one of the most efficient hydro-electric plants in the world, developing at least 300,000 h.p. under 305 ft. average net head.

In the June 20th, 1918, issue of *The Canadian Engineer*, pages 545 to 550 inclusive, appeared an article which dealt with the economics and design of this development. In the September 26th and November 21st, 1918, issues respectively appeared brief descriptions of the proposed turbines and generators. The present article is intended primarily to deal with the methods of construction and the progress that has been made to date.

Referring to the accompanying profile, it will be noted that the canal is entirely in rock excepting from about Sta. 335 to Sta. 350, near the Whirlpool, and from Sta. 0 to Sta. 40, adjacent to the Welland river.

From Sta. 273 (Niagara, St. Catharines & Thorold Railway) to Sta. 460 (the forebay) the canal section has been entirely stripped to rock with the exception of a small amount of work remaining to be done near the Whirlpool gully. Three electrically-driven shovels are at work removing the overburden between Sta. 100 and Sta. 273. With the exception of pilot cuts, practically no earth has been moved between the Welland river and Sta. 200. Rapid progress is being made with the Welland river section of the work, which is being handled by a dredge and a cableway excavator.

A large quantity of rock has been removed at the forebay and between the forebay and Sta. 273.



POWER-HOUSE SITE CLEARED—VIEW FROM THE UNITED STATES BANK OF THE NIAGARA RIVER—LEWISTON BRIDGE, ABOUT A MILE DOWNSTREAM, CAN BE SEEN AT EXTREME RIGHT OF PHOTO

There are ten power shovels at work on the canal, all manufactured by the Bucyrus Co. The three largest are electrically-driven, each being equipped with an 8 cu. yd. bucket for excavation in earth, and each weighing 400 tons. There are also three electrically-driven shovels each equipped with buckets of 4½ cu. yds. capacity, and one electrically-driven shovel (with caterpillar traction) equipped with a ⅞-yd. bucket. There are three steam shovels, one having a bucket of 2 yds. capacity, one 1-yd. and one ⅞-yd., the latter two having caterpillar traction.

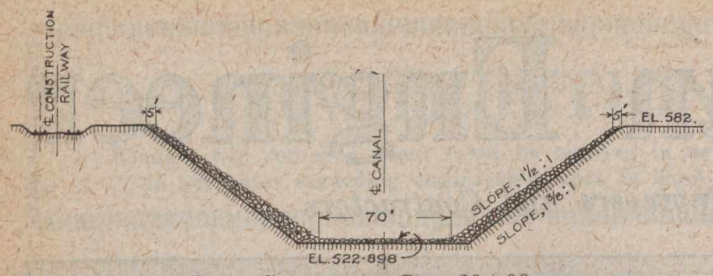
An 8-yd. shovel is at work at the forebay removing the rock to a depth of about 45 ft. The first lift of rock has been entirely removed to a width of 300 ft. at the gate house and the remainder of the rock to the necessary depth has been drilled and blasted to a total width of 500 ft. at the gate-house and is now being loaded by the shovel. Tracks have been laid on top of the blasted rock, at an elevation about 30 ft. above the shovel's tracks, and the electrically-hauled trains of dump cars are run over the rock directly to the shovel.

Between the forebay and Sta. 273, two other shovels are working in rock, one 8-yd. and one 4½-yd. capacity. It should be stated that these capacities, as well as those mentioned above, are the capacities of these shovels in earth. The capacities in rock are, of course, proportionately smaller. For example, each 8-yd. shovel has a capacity of 5½ cu. yds. in rock.

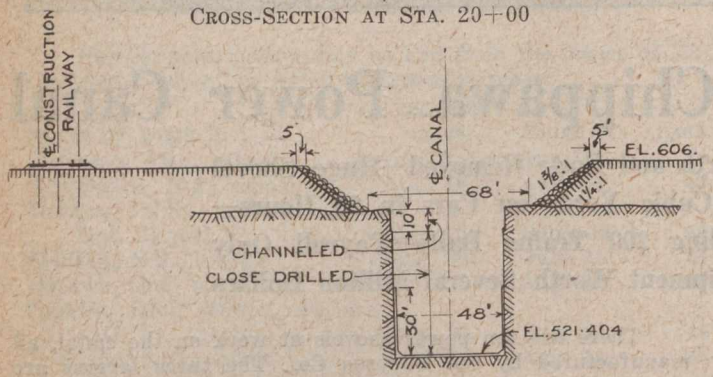
The two shovels that are working in rock between the forebay and Sta. 273, started at Station 295 and are going in opposite directions, the big one working toward the Welland river and the 4½-yd. shovel going toward the forebay, both working on the first lift of rock.

Channeling, drilling and blasting proceeds almost incessantly, day and night, ahead of the shovels. The shovels are being operated by two shifts of ten hours each, an adequate equipment of flood lamps providing plenty of illumination for carrying on the work at night.

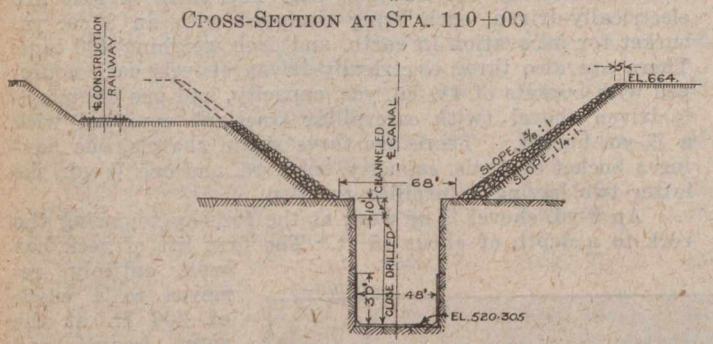
A 4½-yd. shovel is at work at the Whirlpool cleaning up the bottom preparatory to the riprap construction.



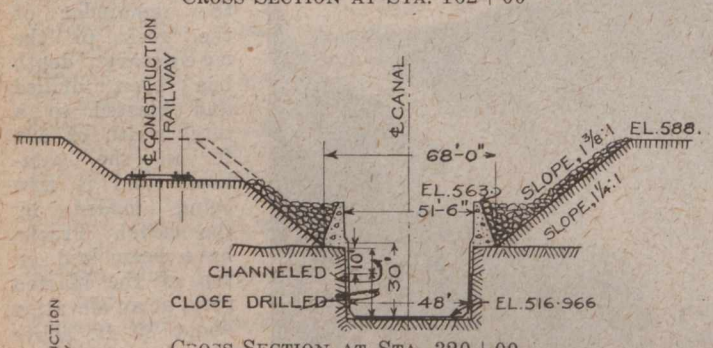
CROSS-SECTION AT STA. 20+00



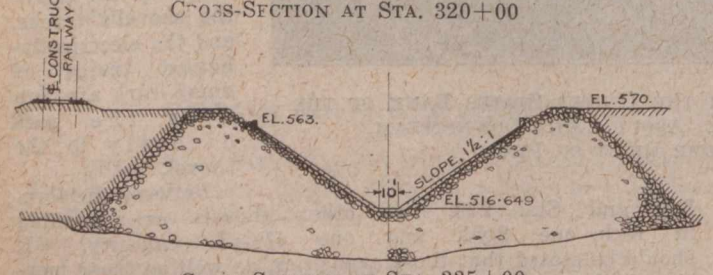
CROSS-SECTION AT STA. 110+00



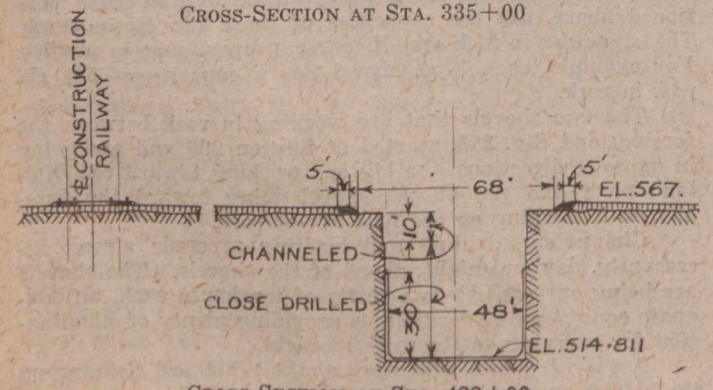
CROSS-SECTION AT STA. 162+00



CROSS-SECTION AT STA. 320+00



CROSS-SECTION AT STA. 335+00



CROSS-SECTION AT STA. 422+00

The 1-yd. shovel is working toward the Welland river, south of Sta. 323 (the Grand Trunk bridge), cleaning the rock preparatory to channeling.

Between the Niagara, St. Catharines & Thorold Railway (Sta. 273) and Muddy Run creek (Sta. 200), there are

BATTERY OF RAND AND SULLIVAN ROCK DRILLS AT THE FOREBAY

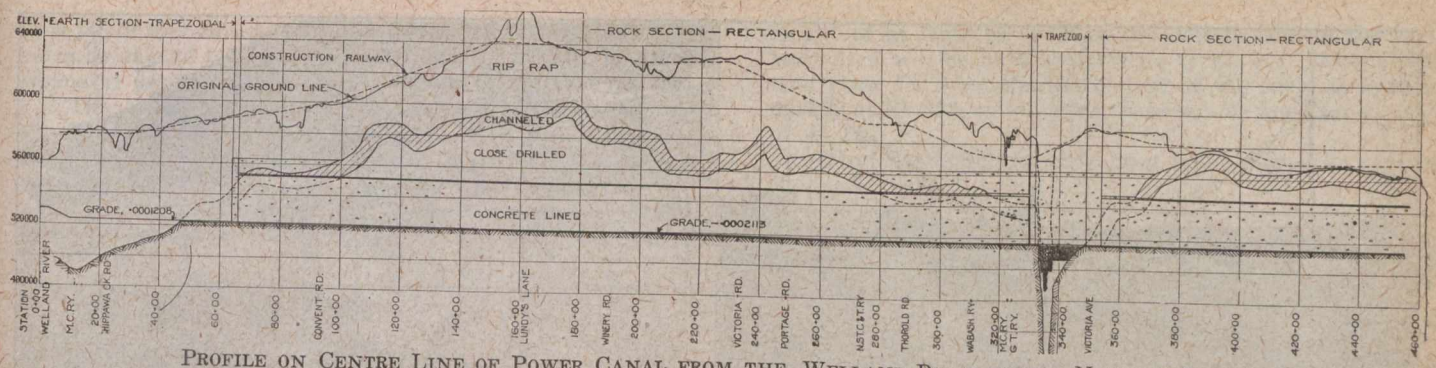
three shovels working in earth: One 8-yd. shovel, one 4½-yd. and one 2-yd.

The steam-driven ⅞-yd. shovel is working south of Muddy Run, digging pilot cuts, ditching, loading, ballasting and doing other miscellaneous preparatory work. The electrically-driven ⅞-yd. shovel is grading the construction railway from Queenston to the power-house site.

Among the other plant on the job are 21 electric locomotives, 7 steam locomotives, 150 twenty-yard Western steel dump cars, 50 sixteen-yard Western wooden dump cars, 12 box and flat cars, one 5-yd. dredge, one Ligerwood cableway excavator (800-ft. span), 2 draglines each equipped with a

CRANE MOVING ROCK IN SKIPS FROM CANAL SECTION AT ENTRANCE TO FOREBAY

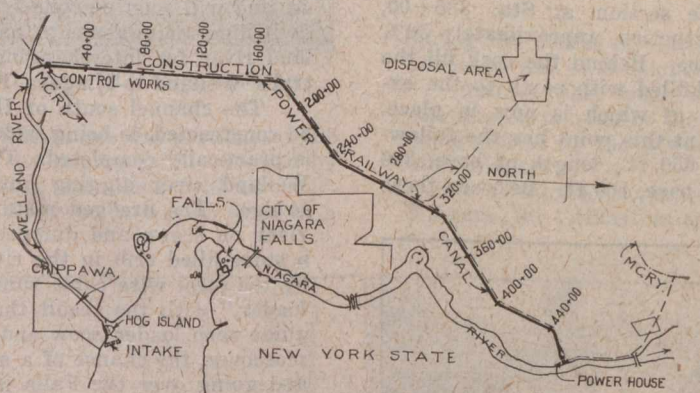
one-yd. bucket, 2 White motor dump trucks, 1 Sawyer-Massey traction engine, 10 Troy 3-yd. dump wagons, 1 Sawyer-Massey road scraper, 3 Bay City cranes of 40-tons capacity at 16½ ft. radius, 2 Bay City cranes of 15 tons capacity at 16½ ft. radius, 2 London concrete mixers, 4 Ransome concrete mixers, 1 Wettlauffer concrete mixer (each of these 7 mixers having a capacity of approximately 1 cu. yd. of mixed concrete), 2 cement-guns of the N-2 type, 1 Ransome grout mixer, 1 McKenna bar bender, several Sterling concrete carts, 1 Stephens-Adamson crushed stone conveyer, 75 Sullivan rock drills, 8 Ingersoll-Rand rock drills, 2 Leyner oil furnaces, 3 Sullivan drill sharpeners, 1 McKiernan-Terry pile hammer, 1 Vulcan pile hammer, 1 Beatty clam-shell bucket, 1 Hayward orange-peel bucket, 1 Orton & Steinbrenner ¾-yd.



PROFILE ON CENTRE LINE OF POWER CANAL FROM THE WELLAND RIVER TO THE NIAGARA RIVER

bucket, 1 Hayward 1½-yd. clam-shell bucket (motor driven), 1 Andresen-Evans 3-yd. bucket (on cableway excavator), 12 Sullivan channellers, 1 McCully No. 5 gyratory crusher, 2 McCully No. 6 gyratory crushers, 1 McCully No. 7½ gyratory crusher, 2 Barber-Green 60-ft. portable conveyors, 1 Traylor 60-in. by 84-in. steel jaw crusher, 36 thousand-watt Davis flood lamps, 13 four-hundred-watt Lyman flood lamps, 2 Napanee hoists, 1 Ligerwood hoist, 1 Beatty hoist, 2 Jordan spreaders, 2 Imperial tie tampers, 1 double-track snow plow built by Canadian Steel Foundries, numerous Herbert Morris hoists, 2 Lincoln track bonders, numerous Norton Jacks and a large quantity of valves, hydrants, pipe, tanks, standpipes, searchlights, transformers, motors, etc. There are about 36 pumps of various types and capacities, a few of which are operated continuously, the others being held for emergencies and intermittent use.

The job is equipped with its own telephone system, which also is connected by private wire direct to the head office of the Hydro-Electric Power Commission in Toronto, and with its own water distribution system and electric light system.



PLAN OF QUEENSTON-CHIPPAWA POWER CANAL

Fifty-five miles of construction railway have been built, including yards, sidings, etc. The 2½ miles of railway from the canal to the disposal area is one of the busiest double track lines in America, carrying from 180 to 200 trains (of ten cars each) daily during the 20 working hours. A despatching system, controlled by telephone, has been found necessary, especially at night.

In the Whirlpool yards are located a large machine shop, store houses, cement stores, forges, etc. The list of equipment above mentioned does not include the many machine tools, trip-hammers, wood-working machines, welding outfits, etc., with which these buildings are equipped nor the thousand and one items with which the store-houses are filled to the roofs in orderly bins and racks, including everything that might possibly be needed, from safety pins and iodine to dynamite and structural steel.

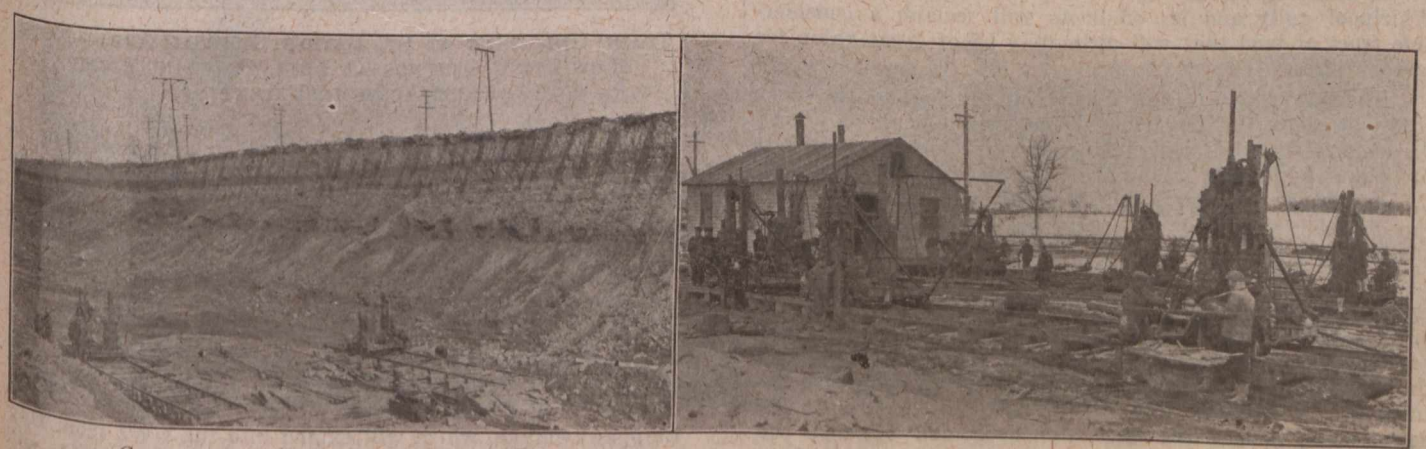
The main transformer house is at station 320. Here are installed 12 Sullivan air compressors, each having a capacity of 1,000 cu. ft. per minute against 125 lbs. pressure. The installed transformer capacity at the station is about 7,500 k.v.a., of which 3,000 k.w. is direct current.

Another transformer house is being erected at Sta. 90. A small transformer house was erected near Chippawa at the beginning of the work for the purpose of supplying the Welland river section. All power is obtained from the Ontario Power Co., which is now controlled by the Hydro-Electric Power Commission. The compressed air is used for operating the drills and channellers and for numerous small tools. It is piped in double 8-in. and single 10-in. lines, with valves every 500 ft.

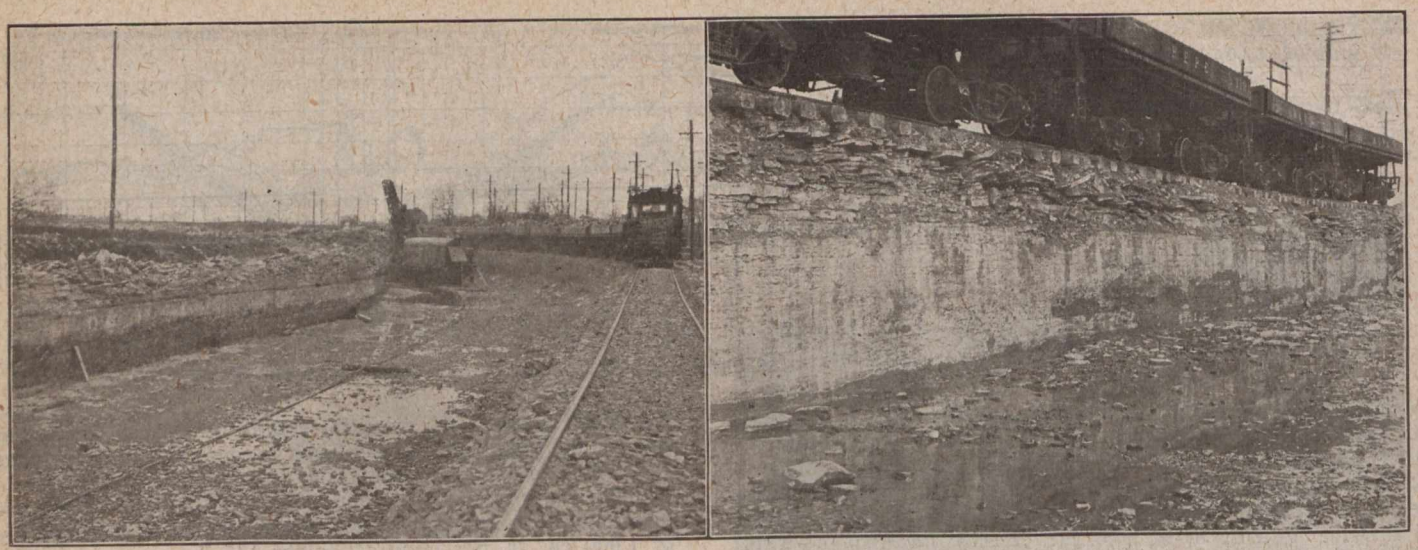
The first shovel on the job was the 2-yd. Atlantic type shovel, which began work in the spring of 1917 at Sta. 324. Since then there has been removed to date a total of a little more than 4,000,000 cu. yds. of earth and 500,000 cu. yds. of rock. The excavating plant has been increased continuously, two of the largest shovels having been received only a few months ago, and the work is now progressing 50% faster than previously. Since January 1st, 1919, approximately 2,200,000 cu. yds. of earth and 350,000 cu. yds. of rock have been removed, partly by the dredge, partly by the cableway excavator and partly by miscellaneous equipment, but mostly by the shovels.

The best day's record for any one shovel was the loading of 420 cars in two 10 hr. shifts, this being equivalent to 8,500 cu. yds. bank measurement.

The total amount of material to be excavated from the canal section is 9,000,000 cu. yds. of earth and 4,000,000 cu.



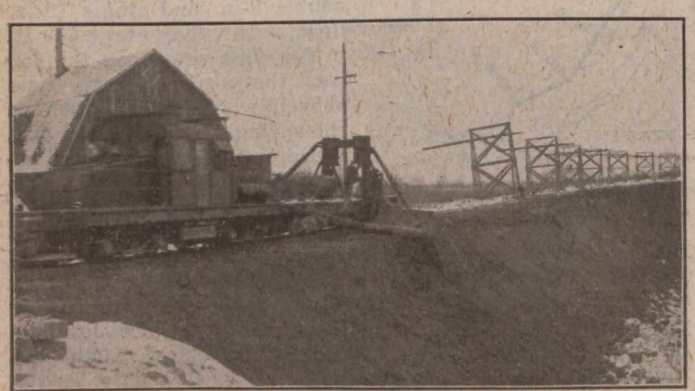
CHANNELERS AT WORK—AT LEFT, STA. 316+25—AT RIGHT, STA. 419+00, SHOWING TRAVELLING SMITHY MOUNTED ON TRUCKS



TWO VIEWS SHOWING CHANNEL CUT—AT LEFT, STA. 443+00, LOOKING WEST—AT RIGHT, STA. 448+00

yds. of rock; and from the river section, 2,000,000 cu. yds., mostly earth. These figures include the work already done.

The heavy rock fill section across the Whirlpool gully, illustrated on page 250 by the section at Sta. 335+00, is in an advanced stage of construction, approximately 50% of the rock being already in place. Behind the rock fill the whole of the gully is being backfilled with earth to the extent of 1,500,000 cu. yds., 80% of which is now in place. Each rock fill flanking the canal at this point has the following dimensions: Length at top, 650 ft.; length at base, 350 ft.; width at top, 20 ft.; width at base, 160 ft. Between these



JORDAN SPREADER PUSHING BACK DUMPED EARTH AT ST. DAVID'S DISPOSAL AREA

rock fills the base of the canal section is backfilled with rock to a depth of 8 ft.

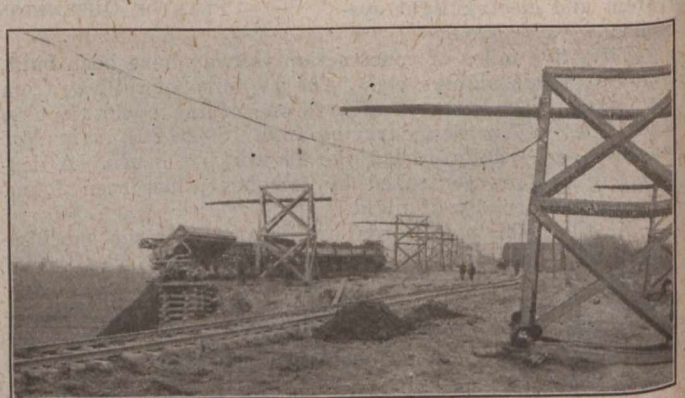
Incidentally it may be mentioned that the filling of the Whirlpool gully and its offshoots will reclaim a considerable tract of land that will ultimately be of great value for factory sites.

The power-house site, which is at the foot of the steep cliff just above the Lewiston bridge, was difficult of access. An electric shovel is now cutting its way from Queenston to the power-house site, along the bank of the river, about 30 ft. above normal water level. Besides cutting its own path, the shovel is doing the necessary grading for the construction railway, which will run right into the power-house site.

As can be seen from the sketch on page 255, this construction railway connects with the Michigan Central, making use of a portion of the International Railway's present tracks and also of the new tracks that will be built by the International Railway. This new route will give the International Railway a better approach, having a much less dangerous grade, to the Queenston dock, and will also permit the use of the large gully south of the dock as a dump for the material excavated from the power-house site.

The construction railway has been completed from the forebay to Sta. 170, and to the disposal area at St. David's. It has also been constructed from the Welland river to Sta. 40, and will soon be connected between Sta. 40 and Sta. 170. Switching arrangements have been completed at the Welland river for interchanging traffic with the Michigan Central's Welland-to-Niagara Falls line.

The channel south of Hog Island, where the intake will be constructed, is being widened and deepened, and this work is practically completed. The dredge is now working in the Welland river digging out the piers of the old highway bridge. The dredged material is floated down the Niagara river on scows and dumped. An "unloader" is moored to a stone-filled crib in the river, and the scows are controlled by the steel wire cable running from the drum of this "unloader," with the result that only two tugs are required to guide each loaded scow and "spot" it over the dumping site; moreover, the chance of a scow breaking loose from the tugs and going over the Falls is largely obviated.



TRAIN UNLOADING AT ST. DAVID'S DISPOSAL AREA—NOTE LOW-LYING GROUNDS AT LEFT, PROVIDING DUMP 200 ACRES IN EXTENT

The towers for the cableway, which is being used to a great extent in the widening of the Welland river, run on standard gauge tracks. Each tower has two tracks at 40-ft. centres and hauls itself along by its own motor by means of a line to a deadman. No work has been done as yet on the control works at the junction of the canal with the Welland river, nor in connection with the intake itself.

Prof. R. W. Angus, of the University of Toronto, has been engaged this summer and last summer in experiments with hydraulic similarity models at Dufferin Islands, near the Ontario Power Co.'s intake in the Niagara river; and the Chippawa intake, which will extend into the river from Hog Island, as roughly indicated on the plan on page 251, will be built in accordance with the results of these experiments.

It is likely that this structure will be of concrete, so designed as to be able to take the water from the bottom of the river whenever desirable in order to avoid ice.

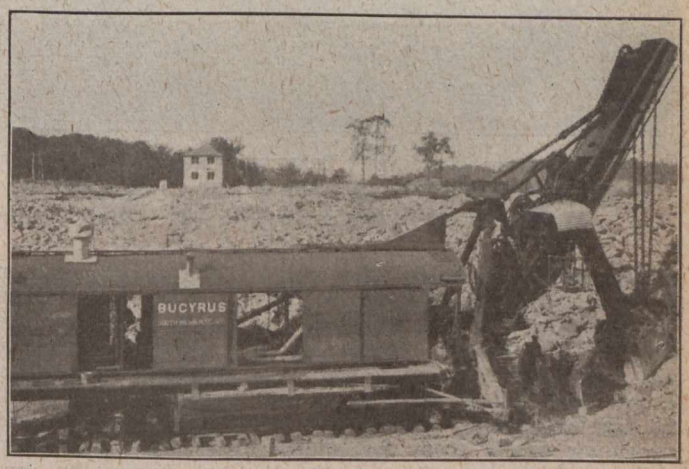
The control works near the junction of the canal and the Welland river will consist mainly of Stoney sluices, so arranged that the canal can be unwatered at any time in case of emergency.

Experiments are now being conducted regarding the relative efficiencies of concrete and gunite (the sand-cement

⅞-Yd. Shovel at the G.T.R. and M.C.R. Diversion

product shot by cement-guns) linings for the portions of the canal that are in rock. It has not yet been fully decided by what method, or to what extent, the canal will be lined. Wherever the canal is in rock, however, it will be lined to a height of at least 30 ft. from the bottom, and in the earth sections it will be lined everywhere to El. 563. At the Welland river for example, the bottom of the canal is approximately at El. 523, so the sides there will be lined for a height of 40 ft.

Over 130 buildings have been built, moved or repaired

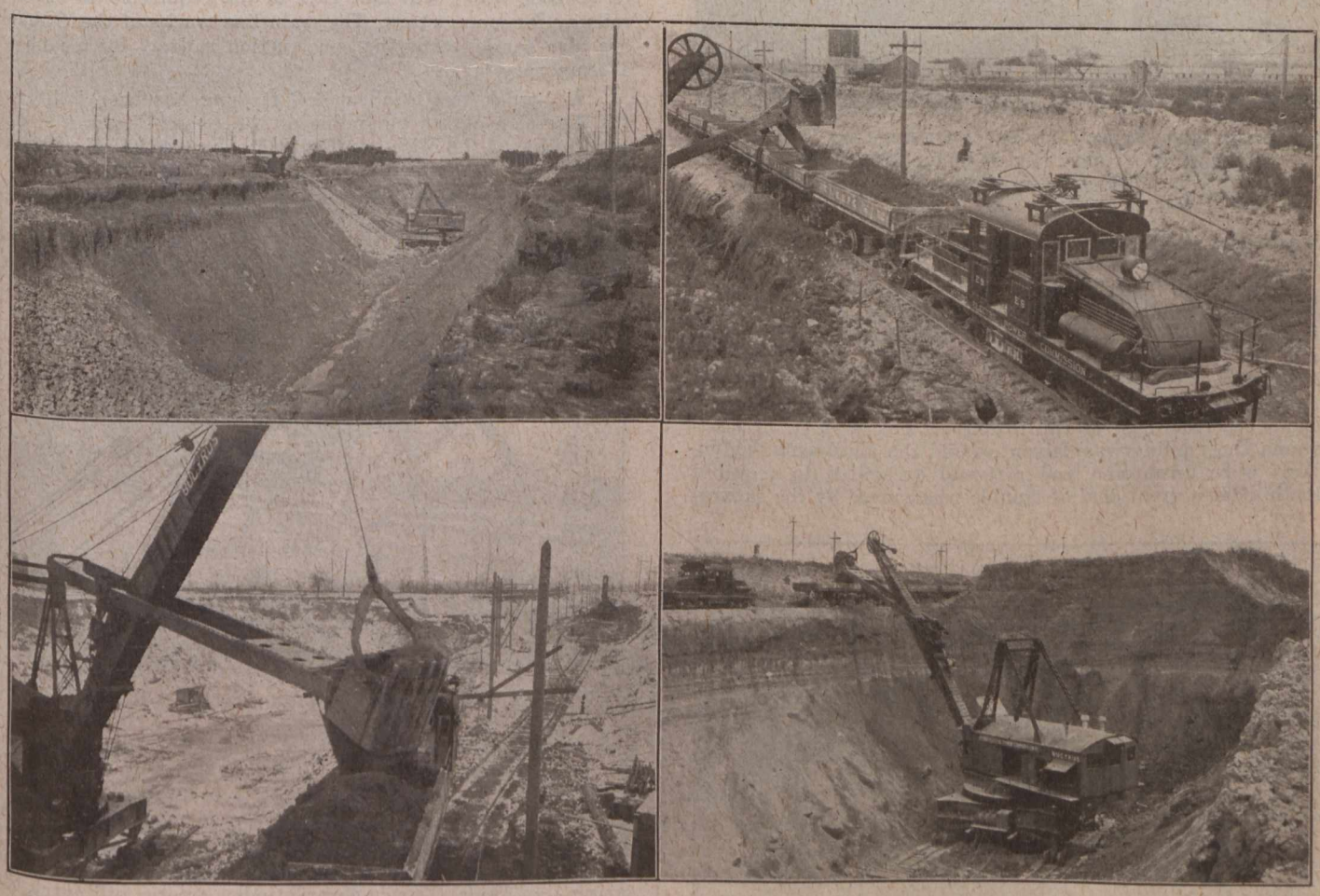


4½-Yd. Shovel in Rock at the Forebay

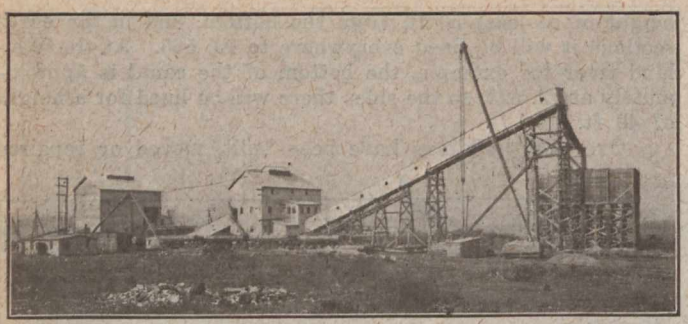
during the course of construction to date. Most of the new buildings are of a temporary nature.

Among other work which is being carried out by the commission to remedy the changes in the landscape that are being caused by the power canal, is the construction of several bridges.

A reinforced concrete arch, 86-ft. span, to carry the Niagara, St. Catharines & Thorold Railway across the canal,

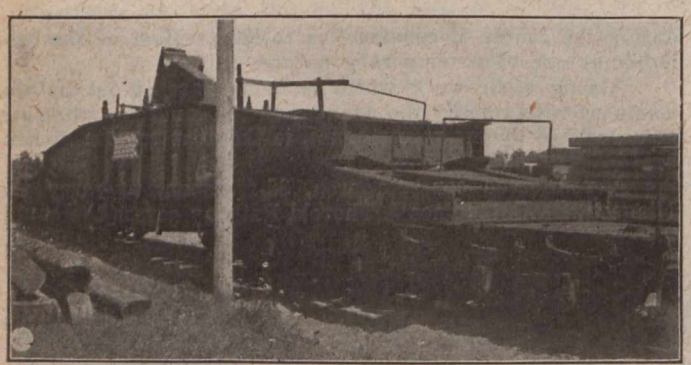


Four Views of One of the 8-Yd. Shovels Working in Earth—Top Left Photo Shows Some Rip Rap in Place—Top Right, Train Being Loaded at Sta. 346+81—Bottom Left, Working South of the Wabash R'y—Bottom Right, Working Against a High Face at Sta. 346+81



CRUSHER PLANT—PRIMARY TRAYLOR CRUSHER AT LEFT, GYRATORIES IN CENTRE, SCREENS ABOUT TO BE ERECTED AT RIGHT—CAPACITY, 3,500 CU. YDS. DAILY

is practically completed. An arch of 100 ft. span has been built to carry the Wabash Railway. Where the Grand Trunk Railway and the Michigan Central Railway cross the line of the canal, the tracks are only about 90 ft. apart; therefore, with a view to future requirements, the skew arches that will carry these railways across the canal will be carried though, making one continuous structure and providing ample room for additional tracks. These two railways have been temporarily diverted during the con-



THE BETHLEHEM STEEL CO.'S SPECIAL ARTILLERY TRUCK WAS REQUIRED TO CARRY THE MASSIVE PARTS OF THE TRAYLOR JAW CRUSHER

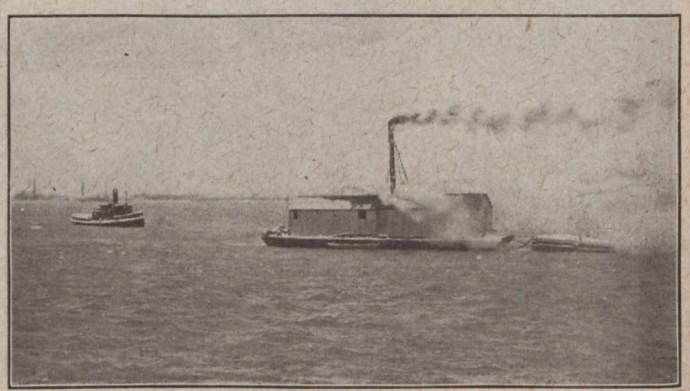
struction of this bridge, and work has begun on the foundations.

The N. St. C. & T. R'y bridge involved the diversion of the existing single track to one side of the bridge site and the construction of a double track reinforced concrete arch with 86 ft. span, having a rise of 25 ft. This arch was designed for Coopers' E-60 loading, and contains approximately 3,500 cu. yds. of concrete and over 90 tons of steel. The depth from base of rail to foundations is 52 ft. Lackawanna sheet piling was driven around the abutments, cofferdams were unwatered and material excavated to required depth after a great deal of trouble was caused by the satura-

DUMPING ROCK FROM TRESTLE FOR FILL AT THE WHIRLPOOL GULLY

tion of the surrounding subsoil. The arch was completed and traffic restored to the original alignment last December. A temporary timber trestle was designed to carry the N. St. C. & T. R'y line over the construction railway tracks, which are in the canal prism and parallel to the centre line of the canal.

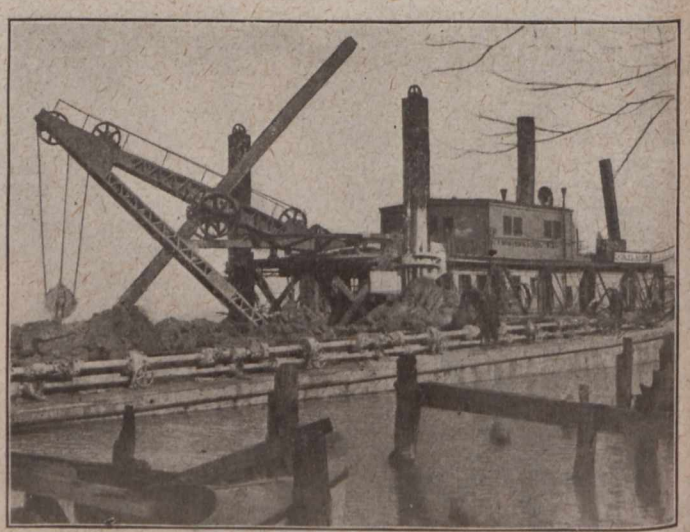
The Wabash line was diverted on a timber trestle over 40 ft. high, extending across the previously excavated canal section. The excavation of the canal prism thus provided natural drainage for the foundations for the 100-ft. reinforced concrete arch. This arch differs in design from the N. St. C. & T. R'y arch, as the Wabash arch has straight wing gravity walls instead of the reinforced cantilever type



SCOW-LOWERING AND REHAULING OUTFIT AT WORK ON THE NIAGARA RIVER

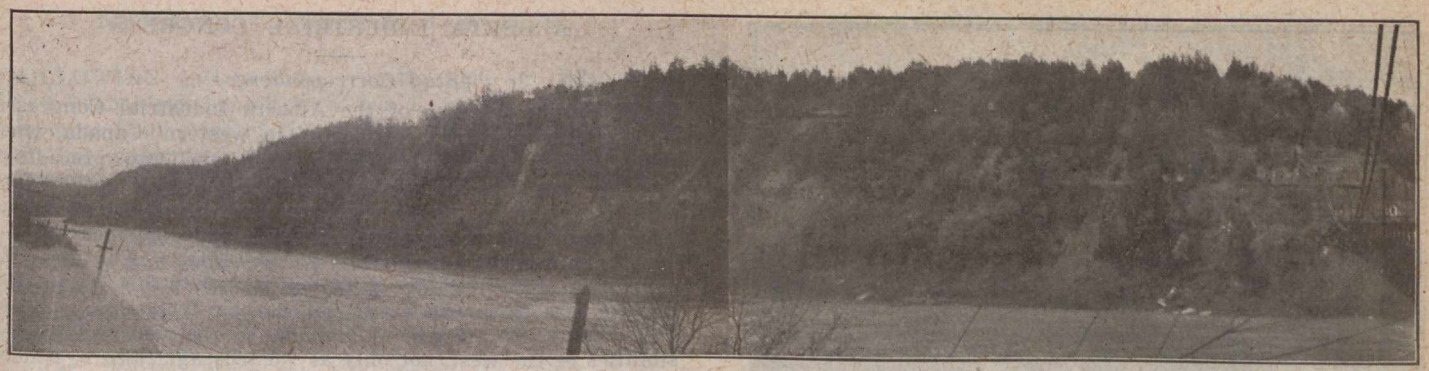
used in the other arch. There are approximately 3,000 yds. of concrete and 65 tons of reinforcing steel in the construction. The structure provides for two tracks, spaced 13 ft. centres, which will take care of the requirements of that railway for many years. The main line tracks of the Wabash are also carried over the construction railway by means of a temporary trestle.

A 3-track trestle about 400 ft. long has been built for the diversion of the main line of the Grand Trunk and the branch line of the Michigan Central. Upon completion of the



DREDGE AT WORK ON THE WELLAND RIVER

outside portions of the new arch, it is intended to re-divert traffic to the present alignment. The new structure will be a reinforced concrete arch, having a span of 72 ft. and rise of 20 ft. and involving the placing of 10,000 cubic yards of concrete and 325 tons of steel. It will provide room for 10 tracks. In the restoration of the G.T.R. and M.C.R. to the original alignment, a temporary timber trestle will carry the tracks over the construction railway. The trestles for diversion and relocation of these railways involve the use of over 300,000 ft. of timber.

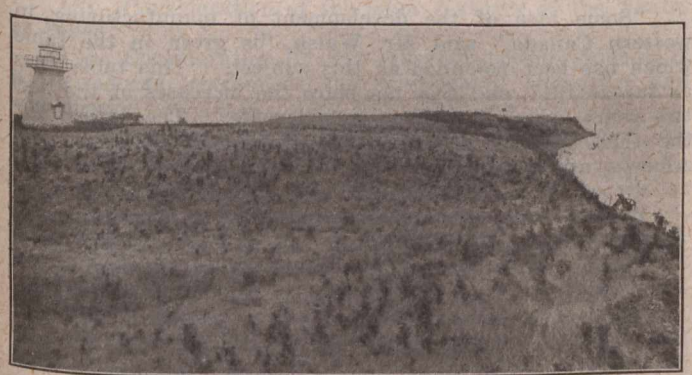


VIEW FROM EAST END OF LEWISTON BRIDGE, SHOWING NATURE OF THE CLIFF ALONG WHICH ⅞-YD. ELECTRIC SHOVEL IS CUTTING PATH FOR CONSTRUCTION RAILWAY, 30 FT. ABOVE WATER LEVEL

The completion of these three arches will greatly assist the progress of excavation, as the equipment will then be free to move to any point, and the innumerable delays occasioned by the railways will be entirely eliminated, and the output of the excavating equipment will not be hampered in its course to the disposal area.

At Lundy's Lane, the highway is now being diverted to the north to a point where the construction railway is at the same elevation as the original ground line. This is preparatory to making the cut at Lundy's Lane, after which a highway bridge will probably be constructed across the canal at a point most favorable in respect to grades and detours.

Two new bridges must be built across the Welland river on account of the enlargement of that stream. These bridges will be of steel, and excavation is now in progress for their foundations. The Michigan Central Railway bridge will be a

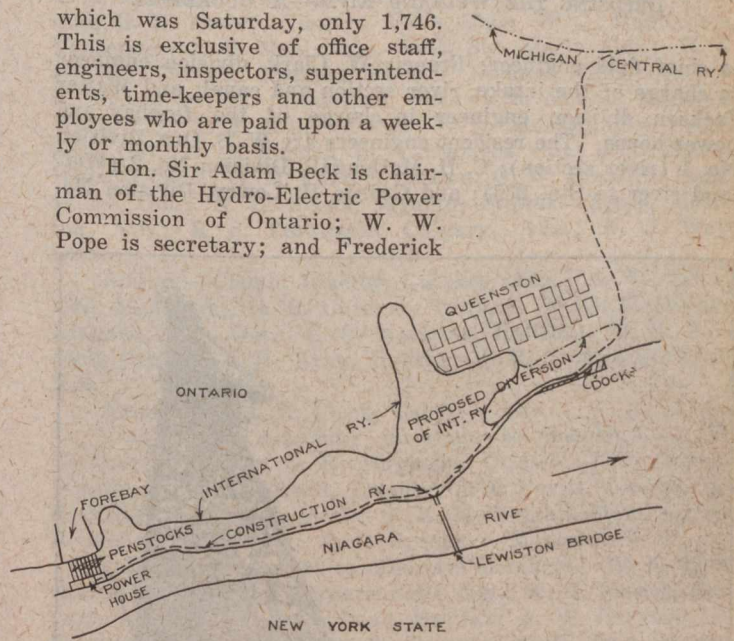


LOOKING ACROSS NIAGARA RIVER FROM HOG ISLAND—THE INTAKE WILL EXTEND INTO THE RIVER FROM THIS ISLAND

swing span, and the highway bridge will be a bascule, with a 90-ft. leaf.

The number of men on the daily pay-roll varies considerably; for instance, on August 14th, 1919, exactly 1,884 men reported for work; the following day, 1,905; on August 16th, which was Saturday, only 1,746. This is exclusive of office staff, engineers, inspectors, superintendents, time-keepers and other employees who are paid upon a weekly or monthly basis.

Hon. Sir Adam Beck is chairman of the Hydro-Electric Power Commission of Ontario; W. W. Pope is secretary; and Frederick

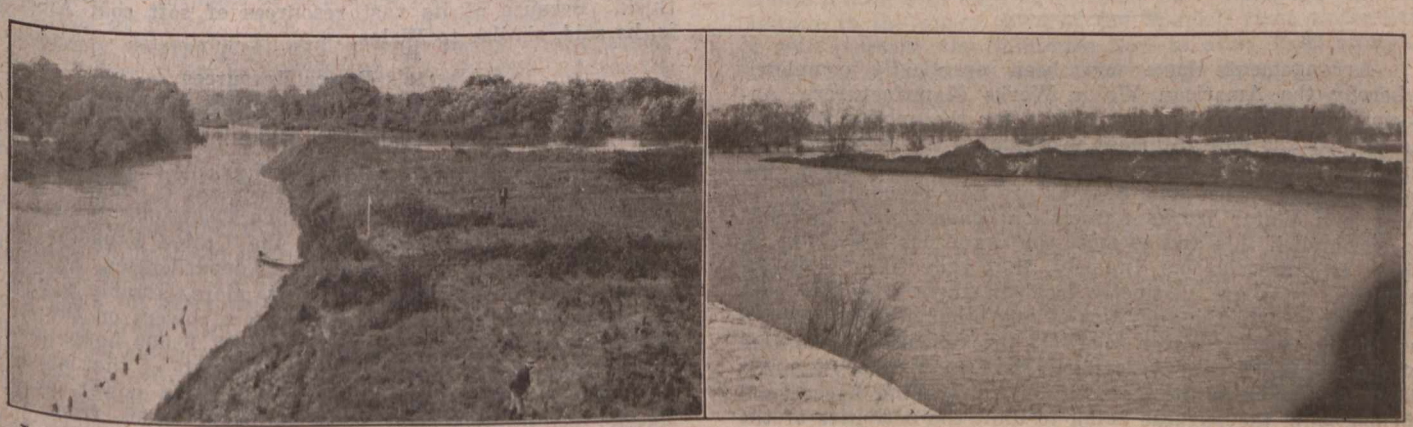


PLAN SHOWING ROUTE OF QUEENSTON CONSTRUCTION RAILWAY NOW BEING GRADED, AND PROPOSED DIVERSON OF INTERNATIONAL RAILWAY'S LINE TO THE DOCK

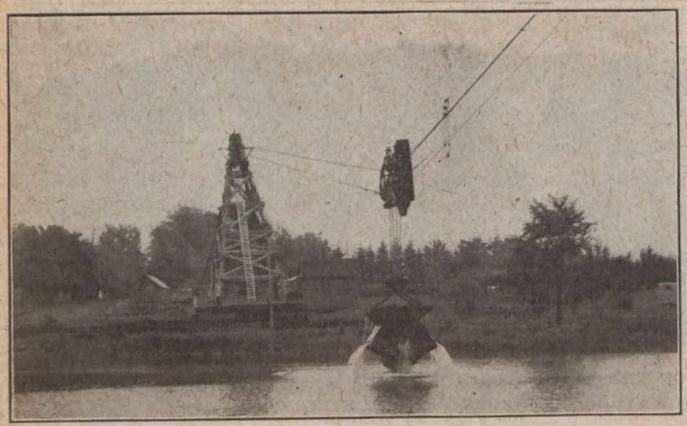
A. Gaby is chief engineer. The design and construction of the Queenston-Chippawa project, with the exception of the electrical work, are under the direction of the Commission's hydraulic department, of which Henry G. Acres is the hydraulic engineer; Thos. H. Hogg, assistant hydraulic engineer; and Max V. Sauer, designing engineer.

E. T. Brandon is the electrical engineer of the Commission; and Arthur H. Hull, assistant electrical engineer.

At Niagara Falls there is a large staff under the direction of J. B. Goodwin, works engineer, and of George Angell, general superintendent of construction. A. C. D. Blanchard

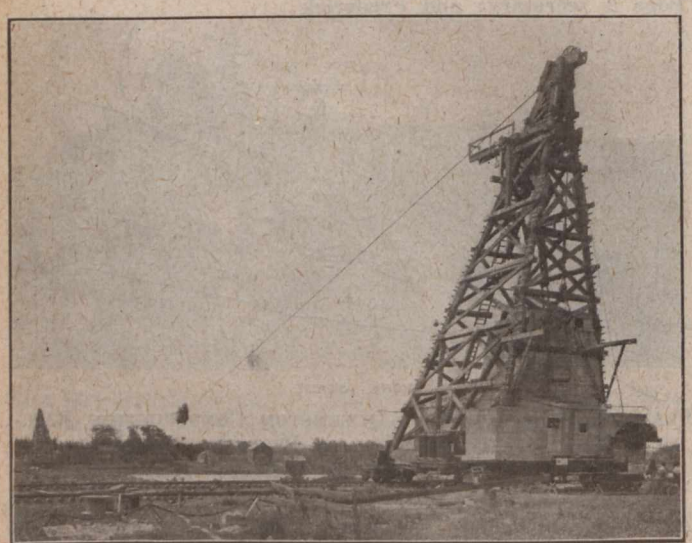


LOOKING UP THE WELLAND RIVER, HOG ISLAND AT THE RIGHT—BEFORE AND AFTER WIDENING THE INTAKE CHANNEL OF THE CANALIZED RIVER SECTION



DREDGING THE WELLAND RIVER—A BUCKETFUL

is chief field engineer; Francis W. Clark, division engineer in charge of the intake, river section and canal; and Walter Jackson, division engineer in charge of the forebay and power-house. The resident engineers are W. S. Orr, Division No. 1 (river section); C. H. McDougall, Division No. 2 (Welland river to Sta. 235); and George H. Lowry, Division No.



THE CABLEWAY EXCAVATOR HAS AN 800 FT. SPAN

3 (Sta. 235 to Sta. 438). Channel Anderson is superintendent of Division No. 1; F. W. Scriven, of Division No. 3; and W. L. LeRoy, of Division No. 4 (forebay, power-house and Queenston construction railway). Harold L. Bucke is superintendent of railway construction; R. T. Gent, plant engineer; P. Reid, mechanical superintendent; and F. F. Cooper, chief clerk.

Arrangements have now been practically completed whereby the American Water Works Manufacturers' Association will assume responsibility for the exhibit features as well as the entertainment program of the New England and also the Southwestern Water Works Association conventions, along the same lines as are now prevailing at the American Water Works Association conventions. In order to accomplish this and to meet the conditions prevailing in these two associations (namely, that they have associate members who are distinctly local in their character and not interested in the activities of any other association such as the American Water Works), the executive committee of the Manufacturers' Association have unanimously approved amendments to the constitution establishing a sectional membership, the purpose being to limit the activities of the sectional members to the one organization with which they are associated.

ALBERTA INDUSTRIAL CONGRESS

(Staff Correspondence)

THE opening session of the Alberta Industrial Congress, the first meeting of its kind in western Canada, was held August 13th, in Calgary. On the two preceding days the delegates had visited Medicine Hat and Lethbridge with a view to seeing the southern portion of the province. After spending two days in Calgary for the business meetings, they went to Edmonton on the 15th. The general impression gained by the delegates was that this is the beginning of a movement which will develop from year to year and awaken the people of Canada to the wonderful possibilities of the west, not only as regards agriculture, which is already recognized, but for industrial purposes. M. A. Brown, mayor of Medicine Hat, acted as chairman of the Congress.

The congress received several addresses of outstanding interest. Dr. A. B. Macallum, chairman of the Council for Scientific and Industrial Research, said that Alberta's coal supply would last only five thousand years with the present population or two thousand years with a population of twenty millions. Canada needed an organized institution that would direct the development of her natural resources. Eugene Coste said Alberta had the biggest oil fields in the world, 1,600 miles by 300 miles wide. A defense of government ownership of railways in its practical working was made by E. A. Warren, general manager of the Canadian National Railways.

Development of the West

A remarkable story of the industrial development of the west in general, and Alberta in particular, was told by J. E. Walsh, general manager of the Canadian Manufacturers' Association.

"Some idea of the development of manufacturing in western Canada," said Mr. Walsh, "is given in the table which has been compiled on this subject. This table goes as far as 1917, and does not show the increases of the last two years, which have been considerable. The figures for the three prairie provinces—Manitoba Saskatchewan and Alberta, are:—

Year.	No. of Establishments.	Capital.
1900	429	$ 9,229,561
1905	554	37,036,193
1910	902	84,479,837
1915	1,881	154,874,530
1917	4,082	197,475,107

"These figures show what a remarkable increase took place in the last two years accounted for. For the period between 1900 and 1917, the figures for the whole of Canada are: In 1900, number of establishments, 14,650, and capital $446,916,437. In 1917 there were, established 34,380 and capital $2,772,517,680."

"The Coal Areas in Alberta" was the subject of an address by D. B. Dowling. He traced the geological formation of the Alberta coal fields and mentioned the surface seam of anthracite in the Crow's Nest district, which is 135 feet thick. Because of its vast resources of soft coal Alberta is, he said, similar to Wales.

Alberta's Power Resources

James White, assistant to the chairman of the Commission of Conservation, dealt with "Power of Alberta—Water, Coal and Natural Gas." Referring to the development of power throughout the world, he stated that 75,000,000 horsepower had been developed, of which 29,000,000 is used in the United States, 13,000,000 in the United Kingdom and 6,000,000 in the British Dominion and dependencies. So far as water power is concerned, Calgary is more valuably situated than any other city in Alberta, the six powers on the Bow River having an aggregate minimum of 60,000 horse-power with regulated river and less than one-half of that amount with unregulated river. The Rocky Rapid power on the Northern Saskatchewan, which is sixty miles from Edmonton, would require the erection of a dam 85,000 feet

(Concluded on page 266)

NATIONAL INDUSTRIAL CONGRESS

FOLLOWING the meeting recently held in Ottawa by the labor sub-committee of the Reconstruction and Development Committee of the Cabinet, the Dominion government has announced that a national industrial conference will be held in Ottawa, beginning September 11th. Following is the agenda:—

(1) Consideration of the question of the desirability of unifying and co-ordinating the existing labor laws of the Dominion parliament and of the provincial legislatures, and the consideration of any new labor laws which are deemed necessary.

(2) Consideration of: (a) Employees' right to organize; (b) recognition of labor unions; (c) the right of employees to collective bargaining.

(3) Consideration of: (a) The recommendations of the Royal Commission on Industrial Relations in favor of the establishment of a bureau to promote the establishment and development of Joint Industrial Councils; (b) the further recommendations of the Royal Commission on Industrial Relations regarding the establishment of joint plant and industrial councils.

(4) Consideration of the recommendation of the Royal Commission on Industrial Relations respecting hours of labor.

(5) Consideration of minimum wage laws.

(6) Consideration of the recommendation of the Royal Commission on Industrial Relations that the findings of the commission be put into effect in all work controlled by the government where the principles of democratic management can be applied.

(7) Consideration of resolutions relating to any other features of the Royal Commission report.

(8) Consideration of the labor features of the Treaty of Peace.

(9) Consideration of any other proposals which may be introduced bearing on the relations of employers and employees.

In connection with the present industrial situation, Sir Robert Borden has issued the following statement:—

"As announced in the Governor-General's speech at prorogation, it is the intention of the government to summon, within a few weeks, a representative conference for the purpose of an intimate and friendly discussion of relations between employers and employed, and for consideration of the report of the industrial relations commission. The provincial governments will be invited to attend, and the various organizations of employers and employed will be requested to appoint representatives. It is hoped that such a conference will be productive of better understanding and a more thorough co-operation. Meantime, it is most important that actual working conditions should be fully realized by the Canadian people. For five years the world has been wasting the productive capacity of about 50,000,000 men actually engaged in warlike activities. The remainder of the producing population has been to a considerable extent occupied in producing munitions and instruments of destruction. Millions of men must now resume the normal activities of peace. The business of the world has been completely disorganized, and a long period will probably elapse before it can be completely re-established. After the present period of inflation has passed, Canada, in common with other countries, probably will face a period of depression.

"To meet the possible imminence of such conditions, the government has pledged the credit of the country to a very large extent in order to provide employment for the gallant men returning to our shores from war service, and for those engaged in war industries which now have ceased. Many employers of labor have undertaken work at little or no profit in order that their lines of industry might afford every possible opportunity for employment. Up to the present such employment has been fairly abundant, but this condition may not continue indefinitely. Efforts to provide employment will obviously be of little avail if the energy of the country is exhausted in lockouts or strikes occasioned by differences which ought to be settled by peaceful methods."

ENGINEERING INSTITUTE ELECTIONS

AT a meeting of the Engineering Institute of Canada, held August 19th in Montreal, the following elections and transfers were announced:—

Members.—T. J. Locke, Shelburne, N.S.; F. D. Reid, Cobalt, Ont.; Sven Svenningson, Montreal.

Associate members.—J. N. Anderson, Vancouver; C. L. Archibald, St. John, N.B.; G. W. Beresford, Ottawa; H. M. Bigwood, Victoria; R. E. Buckley, Niagara Falls, Ont.; M. A. Burbank, Winnipeg; W. R. Campbell, Campbellton, N.B.; W. B. Crombie, Niagara Falls, Ont.; F. M. Dawson, Westmount, P.Q.; C. H. Ellison, Firdale, Man.; C. C. Elliott, Brooks, Alta.; J. L. Franzen, Medicine Hat, Alta.; R. P. Freeman, Halifax; S. R. Frost, Niagara Falls, Ont.; L. L. Gisborne, Niagara Falls, Ont.; William Harland, Toronto; T. L. Hughson, Niagara Falls, Ont.; W. A. Janssen, Montreal; G. H. Lowry, Niagara Falls, Ont.; W. J. MacKenzie, Vancouver; J. G. MacLaurin, Sault Ste. Marie, Ont.; E. S Malloch, Ottawa; Norman Malloch, Niagara Falls, Ont.; J. B. McAndrew, St. Catharines, Ont.; Lyle McCoy, Montreal West, P.Q.; T. S. Mills, Ottawa; W. G. Montgomery, Peterboro, Ont.; R. C. Morgan, St. Catharines, Ont.; J. B. Petrie, Wabana, Nfld.; G. M. Ponton, Ottawa; O. W. Ross, St. Catharines, Ont.; H. R. Silcox, Toronto; Stewart Troop, Moncton, N.B.; R. S. Trowsdale, Calgary, Alta.; E. O. Way, Ottawa.

Juniors.—Claude Bradley, Calgary, Alta.; A. W. Crawford, Hamilton; D. B. Gardner, Toronto; N. G. McDonald, Niagara Falls, Ont.; C. S. MacLean, Halifax; W. B. Pennock, Ottawa; J. H. Ryan, Halifax; F. B. Young, St. John, N.B.

Associates.—J. F. Block, Calgary, Alta.

Transferred, associate members to members.—J. R. Cockburn, Toronto; G. H. Ferguson, Ottawa; J. F. Greene, Winnipeg; A. R. Holmes, Toronto; I. H. Nevitt, Toronto; H. R. Miles, Lethbridge, Alta.; G. K. McDougall, Montreal; D B. McLay, Vancouver; A. R. Sprenger, Montreal.

Transferred, juniors to associate members.—W. E. Blue, Ottawa; J. W. Ford, Niagara Falls, Ont.; M. H. French, Calgary, Alta.; F. I. C. Goodman, Halifax; A. W. Gregory, St. Stephen, N.B.; R. B. Harkness, Toronto; W. W. Hay, Rogers, Mich.; B. B. Hogarth, Ottawa; R. G. Lye, Toronto; J. A. MacGillivray, Winnipeg; R. C. MacLachlan, St. Catharines, Ont.; H. M. Morrow, Montreal; F. O'B. Nehin, Montreal; J. H. Norris, Montreal; J. B. Shaw, Victoria; J. C. Stewart, Ottawa; Norman Wilson, Ottawa.

Transferred, students to associate members.—J. E. Barcelo, Montreal; E. R. Marien, Quebec.

Transferred, students to juniors.—Theodore Dery, Rimouski, P.Q.; R. C. Ward, Toronto.

At Big Eddy, on the Spanish river, Algoma District, Ont., the International Nickel Co.'s conservation dam, now being constructed, will raise the level of the river 100 ft., and will create a lake with an area of 15 sq. mi. Combined with the storage in the upper third of the Spanish river watershed, it will increase the minimum flow to over 1,800 c.f.s., or almost three times the natural low-water flow.

The New South Wales government intends to proceed immediately with a scheme for a large hydro-electric development, says the weekly bulletin of the Department of Trade and Commerce of Canada. Complete plans have been prepared for two independent schemes, the estimated cost of which is about a million dollars. Of this amount it is expected that half will be spent during the next twelve months. Although there is an ample supply of water power at various points throughout the state, it has not previously been developed and all power at present is derived from coal. When the plans and specifications for the proposed schemes are ready, they will be forwarded to the Department of Trade and Commerce at Ottawa for the convenience of Canadian manufacturers who may wish to tender on some of the equipment.

ECONOMIES OF REINFORCED CONCRETE WALLS FOR UNCOVERED RESERVOIRS*

By H. E. Babbitt
Associate in Municipal and Sanitary Engineering, University of Illinois

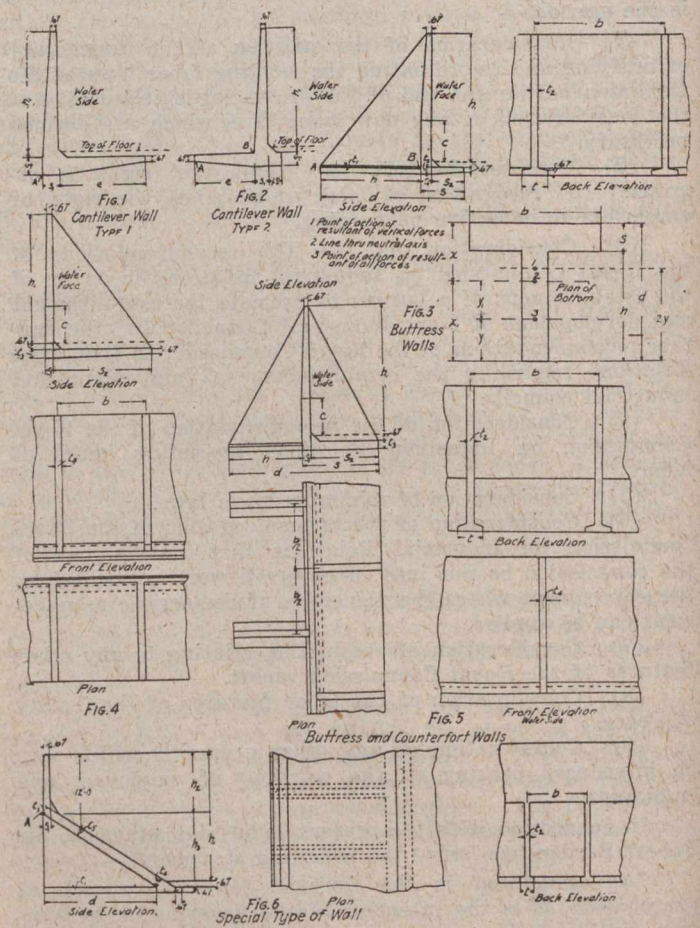
In the design of a reinforced concrete wall for an uncovered reservoir the choice of the type of wall is dependent mainly upon economy. The determination of the most economical wall for any particular conditions can be made by designing walls of various types to fulfill the conditions and making a detailed estimate of cost from these designs. Such designs have been made for walls varying in height from 5 to 30 ft., either with or without earth backing. The types of walls studied are shown in Figs. 1 to 6 inclusive. The least volume of concrete per foot of length of these walls for different heights is shown in Figs. 7 and 8. The relative economy of the different types of walls is indicated by the relative amount of concrete in the different types. The difference in the volume of concrete and therefore the economy of the "special" type of wall, compared with the cantilever wall, is striking.

Although the cost of reinforced concrete walls is not directly proportional to the volume of concrete, for any two walls of the same height and with the same loading, the relative cost is approximately as the volume of concrete. The amount of steel is approximately proportional to the volume of the wall. The cost of the form work is dependent more on the type of wall than upon the volume of concrete. Since the amount of form work on the "special" wall is somewhat greater than for the cantilever wall, the apparent saving by the use of the "special" type is somewhat reduced, but the relative economies of the different types is unaffected.

These designs were based on a factor of safety against overturning of 2. The working strength of steel was taken as 16,000 lbs. per sq. in., and of concrete as 650 lbs. per sq. in. No section less than 8 in. thick was used. The greatest intensity of foundation pressure was 6,000 lbs. per sq. ft. The "active" earth backing was assumed to act as a liquid weighing 20 lbs. per cu. ft. Although these assumptions may not be in accord with all conditions of design, a difference in the unit stresses, thicknesses, etc., will affect all types of wall alike and will not affect the relative economy.

*From "Engineering and Contracting," Chicago.

In making the designs of these walls the relative economy of various details was developed. In the cantilever wall the economical length of the footing is shown in Fig. 9. For the buttress walls, the economical buttress spacing, the best details of the buttresses, and the effect on the volume of the wall by a change in the buttress spacing are shown in Figs. 10 and 11. Similar details are shown for the other



FIGS. 1-6—TYPES OF WALL STUDIED TO DETERMINE MOST ECONOMICAL DESIGN

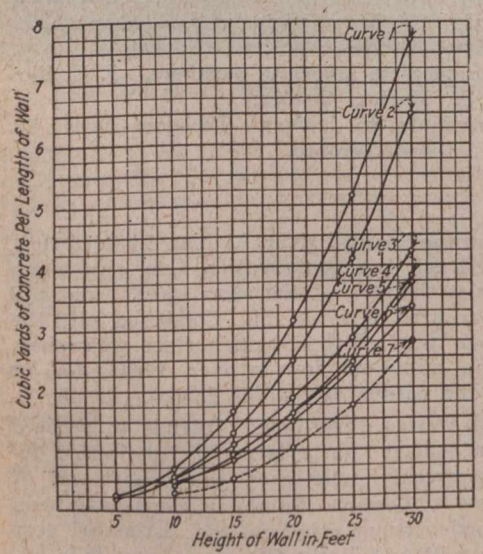


FIG. 7

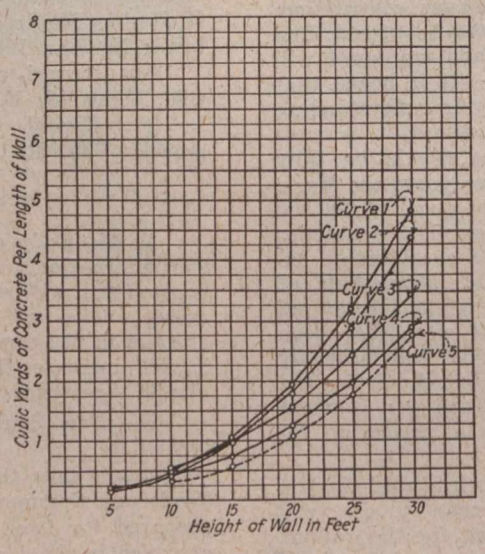


FIG. 8

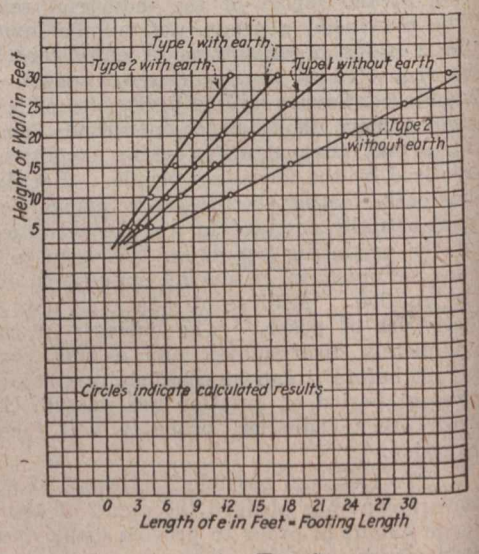


FIG. 9

FIG. 7—AMOUNT OF CONCRETE IN DIFFERENT TYPES OF WALLS WITHOUT EARTH BACKING: Curve 1, Cantilever Wall, type 2; Curve 2, Cantilever Wall, Type 1; Curve 3, Counterfort Wall; Curve 4, Buttress Wall; Curve 5, Buttress and Counterfort Wall; Curve 6, Special Type of Wall; Curve 7, Special Type of Wall Minus the Quantity of Concrete in a Floor 0.67 Ft. Thick and the Same Width as the Base of the Wall. FIG. 8—AMOUNT OF CONCRETE IN DIFFERENT TYPES OF WALLS WITH EARTH BACKING: Curve 1, Cantilever Wall, Type 1; Curve 2, Cantilever Wall, Type 2; Curve 3, Counterfort Wall; Curve 4, Buttress Wall; Curve 5, Special Type of Wall Without Earth Backing Minus the Quantity of Concrete in a Floor 0.67 Ft. Thick and the Same Width as the Base of the Wall. FIG. 9—FOOTING LENGTHS FOR CANTILEVER WALLS: Circles Indicate Calculated Results.

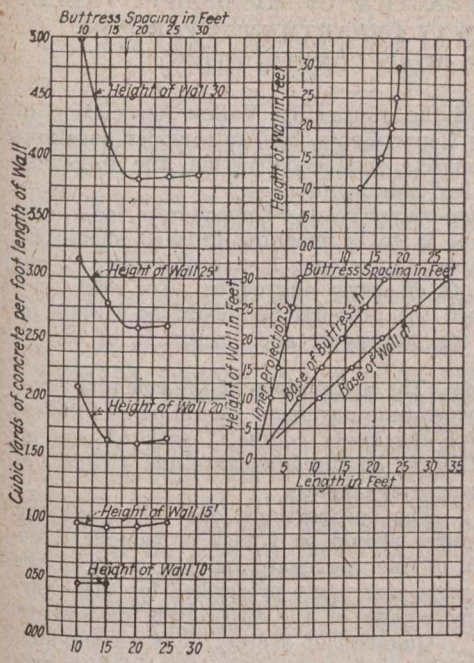


FIG. 10—ECONOMIES OF DETAILS OF BUTTRESS WALLS WITHOUT EARTH BACKING

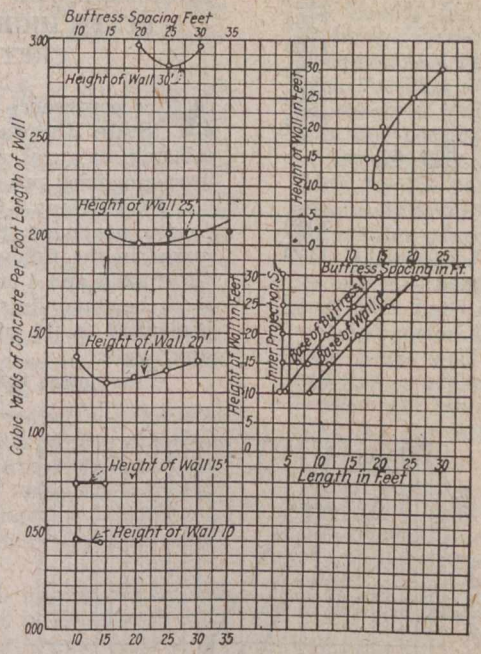


FIG. 11—ECONOMIES OF DETAILS OF BUTTRESS WALLS WITH EARTH BACKING

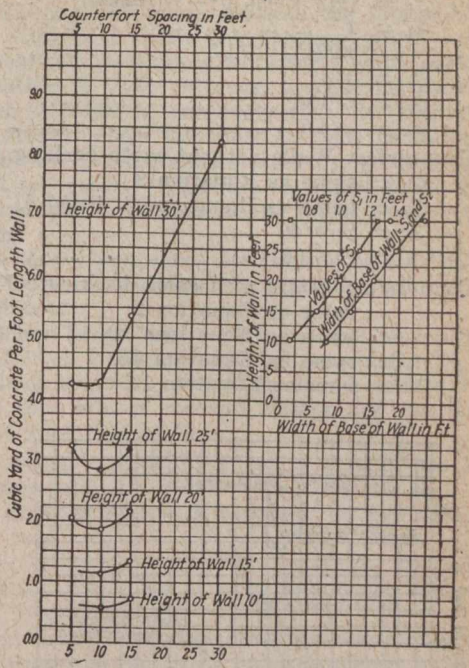


FIG. 12—ECONOMIES OF DETAILS OF COUNTERFORT WALLS WITHOUT EARTH BACKING

types of walls in Figs. 12 to 15.

In determining the volume of concrete in the walls the resisting moment against overturning of all portions of the wall was expressed in terms of as few unknown dimensions as possible. The resisting moment was equated to twice the overturning moment. When it was not possible to express the resisting moment in terms of only one dimension, all but one dimension were assumed and the unknown dimension solved from the equation. With all dimensions known the determination of the volume of the wall was a matter of solid geometry. New values of the assumed dimensions were tried until the least volume of concrete for the given height of the wall was found. It was in the process of such computations that the economical dimensions of the various details were found.

The expressions for the dimensions of various portions of the walls were determined either analytically or by trial in such a manner as to make possible the expression of the resisting moment in but few unknown terms. For certain details the economical dimension is that dimension which will give the least amount of material commensurate with the load which is to be supported. In other details the economical dimension is not a function of the load. Those dimensions which depend almost directly on the load were determined analytically, whereas those dimensions which are not direct functions of the load were determined by a method of trial. The following is a summary of the formulas for the details of all of the walls. In addition to the notation on the figures the ordinary notation used in reinforced concrete has been used except that S'_1 represents the effective depth of a beam and S_1 represents the actual depth.

Cantilever Walls. Types 1 and 2, with or without earth backing. Figs. 1 and 2:—

$$S_1 = M^{1/2}/100 \quad \ldots\ldots (1)$$

Buttress Walls without earth backing. Fig. 3.

$$C = [b(b^2+20h_1^2)^{1/2}-b^2]/10h_1 \quad \ldots\ldots (2)$$

$$S_1 = ch_1^{1/2}/18 \quad \ldots\ldots (3)$$

$$S_1 = [b(h_1-c)^{1/2}]/40 \quad \ldots\ldots (4)$$

$$S_1 = [b(b^2+20h_1^2)^{1/2}-b^2]/180h_1^{1/2} \quad \ldots\ldots (5)$$

$$S_2 = h_1/4 \quad \ldots\ldots (6)$$

with limit of—

$$S_2 = 18S_1/h_1^{1/2} \quad \ldots\ldots (7)$$

Spacing of Counterforts and Buttresses closely 15 ft. for all heights of walls between 15 and 30 ft. high.

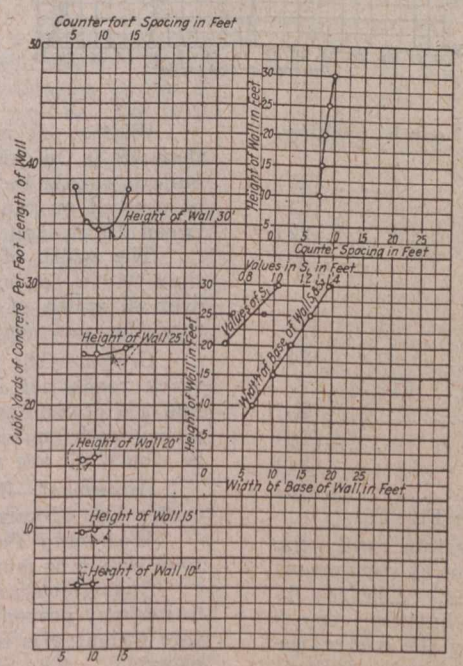


FIG. 13—ECONOMIES OF DETAILS OF COUNTERFORT WALLS WITH EARTH BACKING

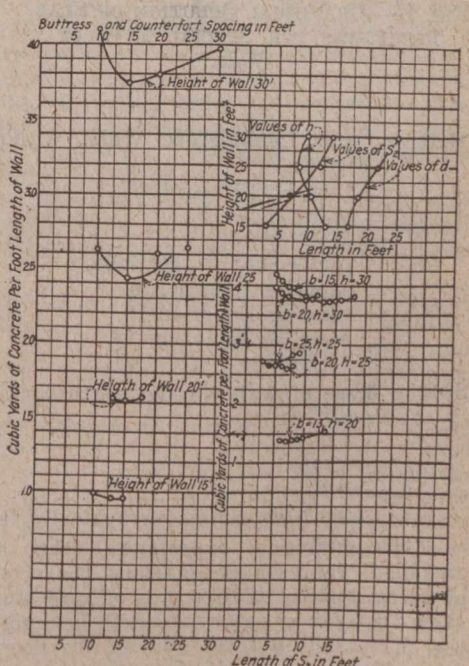


FIG. 14—ECONOMIES OF DETAILS OF BUTTRESS AND COUNTERFORT WALLS WITHOUT EARTH BACKING

$$t = 0.003h_1^2+0.05b+1.5 \quad \ldots\ldots (8)$$

$$t_1 = 0.71(t-t_3)/2, \text{ or approximately } 0.3t \quad \ldots\ldots (9)$$

$$t_2 = h_1/15 \quad \ldots\ldots (10)$$

$$t_3 = S_2h_1/18 \quad \ldots\ldots (11)$$

Buttress Walls with earth backing. Fig. 3:—

C = same as Equation 2.

$$S_1 = ch_1^{1/2}/22 \quad \ldots\ldots (12)$$

$$S_1 = b(h_1-c)/50 \quad \ldots\ldots (13)$$

$S_1 = [b(b^2+20h_1^2)^{1/2}-b^2]/220h_1^{1/2}$ .....(14)
$S_2 = 4$ .....(15)
$t = 0.004h_1^{3/2}b^{1/2}1.5$ .....(16)
$t_1 = 0.3t$ .....(9)
$t_2 = h_1/15$ .....(10)
$t_3 = h_1/4.5$ .....(17)

Counterfort Walls without earth backing. Fig. 4: —
C = same as Equation 2.
S_1 = same as Equations 3, 4 and 5.
$t_3 = bh_1^{1/2}/40$ .....(18)
$t_4 = (h_1+60)/90$ .....(19)

Counterfort Walls with earth backing. Fig. 4:—
C = same as Equation 2.
S_1 = same as Equations 12, 13 and 14.
t_3 = same as Equation 18.
t_4 = same as Equation 19.

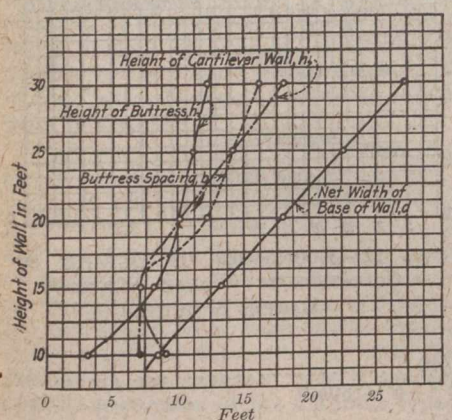


FIG. 15—ECONOMIES OF DETAILS OF SPECIAL TYPE OF WALL WITHOUT EARTH BACKING

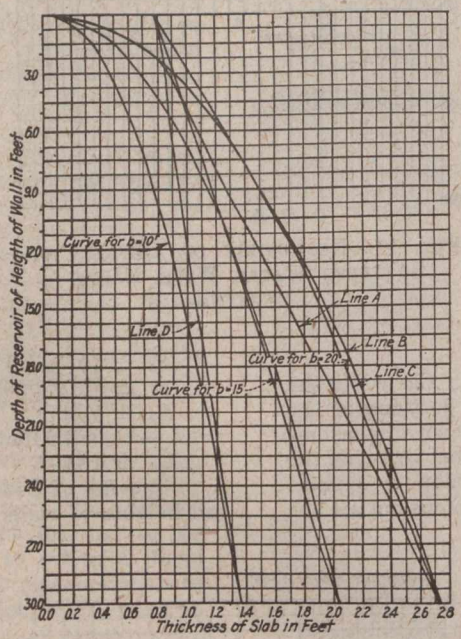


FIG. 16—GRAPHICAL SOLUTION OF SLAB THICKNESS FOR SPECIAL TYPE OF WALL*

Buttress and Counterfort Walls without earth backing. Fig. 5:—
$C = [b(b^2+8h_1^2)^{1/2}-b^2]/40h_1$ .....(20)
$S_1 = ch_1^{1/2}/18$ .....(21)
$S_1 = b(h_1-c)^{1/2}/80$ .....(22)
$S_1 = [b(b^2+80h_1^2)^{1/2}-b^2]/720h_1^{1/2}$ .....(23)
t_1 = same as Equation 9.
t_2 = same as Equation 10.
t_3 = same as Equation 18.
$t_4 = (h_1+6)/24$ .....(24)

Special Type of wall without earth backing. Fig. 6:—
$S_1 = h_2^{3/2}/31$ .....(25)
$t = 1.5$ .....(26)
$t_2 = h_3/15$ .....(27)
$t_1 = 0.67$ .....(28)
t_2, t_4 and t_5 determined graphically from Fig. 16.

The analytical expressions taken together with the graphical representations show the economical dimensions of every portion of the types of wall studied. The results show that for a wall with earth backing a buttress type is the cheapest unless the gain of the floor by the use of the "special" type is taken into account. For walls without earth backing the "special" type is the most economical, regardless of consideration of the saving in the floor area.

*The curves of Fig. 16 represent correct thickness of slab in accordance with the expression $t = bh^{1/2}/40$. Straight lines represent approximate solutions as used.

G. T. Milne, of Montreal, H.M. Senior Trade Commissioner for Canada and Newfoundland, is being transferred to Cuba as commercial secretary to the British legation in Havana.

RECOMMENDED PRACTICE OF MISSISSIPPI VALLEY STATE HIGHWAY DEPARTMENTS FOR CONCRETE ROAD CONSTRUCTION

AT a conference of the Mississippi Valley Association of State Highway Departments, held to consider questions relating to rural concrete road construction, the following "recommended practice" was adopted:—

Proportions.—One-course road: The concrete for a one-course pavement that is to be machine finished should be mixed in the following proportions: 1 sack of cement, 2 cu. ft. of sand and 4 cu. ft. of coarse aggregate. For work that is to be hand finished the proportions should be 1 sack of cement, 2 cu. ft. of fine aggregate and 3½ cu. ft. of coarse aggregate.

Two-course road: The proportions of the concrete for a two-course pavement should be as follows: For the lower course, 1 sack of cement, 2 cu. ft. of fine aggregate and 4 cu. ft. of coarse aggregate.

The proportions for the wearing course should be 1 sack of cement, 2 cu. ft. of fine aggregate and 3½ cu. ft. of the coarse aggregate prescribed for the wearing course of the two-course pavements.

Quantity of Water: It is recommended that extreme care be employed in proportioning the mixture as regards water content, and that this fact be checked by the slump test as follows: For the test, 6 by 12 in. cylinders should be tamped full of the concrete as mixed and the cylinder immediately removed. For work that is to be finished by hand, the slump of the concrete upon removing the cylinder should not exceed 6 in. and for work that is to be machine finished the slump should not exceed 2 in.

Thickness.—The thickness should be not less than 7 in. at the sides nor 8 in. at the centre for two-track roads up to 20 ft. in width. The thickness for single-track roads should be not less than 7 in. at any point.

Widths.—It is inadvisable to build concrete roads less than 18 ft. in width. Where a single-track road must be built it should be made 9 ft. in width and the 9 ft. should be centred on the centre line. Pavements with widths between 10 ft. and 16 ft. should not be built.

The width of grade to be traveled should be not less than 24 ft. for any width of pavement and the minimum over-all width of shoulders should be at least 8 ft. more than the pavement width.

Crown.—The crown should be a total of 1 in. for two-track roads not exceeding 20 ft. in width. If on centre line the crown for single-track roads should be ½ in. If placed with one edge on the centre line the surface should be sloped all one way with a total slope of 1 in.

Alignment.—No radius should be less than 200 ft. on centre line of turns.

Whitening Turns.—On all turns the centre line of the road should be marked by a white strip 8 in. wide.

Superelevation of Curves.—Except when drainage condition may prevent, the grade of the original centre line before widening is to be maintained where pavement is superelevated. The crown of the surface is to be flat where pavement is superelevated.

Grades.—Concrete pavements can be successfully constructed on any maximum grade likely to prove best from general economic consideration. In the middle west maximum grades exceeding 6 to 8% should not be adopted under ordinary circumstances.

Considering the permanency of concrete surfacing a greater expenditure of money is justified in eliminating frequent and minor breaks or changes in grade than is the case with a less permanent type of road.

Vertical curves on steep grades should be sufficiently long to give an unobstructed view of at least 250 ft.

Subgrade.—It is recommended that if possible the subgrade for a concrete pavement be not trenched out and that it be kept higher than the berms, so as to provide drainage directly to the side ditches.

Very careful attention should be given to the rolling of the subgrade. It is recommended that a macadam type of roller be used, weighing not less than 10 tons. If the rolling at any time causes the subgrade to become wavy, the rolling should be stopped immediately over the wavy parts, and the soft material investigated. In clays this is almost always due to moisture and unless it is possible for it to dry out by the sun and wind without delaying the work, it should be removed and replaced with dry clay or other suitable material that can be rolled in a satisfactory manner. If any depressions develop they should be filled with acceptable material as the rolling progresses. Sand and sandy soils require a minimum amount of rolling.

It is recommended that the rough grading be completed very closely to the intended cross section of the subgrade and to the full width of the shoulders. Avoid shallow filling without plowing. Avoid filling narrow, deep ruts without plowing and disking. The finished subgrade immediately ahead of the concrete should be corrected to proper cross section, using a template.

Where the method of depositing the aggregates on the subgrade is followed, the subgrade should be completed fully in sections not exceeding 600 ft. in length immediately before the aggregates are deposited. The surface should be brought to true cross section, using a template or other acceptable method. The roller should be kept in constant operation while the aggregate is being delivered. Any ruts or irregularities caused by the handling of the aggregates should be filled up and thoroughly tamped. Wherever possible, hauling over finished subgrade with teams or motor trucks should be avoided.

Where necessary, to avoid formation of an objectionable layer of dust, the subgrade should be sprinkled in advance of placing materials.

Mixer.—The mixer should be of a standard paving type having a capacity of at least 2-bag batch, commonly known as size No. 14.

The mixer should be equipped with a boom and bucket or some other mechanical device that will deliver concrete of a proper consistency, also with an automatic timing device and a device that will accurately measure the water for each batch.

Water Supply.—In addition to the general recommendation of the American Concrete Institute recommended practice, the water supply should be free from injurious substances, duplicate pumping machinery should be provided, booster pumps should be provided on long pipe lines, and in all pipe lines there should be provided unions at intervals not greater than 1,000 ft. Tees for supply water to the mixer and for sprinkling should be placed at intervals not greater than 100 ft.

Time of Mixing.—Materials should be mixed at least one minute after the entire batch is in the drum. The speed of the drum should be not less than 12 revolutions per minute.

Side Forms.—Steel side forms should be used and after the forms are set the joints should be inspected carefully, using a straight edge to insure proper horizontal and vertical alignment.

Placing Concrete.—The operation of depositing, spreading, and finishing the concrete should be as nearly continuous as possible for the full width and thickness of the pavement. When delays, of sufficient length to permit the concrete deposited to attain initial set, are necessary a suitable header should be placed at right angles to the road and the concrete finished to this header to true elevation and cross-section.

The concrete may be transported from the mixer to place on the subgrade in any convenient manner which avoids the segregation of materials. Any device or method of operation which tends to segregate the materials in such a manner that later operations do not completely eliminate such segregation should not be permitted.

Placing Concrete in Cold Weather.—Every effort should be made to arrange for closing concrete road work in the fall or on about such date as the weather bureau reports for the locality for the past ten years indicate the probability of temperatures materially below the freezing point. If circumstances necessitate continuing work for a short period after freezing weather is likely to occur, precautions should be observed which will insure positively that the concrete may not become frozen under the most extreme conditions of temperature for the period, as indicated by weather reports for the past ten years. Concrete should be protected absolutely from freezing by suitable means for at least seven days after placing.

Expansion Joints.—Expansion joints should be used only in specific cases, such as junctions between the pavement and other fixed objects.

Expansion joints when used should consist of either high grade wool felt or a fibrous material combined with a coal tar or asphalt compound. The filler should contain, by weight, not more than 8% of mineral matter and not less than 5% nor more than 25% of fibre.

Contraction Joints.—Contraction joints should not be used. Construction joints should be made at the end of each day's work or when mixing is stopped for any reason longer than one hour.

Reinforcement.—For pavements up to 18 ft. in width with good foundation the value of any practicable amount of reinforcement is questionable.

For pavements over 18 ft., and especially where foundations are not thoroughly satisfactory, reinforcements, mainly in a transverse direction, may be used to advantage.

Where reinforcement is used it should be wire mesh or separate bar reinforcement, not less than 40 lbs. per 100 sq. ft., and the proportion of transverse to longitudinal steel should be not less than 3 to 1.

The reinforcing should be placed not less than 2 in. from the finished surface of the pavement. Adjacent widths of the fabric should be lapped not less than 4 in. when the lap is made perpendicular to the centre line of the pavement and not less than 1 ft. when the lap is parallel to the centre line.

Machine Finish.—When mixtures of relatively dry consistency are used, such as those necessary to secure maximum strength as far as such strength is determined by the water content, mechanical strikers and tampers should be used. Machines should be so constructed and operated that they strike off and thoroughly tamp the concrete. They should be so constructed that they may be readily operated over the same area repeatedly. Machines to serve the purposes above indicated should be subject to the approval of the engineer. The mechanical device or devices used should be so made and operated as to leave the finished slab true to grade, crown, and surface and absolutely free from porous places.

Hand Tamping.—If a mechanical finisher is not used and the consistency of the concrete is to be as above described, after spreading the concrete should be thoroughly hand tamped by means of a tamper of the nature of a strike board operated by one or two men stationed at each end of the tamper on opposite sides of the roadway. Hand tamping should be vigorous and sufficient to consolidate the concrete in such a manner as to close all voids. The hand tamper should be followed by a final strike board and all operations carried on in such a manner as to leave the surface behind the final strike board true to grade, crown, and surface, and absolutely free from porous places.

Roller and Belt Finish.—If a medium consistency is used, the concrete should be spread, agitated, and tamped in such a manner as to insure positively the avoidance of stone pockets or porous places. It should be struck off true to grade, crown, and surface. It should then be rolled by a light hand roller of approved design operated in such a manner as to remove the surplus water and leave the surface true to grade and crown.

When hand methods of striking and tamping are used the final finishing should be executed by means of an approved belt operated in such a manner as to leave the pavement true to crown and free from waves, ridges, depressions, or other irregularities and with a uniform mat surface.

Curing.—As soon after finishing as may be possible, without marring the surface, the slab should be covered with

canvas. When the concrete has set sufficiently to obviate the possibility of marring, and where local conditions permit, suitable longitudinal and transvere dikes should be built and water supplied to cover the surface of the concrete to a uniform depth of 2 in. The water should be maintained on the surface for not less than 14 days. Under conditions where it is impractical to adopt the ponding method of curing, the surface of the concrete should be covered with not less than 2 in. of earth and kept moist for at least 14 days by wetting not less frequently than intervals of 12 hours.

Traffic should not be permitted to use the pavement in less than 21 days if the pavement has been subject to favorable curing conditions; nor in less than 40 days if subject to unfavorable curing conditions.

Traffic should not be permitted to use the pavement for a period of at least three days after removal of the water or earth covering.

MOOSE JAW WATER SUPPLY*

Commissioner Mackie Favors Plan for a 24-inch Continuous Wood Stave Pipe Line from Caron Head Works to the Saskatchewan River at a Cost of $1,630,000

AT a recent meeting held in Moose Jaw, Sask., at which representatives of nearly every Moose Jaw organization were present, steps were taken and a committee was appointed to take up immediately the question of the Saskatchewan River water scheme for Moose Jaw, as outlined by City Engineer G. D. Mackie, which, in the unanimous opinion of the meeting, was the only solution for the water problem that now exists.

Commissioner Mackie, although he mentioned several alternatives in his address, favored, for financial reasons, the plan for a 24 in. continuous wood stave pipe line from the Caron head-works to the Saskatchewan River, a distance of between 54 and 70 miles, depending on the route selected, which can be constructed and in operation, if started at once, by the end of this year, at an outside cost of $1,630,000, with an effect on the mill rate of from 5 to 7 mills, depending on the city assessment, if the city pays the entire cost, or of one mill only if it is found possible to secure aid from other sources as suggested.

Committee Appointed

The meeting, which was called under the auspices of the Board of Trade, at the suggestion of President George A. Maybee, resolved itself into a Citizens' Committee, with Mayor Hamilton as chairman. Mr. Mackie was then called upon to make his address, and following that, a short discussion which occurred was brought to a close by a motion stated by William Grayson and seconded by George C. Ingram, that the men named below be appointed a committee to go immediately into the engineering, financial and legislative problems that surround the scheme, and report back to a meeting of citizens to be held in the near future.

Mr. Grayson named the following members of the committee: Mayor S. A. Hamilton, City Engineer Commissioner G. D. Mackie, Alderman W. G. Ross and W. D. McIntyre, President George A. Maybee of the Board of Trade, Arthur Hitchcock, John H. Grayson, ex-Mayor W. W. Davidson, W. Gardner and W. E. Stephenson of the Moose Jaw Trades and Labor Council Executive.

Present Supply

Mr. Mackie, in discussing the water situation, dealt with the present water supply of the city, pointing out the fact that the maximum summer flow is now one million gallons per day, and that the maximum winter flow varies from 800,000 gals. per day to as low as 700,000 gals. per day. The average consumption per head per day in 20 cities of Alberta is 74.5 gals. In ten Saskatchewan towns the average is 47.9 gals. per head per day, and in the Dominion, as a whole, it is 111 gals. per head per day. Moose Jaw's average consumption per head per day is 53 gals.

In dealing with the industrial water consumption of the city, Mr. Mackie stated that in Moose Jaw the industries consumed more water than those in any other city in the province, and that in the months of January, February and March of this year one firm alone consumed 300,000 to 350,000 gals. per day. The water situation as a whole, he said, was that the city had a possible maximum supply of one million gallons per day, and that the average consumption in 1918 was 883,000 gals. per day, and that the industrial consumption had increased from 150,000 gals. per day in 1914, to an average of between 300,000 and 350,000 gals. per day.

High Cost Per Capita

Dealing with the cost of Moose Jaw's water system, the commissioner said that Moose Jaw's water system, if carried out as per his proposed scheme, would be the most expensive per head in the Dominion. To date, the total expenditure on the city's water system is $67.65 per capita. The expenditure to date per head in the Greater Winnipeg water area is $106.63, and Moose Jaw's, if the Saskatchewan River line is built, will be $149.15 per head.

Referring to a previous meeting at which he made the statement that there was sufficient water in Moose Jaw Creek to supply the city's needs for several years to come, Mr. Mackie said that he could only repeat that statement. The average run-off of the creek per year for eight years is seven and one-half billion gallons. Were that scheme gone ahead with, it would be necessary to built a ten billion gallon reservoir, which would hold enough water to supply the present population for three years. The land that would be flooded by such a reservoir would be five thousand acres, and the minimum estimated cost would be $1,250,000, of which amount $450,000 would be required for the pipe line alone. Of that sum $400,000 would have to be spent in the east end of the city, because of the fact that there is not at present any water main system there to connect with the mains large enough to start the distribution within the city of such a large amount of water. In addition, another disadvantage of this proposal is that if the city outgrows the supply that can be secured from the Moose Jaw Creek, the expenditure entailed in construction will be lost, because the next scheme possible of consideration is the Saskatchewan River. If the cost is at all comparable, there is no doubt that the Saskatchewan River scheme is the better of the two.

Mr. Mackie then considered the Saskatchewan River as a source of water supply for Moose Jaw. Mr. Francis, who was the engineer in charge of the Caron water works construction, and who recommended the Caron scheme over the Moose Jaw Creek, although admitting that it was only a tentative solution, did recommended Caron, because it was a distance of 20 miles gained toward the then considered ultimate solution, the Saskatchewan River, while the Moose Jaw did not offer that advantage. Mr. Francis, however, estimated on the Saskatchewan River scheme, and his figure was five million dollars.

Other Schemes Very Costly

Various Dominion government schemes are estimated at between eight and fifteen million dollars. Major McPherson, who proposed to build an open ditch carrying water from Pelican Lake, and through Thunder Creek, estimated his project at $850,000, but the disadvantages of his scheme were that the city would have such a supply available for but seven or eight months of the year, and that in order to secure a million gallons per day it would be necessary to pump between ten and twelve million gallons to take care of evaporation and percolation over the 60-mile open ditch. A flow of but one foot every two seconds could be secured.

Local Supply is Limited

It is possible by further development to augment the city's present supply locally, but the outside estimate made by Mr. Mackie is that 150,000 gallons per day could be thus secured, which amount, in his opinion, is not worth considering. With the stock yards in operation, they with the packing house and the C. P. R. could be expected to consume from

*From the "Western Canada Contractor."

one-half to three-quarters of a million gallons per day next winter.

His Saskatchewan River scheme, he said, included pumping at the river of all the water through a pressure pipe to the height of land, a height of 330 feet, into a two million gallon reservoir, and from there to the Caron headworks through a 24-inch continuous wooden stave pipe line.

Sixty-Mile Pipe Line

The shortest route from Caron to the river is 54 miles and the longest route considered is 70 miles. The short route cannot be used, however, owing to the fact that high ground intervenes between the river and Caron. In Mr. Mackie's opinion it will be necessary to build a pipe line of 60 to 62 miles to get the gravity flow from the height of land at the river to Caron. A survey would have to be made to determine the best route, as every mile of pipe line saved means a saving of $17,000.

In determining the size of pipe to be used for his scheme, Mr. Mackie stated that he started with the consideration of four million gallons per day capacity, an amount larger than the present needs. He therefore proposes a pump at the river sufficient only for the present needs, and to keep the cost as low as possible, has not provided for stand-by pump in the event of break down. This means that it could be figured that the pump at the river would have to be shut down two days per month because of accident, during which time the Caron system would be in a position to supply the city's wants. No filters would be used, it being planned to use the same type of infiltration gallery as in use at Battleford and North Battleford.

Wood-Stave Pipe Cheapest

"The cost of the auxiliaries to such a scheme," said Mr. Mackie, "is mere bagatelle to the cost of the pipe line. There has been a great deal of discussion here on wooden pipe lines, but I intend to advocate a wooden pipe line for financial reasons." He then quoted figures showing that the cost of 24-inch wooden pipe laid in the ground, exclusive of the cost of excavation and back-filling is $2.30 per foot, of steel $5.74 per foot, and cast-iron $10.51 per foot. The cost therefore for 70 miles of wooden pipe would be $850,000; for steel, $2,123,000; and for cast-iron, $3,890,000. In addition there would be a tremendous saving in the tonnage hauling cost, the wood tonnage being about 9,000 tons, steel 15,000 tons, and the cast-iron the heaviest, about 45,000 tons.

The outside cost of the entire scheme for the three types of pipe, wood, steel and cast-iron, were quoted by Mr. Mackie as follows: Wood, $1,630,000; steel, $2,900,000; iron, $5,000,000.

Figuring the life of the wooden pipe line at but fifteen years, he said the saving on the carrying charges would be some $60,000 per year, which would amount in fifteen years to a sum sufficient to enable the city to replace the wooden pipe line.

Total Cost $1,630,000

The cost of the system with 24-inch wood pipe, would be as follows:—

Diesel engine and pump at river	$ 148,000..
Force pipe to height of land, 330 ft.	65,000
2 million gallon reservoir at river	65,000
Pipe line laid	1,184,925
Damages	88,630
Engineering and contingencies	78,445
Total	$1,630,000

In further describing the type of pipe line recommended, Mr. Mackie declared that it is different from the old type in that it is of the continuous stave type, thus avoiding joints and the leakage which occurred and always will occur in such joints. In addition, the bands of the pipe, instead of being continuous, are individual, so that when one break occurs the whole pipe will not leak, as in the case of the Snowdy Spring line, for instance. He would lay the pipe but 6 feet in the ground, sufficient only to protect it from rodents, etc., and to keep it below ground. That depth is sufficient to protect from frost at the velocity the water would travel through it. The El Paso Railway was faced with a similar situation for water, he said, and decided on wood because of the prohibitive cost of iron or steel. They now have 116 miles of this pipe in operation, and it is giving satisfaction.

The present Caron line has a capacity for 2,400,000 gals. per day. This can be increased to a maximum of 3,960,000 gals. per day, by different placing of pumps, and different methods of taking water from new to old pipe line, either through Caron reservoir, or direct to the old pipe line. The minimum winter flow of the Saskatchewan River at Saskatoon is 600 million gals. per day.

The Financial Problem

In conclusion, Mr. Mackie dealt with the financial aspect of the scheme, saying that while it did not present any engineering diffiiculties, it does present financial difficulties.

He presupposes the issue of 20-year debentures, assuming that the life of the wooden pipe is fifteen years. In the life of the pipe he plans to set aside a sum of $400,000, which, after the debentures had been retired, could be used as a nest egg for the replacing of the line. The carrying charges on this basis, at 5½% would be as follows: Interest charges, $89,000 per year; sinking fund payments, $54,000, and depreciation, $20,000 per year; a total of $163,000 per year, which, added to the carrying charges of the present water works, would make the carrying charges for the entire system $318,000 per year. Figuring on the sale of half a million gallons per day more water than at present, the annual deficit on water would be $146,000 per year, which on the present assessment would cost the citizens 7 mills additional tax rate.

On the 1913 assessment, he said, this could be handled by 3 mills additional levy.

Mr. Mackie next dealt with the city's borrowing power, which at the present time is $400,000 in round figures. His suggestions for increasing it to bring down the mill rate necessary to handle the water system proposed were several. One method was by increasing the improvement assessment to 60% instead of the present 45%. Another was to revert to the old business tax assessment instead of the present business license. A third was to increase the present land assessment by four million dollars. All three of these suggestions, if adopted, would bring the city assessment up to $31,000,000 and would make it possible to carry the proposed and present water systems for 5 mills instead of 7 mills.

The Canadian Board of Commerce has now been constituted and will shortly be available for such complaints as may be laid before it. It will act under the Combines and Fair Prices Act, and is given power to institute investigations on its own motion or at the request of any responsible parties who bring subjects to its notice. The chairman states that the procedure will be of an informal character.

Perhaps the largest reforestation scheme ever undertaken in Canada is being carried out in Quebec this year. The Laurentide Co., of Grand'mère, is planting over 1,000,000 seedlings, mostly Norway spruce, with some white Scotch and jack pine and balsam. The Riordon Co., of St. Jovite, is also planting about 750,000 seedlings. Much the greater number of the seedlings used are imported from forest nurseries in the United States.

In a recent address before members of the Advertising Club, of Baltimore, Md., H. D. Hubbard, of Washington, D.C., secretary to the U.S. Government Bureau of Standards, made an earnest plea for the adoption of metric units of measurement in the United States and Canada. Mr. Hubbard pointed out that during the war many United States and Canadian manufacturers were forced to use the metric system in the manufacture of guns and other ordnance, and two principal works had to use it in the building of locomotives. If the work on the blue prints for these locomotives had to be done in feet and inches, Mr. Hubbard said, the locomotives would never have been built on this continent. He further said that by refusing to adopt the metric units, United States and Canada are as far behind in the matter of proper standards as was China, but that China has now adopted the metric system.

STRESSES IN CONCRETE ROAD SLABS FROM WHEELS OF HEAVY TRUCKS

AT the present time it is impossible to calculate the proper thickness of a concrete road slab with much certainty. It is known that a thicker slab is required where the subgrade is soft than where it offers a good bearing, and that heavy loads require a thicker supporting slab than light loads; how much thicker, however, has not been determined. The stress in a slab depends upon the bending moment produced in the slab, and this in turn is dependent largely upon the distribution of pressure over the subgrade. It is recognized that ununiform subgrade pressures are due to causes other than the heavy traffic loads carried by the slabs. An investigation to discover how the road slab is stressed directly under the wheels of heavy trucks and to determine whether this stress is apt to be a governing influence in the design of the slab, has been initiated by the United States Bureau of Public Roads. This test is one of a series of investigations outlined to include an adequate range of the different varieties of subgrades and slab thicknesses. The test was made on the concrete road between Camp Humphreys and Alexandria, Va. The road surfacing at this point is 18 ft. wide, 8 in. thick at the centre, and 6 in. at the sides. A 1:1½:3 gravel concrete was used, having a crushing strength, as determined by 6 by 12 in. cylinders cast in the field at the time the road was laid, of 3,190 lb. per sq. in. The aggregates in the concrete at this point were Potomac River sand and gravel. Here the road runs through a 6-ft. cut and the subgrade in the past has remained rather wet and soft. The soil is composed of a sticky clay, which, when wet, has very low bearing value.

Designed Special Pressure Cells

To measure the pressure distribution, four pressure cells were designed in the Bureau of Public Roads. In order to determine the distribution of pressures under heavy wheel concentrations, a class B standard army truck was loaded with 5 tons of sand. The front wheels and rear wheel of the loaded truck were weighed separately and the axle loads were found to be 5,000 lbs. and 17,000 lbs., respectively.

On February 5th, 1919, a test was made on the Camp Humphreys road with this loaded truck. It was backed 1 ft. at a time up to the central measuring cells. When the rear wheels reached a position directly over the cells, the truck was backed 1 ft. at a time still farther until the front wheels were just over the cells. As a second test the truck was backed with the wheels as close to the side of the road as possible so that they would be made to come directly over the cell placed at the extreme side of the road. During the progress of the preliminary measurements, taken over a period of four months, opportunities offered themselves for obtaining some idea of the effect of light loads on the subgrade pressures, and these are presented in the following table:—

		Ford.	Boiler.	Front army truck.	Rear army truck.
Load on slab ...	[1]200	[1]350	[1]3,680	[1]2,500	[1]8,500
Maximum intensity of pressure	[2]0.2	[2]0.4	[2]3.5	[2]1	[2]6.5
Radius of area of distribution	..	[3]2	[3]5½	[3]3	[3]6

[1]Pounds. [2]Pounds per square inch. [3]Feet.

Summarized Results of Investigation

The results of the investigation are given by A. T. Goldbeck, engineer of tests, U.S. Bureau of Roads, in a report made public recently by the Bureau. The tentative conclusions drawn from this preliminary investigation are as follows:—

1. That a concrete road slab under the action of traffic or perhaps under the influence of frost and different percentages of moisture in the subgrade is continually bending, so that the reaction pressures between the subgrade and slab are neither constant nor uniform in intensity.

2. The reaction pressures due to heavy wheel loads are a maximum directly under the loads and vanish to zero in a comparatively small radius, which partially depends upon the intensity of the load. A heavy wheel load is distributed over a larger radius than a light wheel load. For this particular subgrade, a load of 8,500 lbs. has a radius of distribution of pressure of about 6 ft., most of the pressure, however, being exerted over a radius of about 4 ft.

3. As the concrete slab recovers from its deflection after the passage of a load more readily than the soft subgrade, there is a tendency for the continual deflection of the slab to produce areas having very little or no bearing. If the traffic is concentrated at the centre of the road, as it is on many concrete roads, the continual deflection tends to depress a soft subgrade away from the centre of the slab, which would then be more largely supported at its sides. In extreme instances this might account for some longitudinal cracking in concrete roads.

4. As nearly as can be estimated from the results of this test, the tensile stress in an 8-in. concrete slab directly under an 8,500 lb. wheel load at rest on the road is only 34 lbs. per square inch when the slab is well supported on the subgrade. As the modulus of rupture of 1:1½:3 concrete is about 600 lbs. per square inch, it is seen that this pavement should be able to withstand considerable impact before cracking. Should the concrete arch, over very soft spots, so that there is no support directly under the load, the tensile stress may become very high. Such a condition arises when the sides of the slab are raised by frost action or possibly when the subgrade is worked away from under the slab by continual deflection.

5. It is probable that the tensile stress which results in the slab directly under heavy wheel loads is never very great as long as the slab rests on the subgrade and it is unlikely that the slab design would ever be controlled by this stress.

ONTARIO HYDRO ASKS COMPENSATION

FORMAL application has been made to the Minister of Finance by the Hydro-Electric Power Commission of Ontario, asking that the Dominion government reimburse it approximately $5,000,000 for the extraordinary war expenditures incurred on unavoidable extensions due to the necessity of providing power on a large scale for the manufacture of munitions and other materials for war purposes in order to meet the demands made by the manufacturers and the power controller. In support of this application the commission has forwarded to Sir Henry Drayton a file containing the voluminous correspondence and orders covering the period when the extensions were made. It is pointed out by the commission that the power controller, under whose orders much of this work had to be undertaken to meet the needs of the munitions manufacturers, had authority only over Ontario. This control was exercised, it is claimed, almost solely over the Hydro-Electric Commission. In such cases as private companies ordered to make extensions, it is said by Sir Adam Beck that they were either reimbursed by the Imperial Munitions Board or the manufacturers whom they supplied.

In making this application to the Dominion government the commission states its belief that the Dominion government will recognize that the financial burden of the war should be borne by the people of the Dominion as a whole, and not by one province or group of municipalities who happened to be in the fortunate position, owing to the existence of cheap hydro-electric power, of contributing so largely to the defence of the Empire by the manufacture of these munitions.

The items in the Commission's bill, which is for $4,902,000, are as follows: $2,500,000 for the extension to the Ontario Power Co.'s plant, which was temporary for war purposes only and will soon be abandoned; $652,000 for duty on equipment for the O.P.C. extension and the Queenston-Chippawa development; and $1,750,000 for increase in cost, compared with normal times, of extensions of transmission lines and equipment on the Niagara system necessitated by the power requirements of the munition manufacturers. Sir Adam Beck points out that in the United States the government has compensated power companies for extraordinary war expenditures.

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President and General Manager JAMES J. SALMOND
Assistant General Manager ALBERT E. JENNINGS

HEAD OFFICE: 62 CHURCH STREET, TORONTO, ONT.
Telephone, Main 7404. Cable Address, "Engineer, Toronto."
Western Canada Office: 1206 McArthur Bldg., Winnipeg. G. W. Goodall, Mgr.

PRINCIPAL CONTENTS

MODERN MACHINERY SUPERSEDING LABOR

POWER-DRIVEN machinery is being manufactured with ever-increasing capacities, reducing labor costs (in hours, at least, if not always in dollars, owing to increasing wages) per unit of work done, permitting larger jobs to be completed within the same time, reducing the important item of "interest during construction," and providing the engineer with more powerful weapons with which to overcome obstacles and to harness the forces of nature.

A striking example of the utility of big plant for big work, is the Queenston-Chippawa power canal, the progress of which is described in this issue. The amount of earth and rock being handled by a comparatively small force, constitutes a record previously unknown in the construction world. The daily removal of over 20,000 cu. yds. of earth and rock, in addition to the accomplishment of a great amount of other work such as railroad construction, bridge-building, etc., all with an average daily payroll of considerably less than 2,000 men, is a feat that could not have been performed a few years ago without expenditures for plant that would have been enormously out of proportion to the value of the work being done. This feat has been made possible by the development of economical machines that are giants in comparison with the machines of a decade ago.

The construction undertakings of the past were not large enough, with but few exceptions, to permit of huge investments in construction plant, and in many cases where unusually powerful equipment could have been used, it was not designed owing to the recognized impossibility of finding a market for it after the work had been completed. To-day there is almost invariably a market for all construction equipment that is in good condition, regardless of its size.

The power-shovel manufacturers and the builders of large crushers are, in a great measure, responsible for the improved methods of handling rock, and they predict that within a very short time they will be selling 10-yd. shovels, 84-in. by 120-in. jaw crushers and 84-in. gyratory crushers. On the Queenston-Chippawa job there are 8-yd. shovels and a 60-in. by 84-in. jaw crusher. Since this job was started, 66-in. by 86-in. jaw crushers and 60-in. gyratory crushers have been built and placed in successful operation.

The evolution of huge shovels and crushers has been slow but steady and sure. Sizes of crushers built thirty years ago, and at that time considered large, to-day are not manufactured excepting for laboratory work, as their operation is no longer economical.

ARE YOU AN UNRESPONSIVE CITIZEN?

ONE of the greatest statesmen in the United States, whose name, it is said, cannot be disclosed, recently made the following statement concerning the activities of the United States Engineering Council:—

"Your task is appalling. You have been elected to lead engineers into a political reform. They are the most unresponsive citizens that we have. Your organization has a praiseworthy purpose, but if it were sponsored by almost any other group of reputable men than engineers there would be more promise of success. If your organization succeeds, I believe you will find that it will not be the engineers who have carried through. Their aloofness and indifference in all matters outside of their own professional sphere, are among the unexplainable things in our political life."

This statement, we consider, is a totally unmerited condemnation of engineers as public-spirited citizens. They are not "unresponsive citizens." To the contrary, they are among the hardest-working, most unselfish, modest members of society. Because they do not toot their own horns like professional politicians, those politicians, it seems, are prone to consider them "unresponsive." Had the statesman substituted the words "self-effacing" for the word "unresponsive," his summing-up of the situation would have been far more accurate and truthful—all but the last sentence. The last sentence should read:—

"Their hesitation in participating in matters outside of their own professional sphere is explained by the conditions now existing in our political life, whereby lawyers in high places appoint fellow lawyers to all positions of trust and prominence, almost wholly regardless of the special technical knowledge required for a proper fulfillment of the duties of of those positions."

But perhaps the statement doesn't warrant our getting agitated. It is an anonymous statement. The man who made it should sign it and stand behind it, otherwise it must be classed with anonymous letters. The American Association of Engineers has forwarded a circular to all of its members calling their attention to this statement, and apparently attaching great importance to it. The inference made by the association's circular, in describing the statesman as "one of the greatest," is that President Wilson made the statement, because in Washington there is an unwritten law among newspaper men and others that the president must not ever be directly quoted. This rule does not apply to any other statesman. The inference that can thus be taken is undoubtedly unjust to President Wilson, because that great statesman has better sense and a keener insight into all professions than to make the mistake of interpreting the engineer's retiring disposition as indifference or unresponsiveness to the call of public duty, wherever or whenever it may be heard.

The Asphalt Association has decided to open an office in Toronto, and has appointed Capt. Bruce Aldrich as district engineer. Capt. Aldrich has resigned as deputy works commissioner of Baltimore, Md., where he had seven asphalt plants under his jurisdiction. He organized and equipped the municipal laboratory at Baltimore, and supervised the construction of more than 3,000,000 sq. yds. of sheet asphalt and bituminous concrete.

PERSONALS

CAPT. RAY FRASER ARMSTRONG has been elected town manager of Woodstock, N.B., the first town in New Brunswick to adopt this form of municipal government. Capt. Armstrong is a son of R. E. Armstrong, formerly editor of St. Andrew's Beacon. Capt. Armstrong is a graduate of the University of New Brunswick, where he earned the B. Sc. degree, and a post-graduate in engineering of McGill University. He has been an associate member of the Engineering Institute of Canada since April, 1915. Before the war, he served in various engineering capacities in Montreal, Edmonton, Banff, Tofield, Coronation, Vancouver and St. John. He was engineer-superintendent of water works and sewerage at St. John, N.B., when he enlisted in 1916. In France he was transferred to the Canadian Engineers and won his captaincy and the Military Cross in the last big drive.

LT.-COL. H. R. LORDLY, consulting engineer, of Montreal, has been elected a fellow of the Society of Engineers, London, Eng. Col. Lordly is a graduate of Cornell University and holder of the Fuertes medal. He took the 5th Pioneer Battalion overseas in 1916, and also served at the front with the Imperial army. The Society of Engineers is an amalgamation of the former Society of Engineers, established in 1854, and the Civil and Mechanical Engineers' Society, founded 1859. The merger took place in 1910. Under the new charter the membership is limited to one thousand.

ALBERTA INDUSTRIAL CONGRESS

(Continued from page 256)

high. The Baptiste power, 170 miles from Edmonton, might be developed to the extent of 12,000 horse-power, and another site on the Baptiste River would yield 6,000 horse-power. There are numerous other sources but they are for the present too remote to be of practical value.

Water, said Mr. White, is, however, only one source of power and the prevailing impression that it is cheaper than steam power is correct only under certain conditions. Compared with steam power it has the following advantages:—

(1) Cost of operation is usually much lower.

(2) Very few attendants are required in the plant and no fuel is required excepting for heating the building.

On the other hand there are the following disadvantages:—

(1) Usually the cost of development and installation is much higher than with steam power.

(2) The situation of the water power plant is fixed by nature and as a rule a transmission line is required to transmit the electric energy to the user.

(3) The service is less reliable owing to the possibility of (a) injury to the transmission line and (b) lack of power due to unusually low water.

During recent years, owing largely to the introduction of the steam turbine, the capital cost of modern steam plants and of many hydro-electric power developments are coming closer together and some engineers predict that at an early date steam-electric power will be produced at less expense, other things being equal, than hydro-electric energy. Alberta, he said, contains 87 per cent. of the coal in Canada and is, therefore, in an excellent position to produce steam power.

Plea for Scientific Development

Dr. R. D. MacLaurin, professor of chemistry in the University of Saskatchewan, spoke on "A Field for Reconstruction." "During the past five years," he said, "Canada's national debt has rapidly increased until it has reached the sum of $1,950,000,000, incurring interest charges to the amount of $115,000,000. Our adverse balance of trade with the United States in 1918 amounted to $292,000,000, and our exchange rate is 5⅛ per cent. The recommendation by the finance minister of Canada to meet that situation was 'increased production and thrift.' The war made it necessary for Canada to mortgage her resources, human and material, for the purpose of carrying on. The obligations were loyally and willingly assumed, but we are now confronted with the question—How is the liability to be financed? Will 'increased production and thrift' accomplish this?

"For the successful carrying out of a policy formulated for the development of our natural resources, the co-operation of men of scientific attainments is essential. In 1916, in urging the development of our resources, I suggested that provision be made in the case of a research subsidized by the government and leading to a discovery, invention or the improvement of a technical process, protecting the author in the ownership thereof. As government aid had, at least, materially contributed to such discovery, invention or improvement of a technical process, provision should also be made for a royalty to the government on its use for the purpose of maintaining a national research fund.

"The creation by the Alberta government of a ministry of industry, and the calling of this industrial congress by the Industrial Development Association of Alberta, is an outstanding recognition of the value of Alberta's natural resources, and a realization of the urgency for their immediate development.

"The Dominion of Canada ranks second among the nations of the world as regards its potential coal resources, which have been estimated at 1,234,269 million tons, of which 1,059,927 million tons, or 86 per cent. of the total, is possessed by the province of Alberta. Furthermore, the total coal in Great Britain and Ireland, Australia, India, South Africa, New Zealand, Rhodesia, Newfoundland, South Nigeria, British New Borneo, has been estimated at 494,961 million tons; consequently, according to the above figures, Alberta contains more than twice as much coal as Great Britain and her other possessions within the empire."

The speaker then showed how coal had contributed to the industrial development of England, Germany and other countries.

War Interfered with Progress

The closing sessions of the Congress were held in Edmonton on August 15th. The delegates were entertained at a banquet in the Macdonald Hotel given by the Board of Trade, at which A. M. Frith, first vice-president, presided. Short addresses of welcome were given by Mayor Clarke and James Ramsay, M.L.A. An address by Dr. John A. Allen on the mineral resources of Alberta was interesting and instructive. He pointed out that the mineral resources of the province stood second in the matter of basic wealth, the first place going to agriculture. The last few years had seen great strides toward the development of natural resources of Alberta, he asserted, the value of production in 1917 being computed at $16,000,000, and in 1918, $24,000,000. He considered, however, that the vast wealth was yet unknown, and that the north must be looked to for the full determination of the metallic wealth of the west. Here the indications were most favorable. The clay products were so extensive that it has not been possible to develop them. The war caused some hindrance in the matter of production in this regard, for while the value of the products produced in the province in 1912 amounted to one and a half million dollars, at the end of 1917 the output had decreased to half a million.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

ADDITIONAL TENDERS PENDING

Further information may be had from the issues of *The Canadian Engineer*, to which reference is made.

PLACE OF WORK..	TENDERS CLOSE	ISSUE OF	PAGE
Alberni, B.C., school	Sept. 8.	Aug. 21.	48
Boisdale, N.S., wharf	Sept. 3.	Aug. 21.	50
Bridgeville, N.S., school	Aug. 30.	July 31.	41
Chapleau, Ont., school	Sept. 15.	Aug. 21.	48
Fort William, Ont., bridge	Aug. 30.	Aug. 21.	248
Fort William, Ont., pavements	Aug. 29.	Aug. 21.	248
Halifax, N.S., schools	Aug. 30.	July 31.	41
Hespeler, Ont., water mains	Aug. 30.	Aug. 21.	48
Moose Jaw, Sask., sewer and water mains, water works construction	Aug. 30.	Aug. 21.	48
Ottawa, Ont., pumps, engines, etc.	Aug. 30.	July 31.	44
Peterborough, Ont., public school	Sept. 1.	Aug. 7.	48
Port Hope, Ont., hospital buildings	Aug. 30.	Aug. 21.	50
St. Adolphe, Man., roads and culverts	Sept. 2.	Aug. 21.	46
St. Jean d'Orleans, Que., repairs to wharf	Sept. 3.	Aug. 21.	52
Ste. Martine, Chateauguay, Que., pavement	Aug. 30.	Aug. 14.	42
Toronto, Ont., pavements	Sept. 2.	Aug. 21.	46
Toronto, Ont., postal station "A"	Sept. 5.	Aug. 21.	52
Trenton, Ont., 27 houses	Sept. 1.	Aug. 21.	50
Winnipeg, Man., water recorder	Sept. 1.	July 31.	46
York Township, Ont., sidewalks	Sept. 6.	Aug. 21.	48

BRIDGES, ROADS AND STREETS

Beloeil, Que.—Tenders will be received until 5 p.m., September 8th, by the town council, for reconstruction of macadamized roads. A. M. Cormier, secretary-treasurer.

Boston Creek, Ont.—The provincial government contemplates construction of roads through the Boston Creek mining district to the Skead area.

Brandon, Man.—The city council contemplates construction of the following macadam pavements, including intersections: Eighteenth St., Rosser to Victoria Ave., 42 ft. wide. Estimated cost, $12,755. Princess Ave., First to Sixth St., 42 ft. wide. Estimated cost, $8,254. Princess Ave., Fourteenth to Eighteenth St., 42 ft. wide. Estimated cost, $6,350.30. First St., Rosser to Victoria Ave., two pavements each 19 ft. 6 in. wide. Estimated cost, $12,020.80. Harry Brown, city clerk.

Brandon, Man.—The public parks board contemplate construction of the following works: Boulevard and curb on Princess Ave., both sides, First to Sixth St., length, 2,540 ft. Estimated cost, $2,794, and both sides from Fourteenth to Eighteenth St., length, 1,590 ft. Estimated cost, $1,749. Six foot boulevard and curb on Eighteenth St., Rosser to Victoria Ave., both sides, length, 4,304 ft. Estimated cost, $4,949. Twelve-foot boulevard and curb on First St., Louise to Victoria Ave., both sides, length 1,000 ft. Estimated cost, $2,000. Harry Brown, secretary.

Chatham, Ont.—Tenders will be received until noon, August 30th, by the Chatham township council, for construction of a steel and concrete bridge over the Little Bear Creek drain at the Lindsay Rd. Plans, etc., may be seen at the office of W. G. McGeorge, engineer, Chatham. L. A. Pardo, county roads superintendent, Chatham.

Como East, Que.—Tenders will be received until 6 p.m., September 8th, by the municipal council, for construction of roads. W. Sanderson, secretary-treasurer.

Elmira, Ont.—Construction of the local section of the provincial highway has commenced. This road is being poured in concrete, 16 ft. in width. It is expected that other stretches of concrete highway will be commenced near here in the near future.

Hamilton, Ont.—Plans and estimates are being prepared by the city engineer's department for construction of steps up the mountain on Sherman Ave. E. R. Grey, city engineer.

Haney, B.C.—Tenders will be received until noon, August 30th, by the department of public works, Victoria, B.C., for construction of a bridge on the River road. Plans, etc., offices of district engineer, court house, Vancouver, and at Parliament buildings, Victoria, B.C. A. E. Foreman, engineer.

Islington, Ont.—The Etobicoke township council has awarded contract to the Law Co., Toronto, for construction of 2.75 miles of macadam roadway on Queen St. from Lake Shore Rd. to Kipling Ave. Contract price, $22,200.

Kitchener, Ont.—City council contemplates widening street and constructing a subway on King St., under the G.T. Ry.

Lindsay, Ont.—The county good roads board intend to rebuild the road from the hospital westerly through Mariposa. Estimated cost $10,000 per mile. It was also decided to extend the pavement on Lindsay St. south from the swing bridge to the southern boundary of the Riverside cemetery. B. L. McLean, mayor.

Niagara Falls, Ont.—City council will construct pavement and curb on Benson St., from Victoria to St. Lawrence St.

Niagara Falls, Ont.—City engineer's estimates for pavement consisting of 2 ins. Willite on a 5-in. concrete base for Palmer St., between Benson and Victoria, is $3.35 per sq. yd. Total cost, $43,353.

Ottawa, Ont.—Contracts have been awarded by the department of the interior, Ottawa, for construction of the following roads: Banff-Windermere and the Edith Cavell highways, to J. A. Stephen, 249 Argyle Ave., Ottawa; Castle-Laggan highway to G. R. Long, 51 Sparks St., Ottawa; Mount Revelstoke highway to McPherson & Beam, Regina, Sask. J. B. Harkin, commissioner, Dominion Parks branch, Department of the Interior, Ottawa, Ont.

Portage la Prairie, Man.—Contract has been awarded by the municipal council for construction of reinforced concrete culverts to La Cour & Schioler, 858 McDermot Ave., Winnipeg. D. McCowan, secretary-treasurer.

Quebec, Que.—Of the sixty bridges under construction in the province of Quebec, fifteen are in the district of Quebec, the biggest of which being erected, is the Metabetchouan, 600 ft. long and 100 ft. clear of the river. Ivan Vallee, chief engineer, department of public works, Quebec.

Regina, Sask.—Contracts have been awarded by the department of highways, Regina, for construction as follows: Concrete bridge over Wascana Creek, south-east of Regina, E-9-17-19, west of 2nd meridian, to E. J. St. Onge, Maple Creek, Sask. Concrete abutments over Dog Hide Creek near Tisdale, 1-45-15, west of 2nd meridian, to the Parsons Building Co., Regina. Concrete abutments over Swan River, N.E. ¼-22-34,30, west of 1st meridian, to the Parsons Building Co., Regina. H. S. Carpenter, deputy minister.

Riverside, Man.—Tenders will be received by J. H. Putman, secretary-treasurer, up till noon, on Saturday, September 13th, 1919, for the construction of a 16-ft. span girder bridge on the N. of N.E. ¼-20-5-17. Plans and specifications may be secured from the office of the highway commissioner, Winnipeg.

Sarnia, Ont.—Hon. F. G. Macdiarmid, Ontario minister of public works, has communicated with the local Chamber of Commerce to the effect that the government has under consideration the extension of the provincial highway system in western Ontario. The communication refers to the highway which would connect London and Sarnia, and states that probably a survey of the route will be undertaken shortly.

Scarboro Tp., Ont.—Tenders will be received by W. D. Annis, township clerk, up to noon, Tuesday, September 2nd, 1919, for grading and gravelling Courcelette Road, from Kingston Road to Windsor Ave., and Lakeside Ave., from Kingston Road south. Plans and specifications may be seen at the office of the engineers, James, Loudon & Hertzberg, Ltd., 36 Toronto St., Toronto.

St. Jacobs, Ont.—Construction has commenced on the new 16-ft. concrete, provincial county road north of St. Jacobs. Length of road to be built, three miles. Contractor, Lichty Bros., Wellesley.

Toronto, Ont.—At a meeting of the city council, the following by-laws were passed: extension of Duplex Ave. and opening of Cleveland St., $119,211.73; asphalt pavement on Danforth Ave., widening Kingston Rd. from Balsam to Silver Birch Ave., widening Morton Rd., construction of sewer on Queen St. from Pape to Leslie, $84,559; completion of Strachan Ave. bridge, $16,000, and Cherry St. bridge, $100,000. R. C. Harris, commissioner of works.

Vancouver, B.C.—Tenders will be received by Wm. McQueen, city clerk, up to 2 p.m., Tuesday, September 2nd, 1919, for the construction of a protection pier and fender, at Granville Street bridge. Plans and specifications may be obtained at the city engineer's office, city hall.

Welland, Ont.—City council passed a by-law providing for the construction of a cement sidewalk on the west side Crowland Ave. City Engineer, Charles L. Coulson.

York Township, Ont.—Contracts have been awarded by the county commissioners for construction of the following concrete structures: Abutment for Baldwin bridge to R. H. H. Blackwell, Aurora, Ont., $2,290. Ramsden bridge to W. H. Sheridan, Toronto, Ont., $1,512. Frank Barber, engineer, 40 Toronto St., Toronto.

WATER, SEWAGE AND REFUSE

Brantford, Ont.—The city council has decided to enlarge the pumping station at the waterworks plant. Two new engines and two pumps are being installed at present.

Chatham, Ont.—The engineers are considering a proposition to pump water to Chatham from the Snye. This source of supply will probably be incorporated in the official report.

Edmonton, Alta.—The department of public works, Ottawa, is considering an alternative route for the sewer outlet of the city, to remove same from its present position close to the penitentiary grounds. Commissioner Ormsby.

Edmonton, Alta.—Construction of the clear water basin has commenced. Estimated cost, $30,000. A. W. Haddow, city engineer.

Edmonton, Alta.—Tenders will soon be called for construction of a sewer for the Swift packing plant. Estimated cost, $45,000. A. W. Haddow, city engineer.

Halifax, N.S.—In a report presented to the city board of health, Dr. K. G. Mahabir recommended that the city abandon Chain Lake as a source of supply; purchase certain properties on the water-sheds and draw water from Long Lake and Spruce Hill Lake; extend the existing intakes, which are in the "dead" ends of the lakes into deeper water near the centre.

Hespeler, Ont.—Tenders will be received until 5 p.m., August 30th, by the town council for laying approximately 5,448 lin. ft. of water mains. Town clerk, M. E. Jardine. Engineer, Herbert Johnston, 130 Lancaster St. E., Kitchener, Ont.

London, Ont.—Contract has been awarded by the London township council, for construction of Ox Bow drain, to W. P. Godson & Co., 30 Leopold St., Toronto. Contract price, $10,146.95. Rejected tenders, E. P. Murray, Stratford, $13,300, Peter Winter, Parkhill, $19,500. Mary Grant, clerk.

Moncton, N.B.—The city engineer's department will construct sewer along Victoria Ave., Wesley to Pearl St. J. Edington, city engineer.

Moncton, N.B.—Contract has been awarded by the city council for construction of sewers on Henry and Cornell St., to Lewis Stephens & Co., St. John, N.B. Contract price, $12,786.25.

Parry Sound, Ont.—Contract has been awarded by the town council for construction of a 6-in. water main on Armstrong Ave., to R. Kenny.

Quebec, Que.—Plans and estimates are being prepared by the department of works for construction of sewers in St. Roch's, St. Sauveur and St. Malo on the south side, and along the Limoilou on the north side of the St. Charles River. W. D. Baillairge, city engineer.

Sandwich, Ont.—Town council has awarded contracts for sewers as follows: Randolph and Rankin Ave., to Merlo, Merlo and Ray, $7,000; Felix Ave., to Pettypiece, Ltd., $4,000; Matchet Rd., and Manchester Ave., to West & Sheehan, $15,000.

Sarnia, Ont.—Tenders will be received until 10 a.m., September 1st, by the Sarnia Cemetery Co., for construction of water works system of piping in Lake View Cemetery. M. A. Sanders, secretary, 215½ Front St. N., Sarnia.

Toronto, Ont.—At a recent meeting of the city council, the following by-laws were passed: for relief sewers, $394,000; for extending and improving waterworks, $386,000. R. C. Harris, commissioner of works.

Welland, Ont.—City council passed a by-law for the construction of a sewer on River Road. City engineer, Charles L. Coulson.

Welland, Ont.—A report on the construction of a sewer in the north ward to Parkway Heights was submitted to the city council by City Engineer Coulson. The total cost of the proposed sewer is $39,369. Consideration of the report was laid over until next meeting.

Winnipeg, Man.—The following tenders were received by the department of public works, Winnipeg, for excavating 300,000 cu. yds. material in drainage district No. 2; high tender, Lunt Engineering Co., Winnipeg, 26c. per cu. yd.; low tender, Carter, Halls & Aldinger, Winnipeg, 22.5c. per cu. yd. Estimated cost of work, $81,000. G. A. Grierson, minister.

Woodstock, Ont.—Plans will soon be completed for the treatment and disposal of sewerage for the south side intercepting sewer scheme. By-law to be submitted to the ratepayers, calls for an expenditure of $110,000. City engineer Ure.

York Tp., Ont.—Tenders will be received by the township engineer, Frank Barber, 40 Jarvis St., Toronto, up to 12 o'clock noon, Saturday, September 6th, 1919, for the construc-