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# OLYMPIC BRIDGE, ISLAND PARK, TORONTO

## DESCRIPTION OF A REINFORCED CONCRETE ARCH BRIDGE WITH UNIQUE AESTHETIC FEATURES—NOTES ON ITS DESIGN AND CONSTRUCTION.

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OLYMPIC BRIDGE is a footbridge connecting Olympic Island to Centre Island Park at Toronto. Being over one of the Island lagoons, and in one of the most prominent situations at Centre Island, it was necessary that the bridge should present a pleasing appearance, and, if possible, add to the beauties of Island Park. The clear waterway was fixed at 60 feet and the clearance under the bridge at high water was required to be at least 5 ft. 6 ins. How well the civic bridge department succeeded in meeting these conditions may be judged from the following brief description. Figs. 1 and 2 show general views of the bridge.

It is a reinforced concrete arch bridge supported on battered pile foundations. The arch rib is approximately a parabola in shape, while the handrail is an irregular curve, put in to the most pleasing lines. The general dimensions are as follows: Span, 60 ft. at springing line; length, 84 ft. out to out of handrailing; width, 10 ft. over all, 8 ft. clear foot path; rise of arch ring, 9 ft.; crown thickness, 12 in. There are 16 battered and 6 vertical piles in each foundation.

Fig. 1.—The Olympic Bridge Over a Lagoon at Island Park, Toronto.

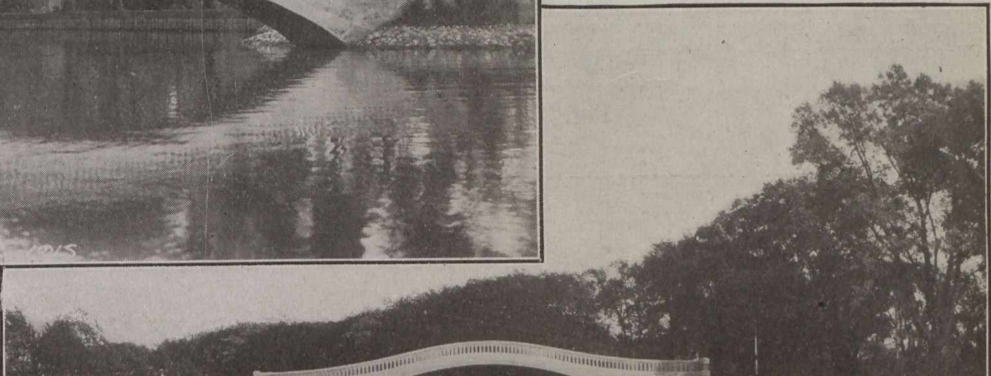

Fig. 2.—Its Artistic Lines Harmonize Well With the View from the Ferry Dock.

The arch rib is designed for full dead load and a live load of 150 lbs. per square foot, This live load is sufficient to take care of the horse and cart belonging to the gardeners that frequently crosses on the bridge. Standard unit stresses for concrete and steel were used. The axial load per pile is 20,000 lbs.

The details of the bridge are shown in Fig. 3. The arch rib is reinforced with 17 pairs of ⅝-inch square twisted steel rods, the spandrel walls with expanded metal, the handrail with two ½-inch diameter rods and each spindle with one ⅜-inch square twisted rod.

Construction was commenced in the summer of 1914 and completed in the fall of the same year. Coffer-dams drop hammer, the leads of which were sloped to the required batter. After the removal of the jet the piles were given a few blows of the hammer to secure the required penetration. On several occasions a pile, adjacent to the

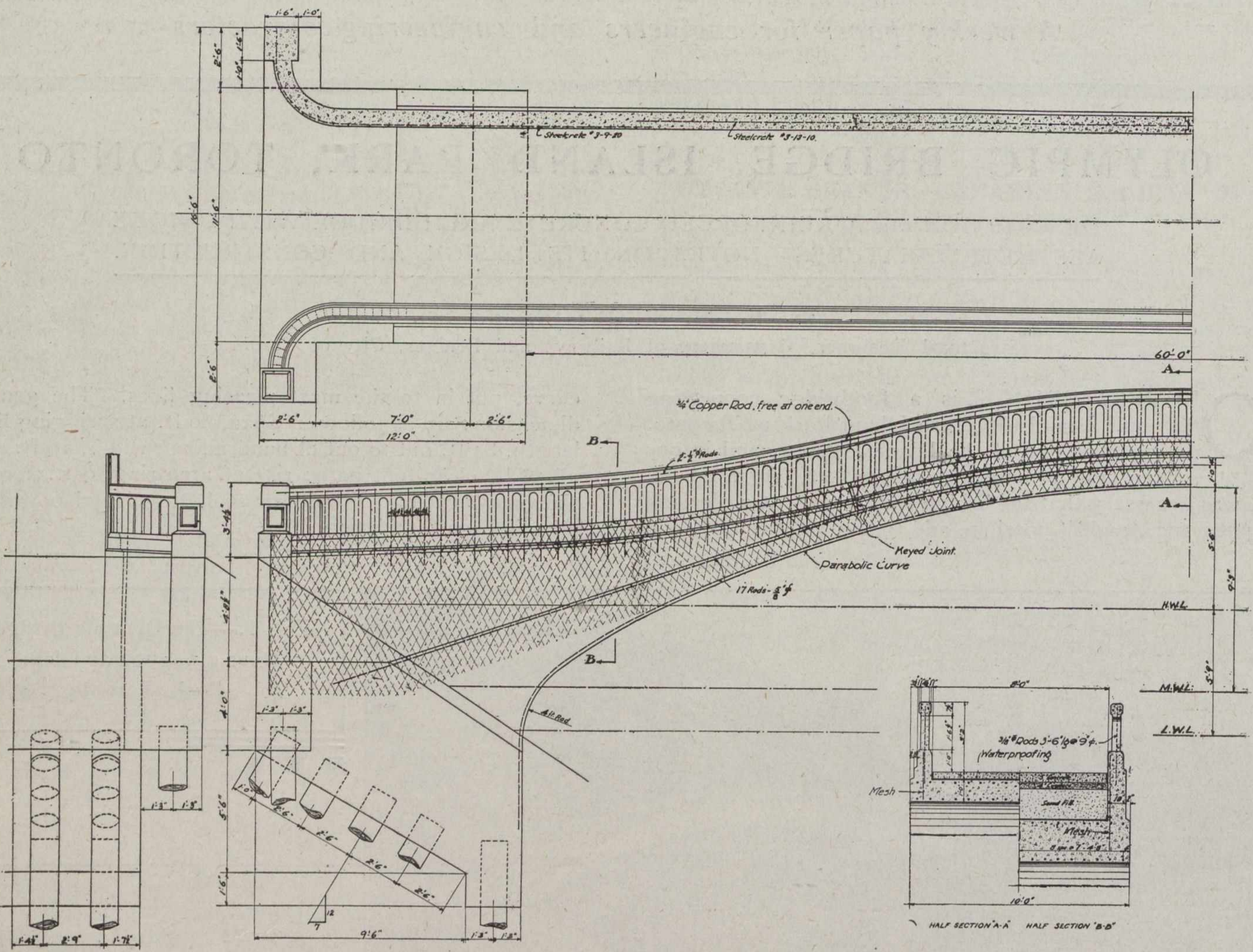

Fig. 3.—Details of Arch Rib, Spandrel Walls and Abutment.

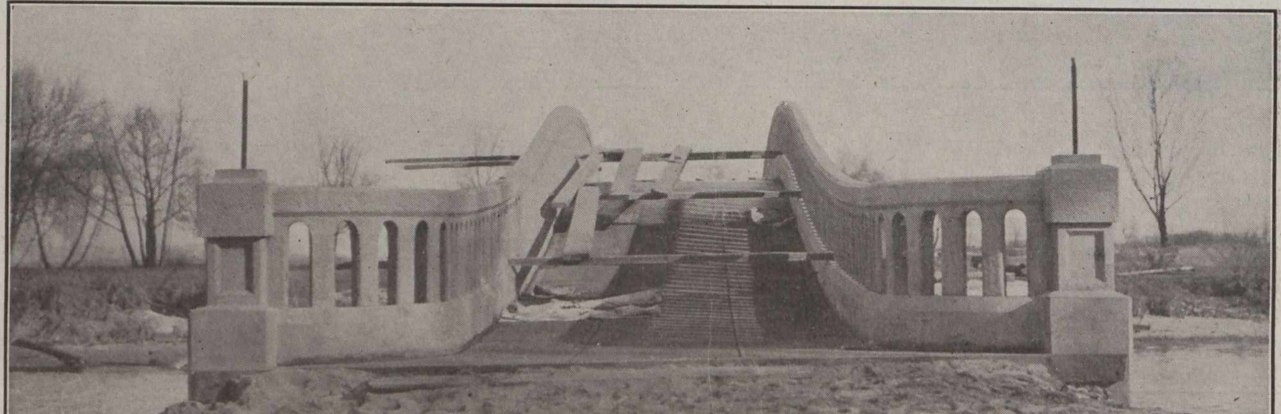

Fig. 4.—End View of Bridge During Construction.

were built around each abutment and three pile bents (Fig. 7) were driven to support the arch centering and form work. The piles were sunk into place, the soil being sand, by means of a water jet aided with a light pile being jetted, would pop out of the water, the jet evidently having loosened the sand surrounding it. This method of pile driving was found to be very satisfactory.

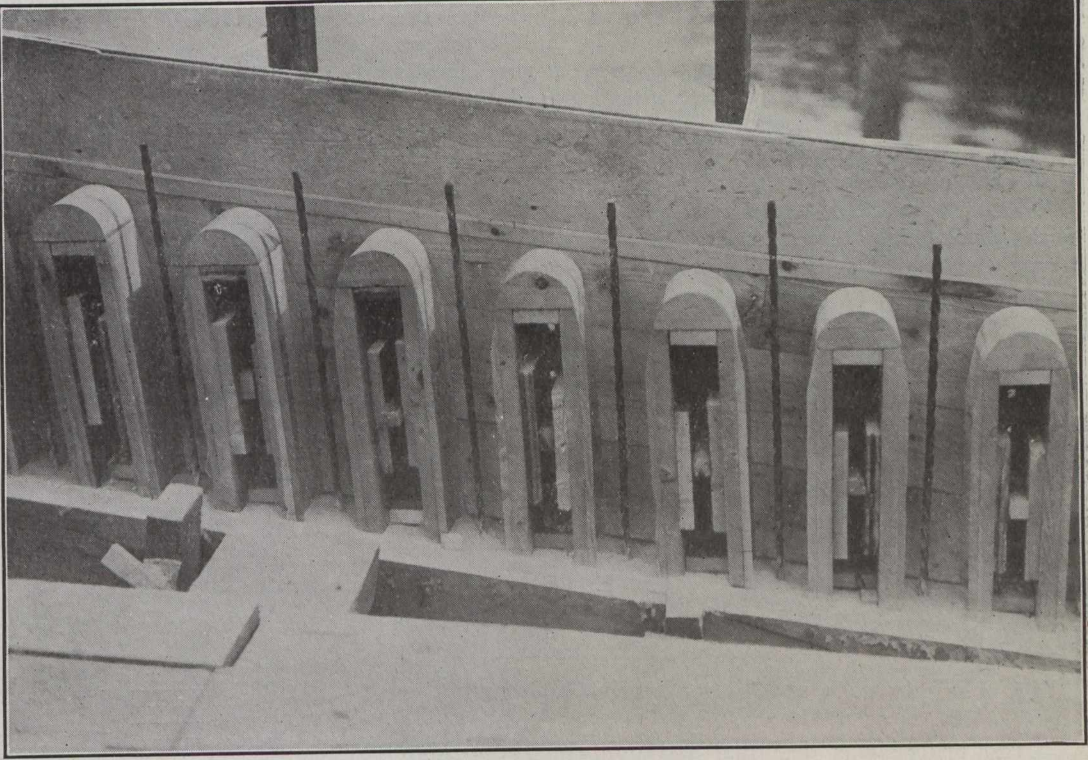

**Fig. 5. Details of Forms for Handrailing.**

The order in which the concrete was placed is as follows: First, the abutments up to the springing; second, the arch rib working from both ends at the same time in order to produce symmetrical deformations in the falsework; third, the parapet walls; fourth, the spindles and railing.

Three types of surface finishing are used on the exposed surfaces of this bridge. The projecting ends of the arch ring are given a so-called pebble surface finish. The finish was secured as follows: Concrete, three or four inches thick, made with lake shore pebbles, one-half to two inches in diameter, was placed next to the forms. Before this concrete had firmly set, the forms were removed and the mortar was scrubbed out from around the pebbles with fine wire brushes, thus leaving the pebbles projecting and making the arch ring more pronounced. The parapet walls were given a cement wash finish, which was applied as follows: After the concrete had set, the forms were removed and all air holes filled with mortar and the surfaces rubbed down with carborundum brick. When a smooth, even surface had been obtained a very thin wash of cement was applied. This wash leaves a uniform and neat surface and proves to be a very satisfactory method of finishing concrete surfaces. The spindles and railing (Fig. 6) were made with concrete, the stone in which was crushed granite of different shades. Before this concrete had firmly set the forms were removed and the mortar brushed out from around the stone with fine wire brushes. When the concrete had become well set, the top railing was smoothed down with carborundum brick. If the concrete at times became too firmly set to allow the use of the wire brushes, a 1:1 solution of muriatic acid was used to aid in the removal of the mortar from around the stone.

The top of the arch ring is waterproofed with three ply of Samson ready roofing, laid with hot tar and pitch mixed in equal proportions.

Concrete sidewalk paving was laid on the top of the sand fill between the spandrel walls, care being taken to provide plenty of longitudinal and transverse expansion joints.

Three expansion joints were provided in the railing, one at the centre and one at each quarter point. The joint is a simple keyed joint in the parapet wall, and in

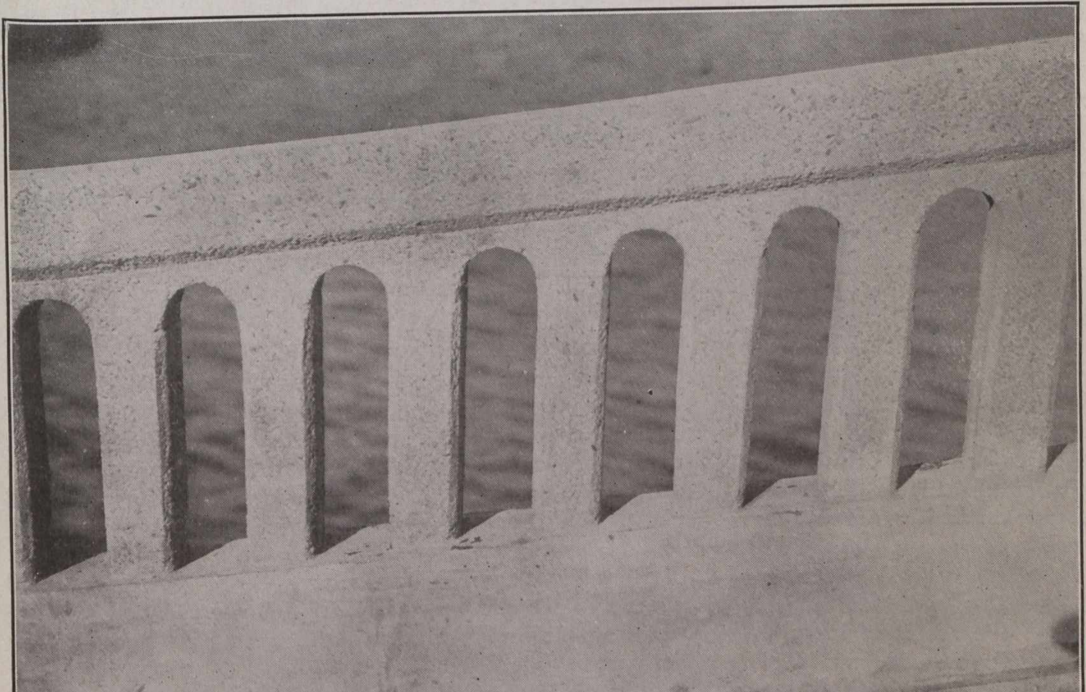

**Fig. 6. Detail of Handrail Finish.**

the top railing a ¾-in. dia. copper rod set in the concrete, with one end free, holds the railing in alignment. Copper was used for this purpose to prevent rust streaks on the concrete. The fact that, after a year's service, there are no cracks in the handrailing or the parapet wall is ample justification for placing three expansion joints in so short a span.

The Parks Department have laid out the approaches with shrubs and flower beds, and when these are in bloom the bridge setting is very much improved.

**Fig. 7.—Falsework and Forms During Concreting.**

The bridge was designed and built by the Bridge Section of the Department of Works of the City of Toronto. Mr. G. A. McCarthy is Engineer of the Railway and Bridge Section, and Mr. R. C. Harris Commissioner of Works.

## LAYING SPECIAL WORK FOR STREET RAILWAYS.

The British Columbia Electric Railway Company appears to have been very successful in its use of solid manganese special work, and Mr. H. J. Trippet, maintenance-of-way engineer for the company, attributes the success to the exceptional care taken to secure solid foundation. Writing in "Electric Traction," he describes the manner in which the work is carried out as follows:—

The special work is laid on ties spaced 3 ft. centre to centre and blocked up to grade to permit of about 8 in. of concrete under the ties. The concrete is of the proportion of 7 to 1 and is tamped under the ties and up to 2 in. below the base of the rail; at the same time a wood block is embedded in the soft concrete between each of the ties, under the rail, with the top of the block also 2 in. below the base of the rail and flush with the top of the concrete. This concrete is permitted to set for 6 or 10 days, according to weather, and then the rail support is shifted to the wood block which was set in the concrete, by means of wedges driven between the block and the rail. These wedges are then bored with an auger and the rails spiked down to them and the block beneath them. This takes the weight of the rail off the ties. The spikes in the ties are then drawn and the ties pounded down to the concrete bed, as the traffic will probably have caused slight vertical movement of the ties in the soft concrete while it was setting. The rails are then shimmed up on the ties with tie plates of the required thickness which are also spiked in place. This eliminates any movement as the result of installation under traffic and supports the rail on the tie and block alternately every 18 in. The remaining concrete is then put in up to the required paving level.

## MUNICIPAL DEVELOPMENT IN CALGARY.

The city of Calgary, whose population has increased in the past decade from 10,500 to 80,000, has experienced a development exceptionally rapid and typical of the Canadian West. Its favorable geographical location has had much to do with the phenomenal growth. What follows is a brief outline of municipal engineering features that are particularly worthy of note in a review of the city's development.

**Street Railways.**—In its street railway system Calgary has 71½ miles of track, 35 miles being upon paved roads, and there are 65 cars in operation. The service has shown a surplus in every year since the commencement of operation in 1909. The capitalization of the system in debentures of the city is approximately $2,330,000, including paving costs. Power is supplied by two 500-kw. direct-driven steam units and one 1,500-kw. motor-generator at the central power station. Two additional sub-stations are under construction which will increase the power by 1,200 kw.-hours. In five years the growth has been as follows:—

| Year | 1910 | 1911 | 1912 | 1913 | 1914 |
|---|---|---|---|---|---|
| Passengers carried ...... | 3,649,697 | 7,176,086 | 12,941.630 | 16,986,658 | 16,213,731 |
| Miles operated.............. | 500,622 | 801,086 | 1,643,328 | 2,648,234 | 3,112,407 |
| Surplus ...................... | $29,435.53 | 87,206.64 | 107,253.49 | 69,492.82 | 3,831.60 |
| Cars operated .............. | 15 | 22 | 48 | 65 | 65 |
| Miles of track .............. | 16½ | 26¼ | 54 | 70½ | 71½ |
| Number of employees... | 62 | 102 | 246 | 348 | 380 |

**Waterworks.**—Calgary obtains its water supply from the neighboring Bow and Elbow Rivers, pumping same from the Bow and obtaining a supply from the Elbow by a gravity pipe line. The intake on the gravity line on the Elbow is located about 13 miles west of the city, and the line furnishes a supply of 8 million gallons per 24 hours. The level at the intake is approximately 300 feet above the general level of the centre of the city. At the west end of the city on the gravity line is a reservoir of 16 million gallons capacity. At the present time plans are being prepared to increase the capacity of the gravity system by an additional 5 million gallons per 24 hours, by extensions and improvements at the intake, and to increase the storage capacity of the reservoir by approximately 16 million gallons. The supply from the Bow River is obtained by pumping, the new pumping station at Twenty-first Street West having a capacity of 20 million gallons per 24 hours. The higher levels of the city are dealt with separately, water being pumped into an elevated storage tank and distributed over that district.

At the present time there are 190.32 miles of water mains in service in the city and 13 miles of 30-inch wood-stave pipe in the gravity line. There are 9,879 connections, 1,027 hydrants, 140 public water taps and 12 public water troughs. A pressure of 85 pounds per square inch is maintained in the mains, which with the aid of the pumps can be materially increased in times of emergency.

**Sewers.**—In the sewer system there are 201.43 miles of sewers, including about 30 miles of trunk sewers. There are 8,880 connections, 1,974 manholes and 1,186 catch basins. Until recently the outfall was into the rivers, but all the outfalls are now being picked up and centralized to the site of the proposed sewage disposal plant. A site for the plant has been chosen on the banks of the Bow River on the southeasterly limits of the city of Bonnybrook. The particular style of sewage disposal plant has not yet been fully decided upon, but investigations are being made along the lines of a plant of the activated sludge type.

In order to connect the north side of the Bow River with the direct trunk sewer to the disposal plant, a reinforced concrete tunnel has been driven under the river at Fifteenth Street East. The tunnel is 958 feet long, and there passes through it an inverted syphon consisting of three pipes of 20, 24 and 33 inches diameter, with a capacity of approximately 50 cubic feet per second. This will take care of all the sewage from the north side and convey same to the disposal plant for treatment.

It will be interesting to note that during the past winter construction was started—as relief work—on the Nose Creek trunk sewer. Constructing a concrete sewer in winter was an innovation in the city, but with proper safeguards a very satisfactory job was performed at a reasonable cost, and no concrete work was lost through frost.

**Streets.**—Calgary is one of the best paved cities in the West, having 61.69 miles of pavement of various kinds—wood block, granitoid, bitulithic, asphaltic concrete and sheet asphalt. In former days pavement was laid by contractors, but in 1912 the civic authorities inaugurated the municipal paving plant. This step has been fully justified, for since commencing operations the plant has laid a large amount of asphaltic concrete pavement at a less cost than previously. A summary of the operations of the department follows:—

| Year. | 1912. | 1913. | 1914. |
|---|---|---|---|
| Asphaltic concrete pavement, sq. yds. | 30,233.7 | 132,424.0 | 140,252.7 |
| Extra asphaltic concrete surface | 7,455.1 | ...... | 6,279.3 |
| Curbs and gutters, lin. ft. | 29,908.5 | 60,869.2 | 69,857.9 |
| Sidewalk, sq. ft. | 2,539.0 | 4,818.1 | 472,693.2 |
| Retaining wall, cu. yds. | 50.0 | 175.0 | 75.0 |
| Concrete pavement, sq. yds. | ...... | 5,063.0 | 888.3 |
| Stone pavement, sq. yds. | ...... | 10,504.9 | 4,027.9 |
| Brick pavement, sq. yds. | ...... | ...... | 745.0 |
| Concrete header, lin. ft. | ...... | 4,610.0 | 14,327.7 |
| Sub-base under street railway, single track, lin. ft. | ...... | 32,284.6 | 25,079.3 |
| Asphaltic concrete pavement, cost per sq. yd. | $2.02 | $1.89 | $1.85 |
| Total expenditure for all work | $71,709.13 | $419,362.91 | $579,771.97 |

In addition to the above the municipal plant performed all repairs to cuts in pavements.

The permanent improvements to streets are as follows:—

| | |
|---|---|
| Miles of pavement | 61.69 |
| Miles of concrete walk | 160.65 |
| Miles of curb and gutter | 69.61 |
| Miles of heavy curb | 4.35 |
| Miles of streets graded | 109.41 |
| Miles of streets boulevarded | 47.11 |
| Miles of conduits laid— | |
| Trench miles | 20.68 |
| Duct miles | 116.80 |

**Bridges.**—Spanning the Bow and Elbow Rivers are eight steel bridges and one concrete bridge, whilst a high and low level concrete bridge is now under construction. These are all traffic bridges and do not include the numerous railroad bridges built by the three transcontinental lines. Special mention may be called to the new Mission bridge across the Elbow River at Fourth Street West, and the Centre Street bridge.

The Mission bridge is a reinforced concrete bridge built in a style which closely harmonizes with its name. It has four spans, one 86 feet, one 76 feet and two 34 feet wide. The roadway is 40 feet wide and there is a 6-foot walk on either side, while the width of the bridge over the abutments is 60 feet. The cost of this bridge was $48,000.00.

At Centre Street construction has started on the new bridge. When complete it will be one of the most imposing structures in the west. The design is for a high-level bridge of reinforced concrete, with a suspended low-level bridge. The bridge will consist of a series of arches, three main spans each 150 feet long, crossing the river; a 62-foot span crossing a boulevard on the north side of the river, and a series of short spans at the south end, with a retaining wall approach. The grade from the south to the north side will be 3.85 per cent., and the width of the roadway will be 42 feet to admit of street car and vehicular traffic, while a 7-foot walk on either side will carry the pedestrian traffic. The suspended low-level bridge will have a width of 18 feet. The height of the retaining wall on the north side of the river is 50 feet, and the hill behind will be graded to correspond with the grade of the bridge. On the abutments four towers will rise to a height of 18 feet above the bridge and be surmounted with a statue of a lion on each tower. The estimated cost of this bridge is $375,000 and it is expected that it will be completed by the end of 1916.

The city is governed by an elective board of commissioners. The present method of distribution of the various civic departments under the system is as follows:

The mayor looks after the departments devoted to finance, fire, police and general executive business. The commissioner of public utilities has under his direction the street railway, waterworks, market, power and electric light. The commissioner of public works is in charge of paving, grading, sewers, streets, parks, public works and buildings. Mr. George W. Craig is the city engineer.

These interesting notes were derived from a booklet prepared by the city, the Canadian Pacific Railway Co., the Calgary Power Co., the Calgary Branch of the Canadian Society of Civil Engineers and other members of the civil, mining, mechanical and electrical engineering professions in Alberta, for presentation to the members of the national engineering societies of America who returned from the International Engineering Congress via Canada. The enterprising publication contained a description of the irrigation works of the Canadian Pacific Railway Company, prepared by H. B. Muckleston, assistant chief engineer, Department of Natural Resources, C.P.R.; a résumé of the water powers of Canada, by J. B. Challies, superintendent of water powers, Department of the Interior, Ottawa; the Horseshoe Falls and Kananaskis Falls plants of the Calgary Power Company on the Bow River, by F. J. Robertson, general superintendent, and numerous other references to the resources of the Bow River Valley.

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In the absence of sufficient reliable data on the efficiency of impregnating materials, the best source of information appears to be statistical data on the life of various types of telegraph poles. In Germany such data have been collected since 1850 and published at various periods, in particular, by Christiani in 1905. These data have shown that of all of the processes of impregnation those using kyanization and impregnation with tar oil, have given the best results. The economic value of impregnating poles may be determined in accordance with the following formula:—

$$\text{Economic efficiency} = \text{average cost per annum} = \frac{\text{cost of operation}}{\text{average life.}}$$

The cost of operation includes, of course, both the impregnation and the delivery of the poles to the spot, and is, as a rule, given by the accepted bids, but the average life of the pole is, to a greater or less degree, an unknown quantity. On the whole, the life of impregnated poles may be predetermined by the application of the usual laws of probability and the destruction of wooden poles through decay follows the usual probability curve.

## THE QUEBEC BRIDGE PUMPING PLANT.

**By J. W. Davis, Montreal.**

THE problem of securing an adequate supply of water for the Transcontinental Railway yards at the New Quebec Bridge was the subject of careful investigation by the engineers of the Commission. The rise and fall of the tide, the height of the embankment, and the unsuitability of the river water were some of the determining factors in favor of drilling a deep well. Moreover, the use of river water would have necessitated the construction of a pumping plant at a distance from the power-house and would have increased the cost of attendance. The location of the well and plant is shown in Fig. 1.

The drilling contract was awarded to the Wallace Bell Company, Limited, of Montreal, who have carried out most of the large drilling contracts in Quebec province. Work was started in September and finished in December, 1912.

Forty-three feet of 8-in. wrought iron pipe was driven from the surface to the rock, and from that point a 5-in. bore hole was started. The well was drilled entirely in shale, red and gray alternating.

On September 30th a depth of 400 ft. had been reached, and a rough pumping test yielded 200 imp. gal. per hour. At 280, 520 and 700 ft., respectively, dry crevices were encountered, while at 775 feet water was struck in considerable quantity. The hole was then reamed to a diameter of 8-in., and a subsequent test yielded 3,200 imp. gal. per hour.

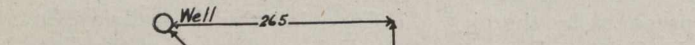



**Fig. 1.—Sketch Showing Location of Well, Tank and Power House.**

At a depth of 980 ft. another water crevice was opened up and at a depth of 1,012 ft. drilling was discontinued. The whole well was then reamed out to 8-in. diameter. A large plunger pump was used for a 24-hour test, and with 400 ft. of rods in the well a yield of 5,400 imp. gal. per hour was maintained. This pump was afterwards operated for eight days to clean out the well, and a sample of water submitted to Milton Hersey Co., Limited, of Montreal, was analyzed and reported satisfactory for both boiler and domestic purposes.

When the well is not being pumped water rises to the surface; when being pumped to capacity it drops, however, to a depth of 400 ft. from the surface.

A joint contract was awarded to Canadian Ingersoll-Rand Co., Limited, and Williams and Wilson, Limited, of Montreal, for furnishing and installing a suitable pumping plant. The air-lift system was adopted owing to its numerous advantages over other systems of deep-well pumping, as with this system there are no moving or wearing parts in the water and the air-compressor may be located at any distance from the well.

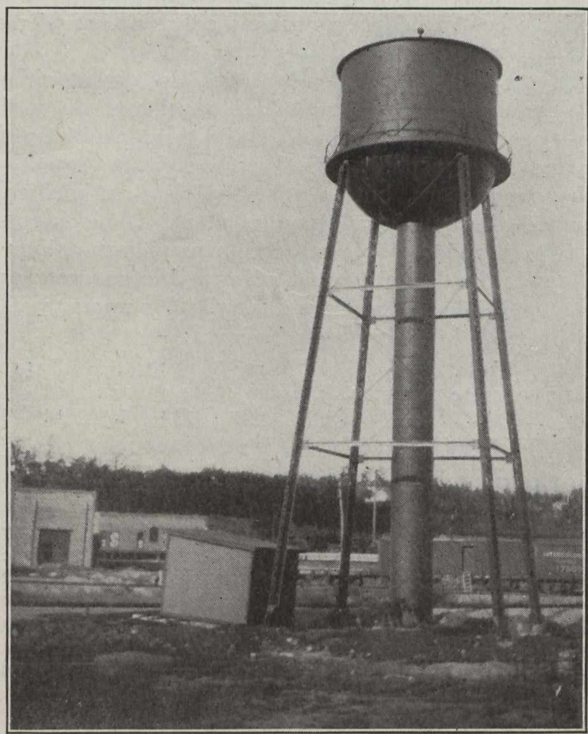


**Fig. 2.—Steel Tank in Connection With Plant.**

The pipes and foot-piece were lowered into the well under the supervision of Mr. William Perry, Hydraulic Engineer, of Montreal, who has had extensive experience in the installation of such systems. Extra heavy pipe was used, and owing to the great weight extreme care had to be taken to avoid dropping it down the well. This work was accomplished without a mishap of any kind.

The air-compressor is a Canadian Ingersoll-Rand tandem compound steam-driven machine, designed for a terminal pressure of 250 pounds, and the air cylinders are fitted with a new type of valve known as the circo-leaf valve, which is absolutely noiseless in operation. The frame is fully enclosed, and the moving parts work in a constant flood of oil. A combined speed and pressure governor controls the compressor.

The air-lift foot-piece was manufactured by the Harris Air Pump Co., of Indianapolis, whose pumps are extensively installed throughout Canada. The column of water is carried by an air-jet situated below a choker, which arrangement eliminates slippage and causes the air to be distributed through the water in small bubbles. The booster pump was also furnished by the same firm.

The latter is a recent invention, and this is the first installation of it in Canada.

Water is discharged into a steel tank furnished by the Des Moines Bridge and Iron Co. This tank is 24 ft. in diameter, and the total capacity, inculding the leg, is 61,170 imp. gal. The level of the water in feet is indicated by a marker on the outside of the tank, and by this means it is possible to accurately gauge the capacity of the plant. The tank is supported by a steel frame resting on a concrete base, in which are located the valves and connections to the service mains and to the main drain. Steam is furnished to the compressor at 110 lbs. pressure. Owing to the depth to which the water drops in the well three air lines are used, two being tapped into the water discharge line at different depths, and the third entering the Harris foot-piece.

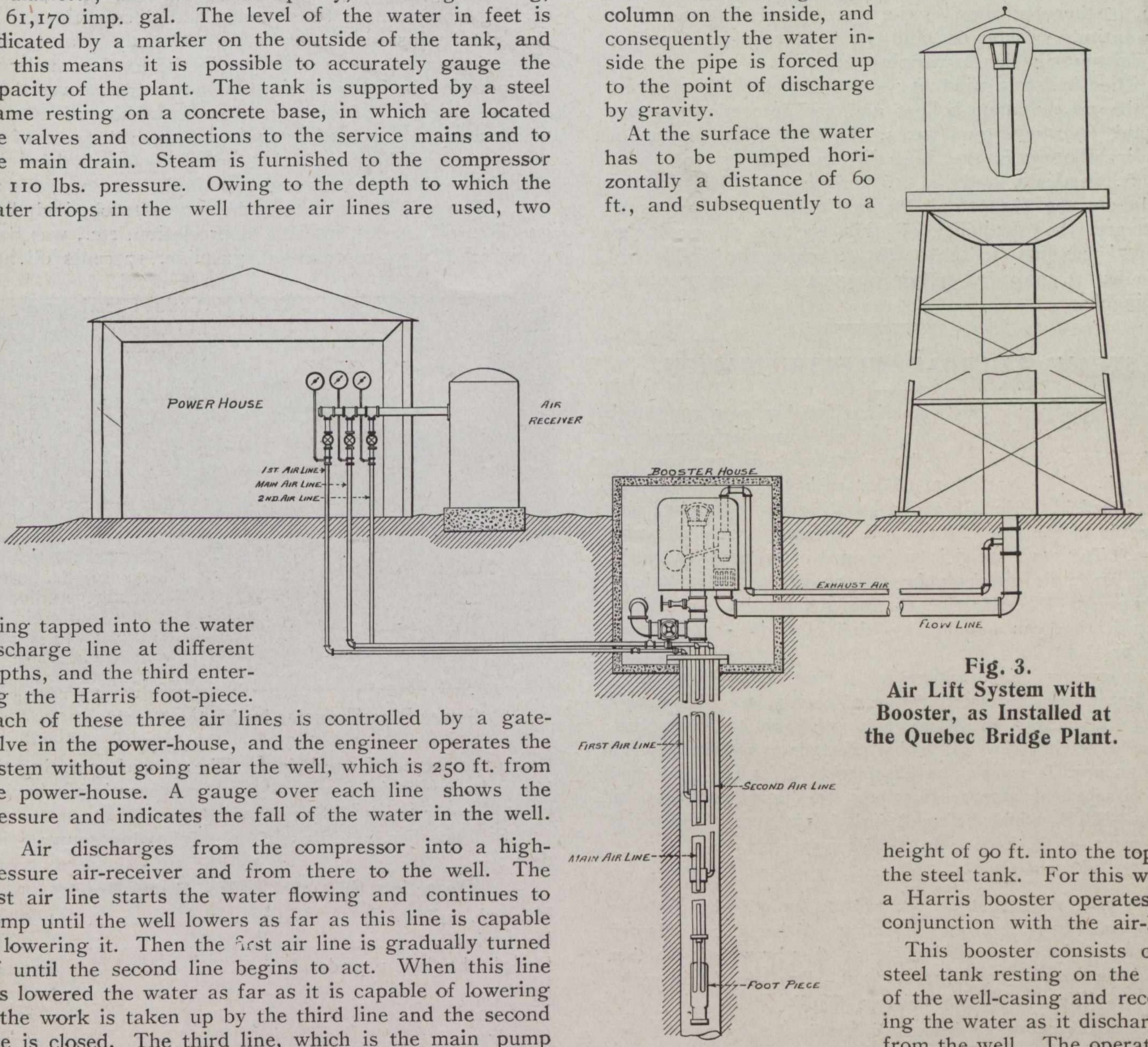



**Fig. 3. Air Lift System with Booster, as Installed at the Quebec Bridge Plant.**

Each of these three air lines is controlled by a gate-valve in the power-house, and the engineer operates the system without going near the well, which is 250 ft. from the power-house. A gauge over each line shows the pressure and indicates the fall of the water in the well.

Air discharges from the compressor into a high-pressure air-receiver and from there to the well. The first air line starts the water flowing and continues to pump until the well lowers as far as this line is capable of lowering it. Then the first air line is gradually turned off until the second line begins to act. When this line has lowered the water as far as it is capable of lowering it the work is taken up by the third line and the second line is closed. The third line, which is the main pump line, then continues to furnish air as long as the system is in operation.

The object of the first two lines is to enable the accumulation of water in the well to be pumped away without resorting to an abnormally high air pressure. These lines are only used in starting the system.

The yield of the well is 5,400 imp. gal. per hour delivered into the tank, and under continuous operation the air pressure at the receiver is about 160 lbs. When the system is first started the yield reaches a total of about 6,000 imp. gal. per hour, this being due to the accumulation of water filling the well to the surface. The yield gradually decreases under continuous operation until the normal capacity and pumping head are reached.

The operation of the air-lift system is extremely simple. The lower end of the pipe being open, water rises inside the discharge pipe to the same height as it stands on the outside. Admit air under pressure into this column of water inside the pipe and the process of aeration naturally lightens the water, or reduces its specific gravity. As no air is admitted to the water on the outside of the pipe, this body of water is naturally heavier than the lightened column on the inside, and consequently the water inside the pipe is forced up to the point of discharge by gravity.

At the surface the water has to be pumped horizontally a distance of 60 ft., and subsequently to a height of 90 ft. into the top of the steel tank. For this work a Harris booster operates in conjunction with the air-lift.

This booster consists of a steel tank resting on the top of the well-casing and receiving the water as it discharges from the well. The operating parts consist of a float and valve located inside the tank. The water and air are separated in this tank, the air rising to the top and maintaining sufficient pressure to force the water to the elevated tank. As the solid column of water discharges the float drops, allowing the surplus air to exhaust from the tank. This whole operation requires only a few seconds, as a discharge takes place every time the booster is about two-thirds full. In fact, practically a constant flow is maintained.

The surplus air may be piped back to the compressor intake or discharged into the vertical riser to lighten the column of water and reduce the operating pressure. This latter plan was followed in the case of the plant at Quebec. The booster is automatic in operation and requires no attention. It also operates without noise. This apparatus is located in a concrete sump below the ground and is reached through a door in the roof. A by-pass is connected to the main drain so that the well can be pumped directly into the sewer for cleaning purposes.

The plant was operated by the contractors for several days under the supervision of Mr. Alex. Porter, Assistant Engineer of the Transcontinental Railway, who, at the expiration of the test, stated that the plant was entirely satisfactory and the most reliable of any of the railway divisional pumping units.

The water is used for supplying the locomotives, for the power plant boilers and for domestic purposes around the station and yards. An interesting feature of this installation is the high lift, amounting to about 500 ft. vertically and 60 ft. horizontally. This is undoubtedly the highest air-lift in Canada, and serves to illustrate the flexibility of this system of pumping. There is no limit to the height to which the air-lift will raise water, provided a fair amount of submergence is obtainable.

## STEAM RAILROAD ELECTRIFICATION.

No railway that has been electrified has ever gone back to steam. The Pennsylvania has made wonderful progress in the east in handling the heavy traffic at the rate of 50 to 70 m.p.h. The Norfolk and Western has electrified the line from Bluefield to Norfolk and is handling heavy freight trains up grade at the rate of 14 m.p.h., as against 7 m.p.h. with steam. The same speed is maintained in going down grade. There are more wrecks going down grade than from any other cause. Electrification eliminates down grade accidents. Electrification can handle any kind of traffic—fast, heavy, light or slow.

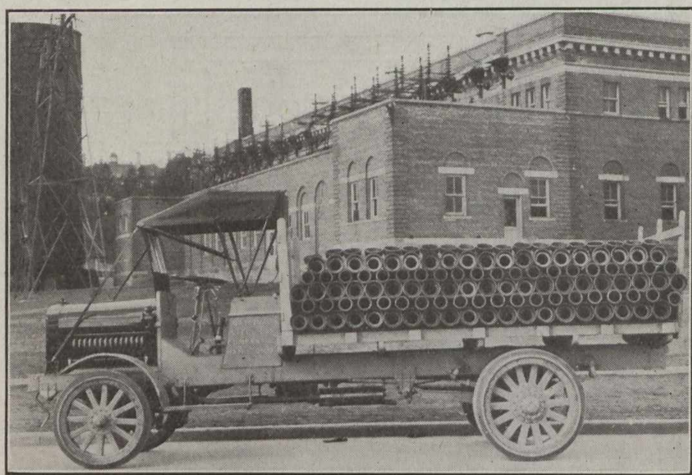
Its greatest disadvantage is the first cost. Many cities are demanding the electrification of terminals. This should be carefully investigated before insisting on its accomplishment. Electrification will enable railroads to reclaim all land they occupy. It means the elimination of smoke and dirt. It eliminates the expense of rolling stock lying round in the yards.—N. W. Storer before American Institute of Electrical Engineers, at St. Louis, Mo., October 19, 1915.

In order to save time at transfer points, the Calgary Municipal Street Railway, of Calgary, Alberta, has adopted the plan of the cars notifying one another by whistle whether they have transfer passengers or not. One whistle, in reply, indicates "Yes," and two whistles "No."

With the enormous increase in traffic density on railways and its effect upon rail, it is not surprising that there have arisen many instances of rapid rail wear. This has led to efforts to secure some metal other than Bessemer or open-hearth steel which will give a greater life at these particular places, and has given rise to the experiments with special steels described by W. C. Cushing in another column. To be successful, any substitute metal must possess the valuable qualities of the present open-hearth steel, while at the same time affording a greater resistance to wear, and must yield itself to manufacture at a cost sufficiently low to enable it to be used with economy. These are rigid requirements and it is neither surprising nor discouraging to note that no entirely satisfactory substitute has yet been developed. Material progress is being made in the development of materials of the required physical characteristics, and with increased use the cost of manufacture will decrease materially. It is important that these and other experiments be continued, even at heavy initial cost to the railroads as well as to the manufacturers, for it is certain that the traffic will continue to grow in the future as it has in the past.

## HORSE-DRAWN vs. MOTOR TRUCKS.

The motor truck vs. the horse-drawn vehicle was the subject of an article in *The Canadian Engineer* for November 11, 1915, which presented some interesting data concerning comparative tests under actual conditions. In the specific instance referred to, an analysis of results showed a saving of over $2,500 in the total annual cost of operation in favor of a 5-ton motor truck over three 2-horse trucks. Another instance is worthy of note in which a one-day run of a truck making a distance of 60 miles accomplished work that ordinarily would have required two double teams and two single-horse wagons all day. The cost of operating the motor truck, including gasoline, oil, wages, interest, depreciation, etc., was $12, of which $1.30 represented gasoline, 17 cents oil and



**Sewer Pipe Transfer by Motor Truck.**

$1.50 the wages of one helper. The cost of operating the horse-drawn vehicles was $26.91, representing a saving by the motor truck of $14.91 per day.

Still another instance gives the following comparative data:—

**Operating Cost of 1½-Ton Motor Truck.**

| | |
|---|---|
| Mileage, miles | 6,888 |
| Deliveries | 8,188 |
| Freight hauled, pounds | 593,052 |
| Rent | $120.00 |
| Insurance | 97.93 |
| Repairs | 7.25 |
| Sundries | 19.23 |
| Gasoline | 139.40 |
| Oil | 15.80 |
| One chauffeur, at $15 per week | 780.00 |
| Tire expense | 160.00 |
| | $1,239.61 |

**Cost Per Annum of Operating Two 2-Horse Wagons.**

| | |
|---|---|
| Two drivers, at $12 per week | $1,248.00 |
| Feeding 4 horses, at $4 per week | 832.00 |
| Shoeing 4 horses, at $2 per month each | 96.00 |
| Repairing and painting 2 wagons | 60.00 |
| Repairing 4 set of harness, at $5 each per year | 20.00 |
| | $2,256.00 |

The accompanying view illustrates a 3½-ton truck which the Toronto and Hamilton Sewer Pipe Company is operating in Toronto. It is the product of the National Steel Car Company, Hamilton, Ont.

## TREATMENT OF WATER WITH HYPOCHLORITE.

In the Journal of the Society of Chemical Industry for September 30, 1915, there appears on this subject a paper presented at an earlier meeting of the Canadian Section of the Society, by Mr. Joseph Race, F.I.C., city chemist and bacteriologist, Ottawa, Ont. The paper is of considerable interest, following up as it does, some important points in hypochlorite treatment that have been dealt with in these columns and elsewhere by the same author and by others. A previous paper by Mr. Race pointed out that efficient mechanical intermixture of the hypochlorite solution was much more effective than a prolonged contact period without this admixture. Certain conditions in Ottawa enabled further observations to be made on this important point. In June, 1914, a sedimentation basin was placed in operation at the mouth of the Ottawa intake pipe, and during July the hypochlorite solution was added at the entrance to this basin. The method of addition was by means of a perforated pipe which stretched across the entrance to the basin, and the bleach solution and water were there mixed as thoroughly as was possible without having recourse to mechanical methods. The basin was baffled and had a normal capacity equal to approximately two hours' consumption. The results obtained were as follows:—

Available Chlorine = 1.88 p.p.m.

| | Bacteria per c.c. Agar 3 days at 20° C. | Agar 1 day at 37° C. | B. coli index per c.c. |
|---|---|---|---|
| Raw water | 410 | 104 | 0.280 |
| Treated water | 49 | 26 | 0.036 |
| Percentage purification | 88.2 | 75.0 | 87.5 |

During August the connection at the entrance to the basin was closed and the bleach liquor added directly to the suctions of the low lift pumps, which take water from the sedimentation basin and place it in the intake pipe under a small positive pressure until it reaches the high lift pumps. During both months the samples of treated water were taken from the well which receives the mixed discharges of the low lift pumps. The results for August were:—

Available Chlorine = 1.55 p.p.m.

| | Bacteria per c.c. Agar 3 days at 20° C. | Agar 1 day at 37° C. | B. coli index per c.c. |
|---|---|---|---|
| Raw water | 448 | 100 | 0.600 |
| Treated water | 26 | 12 | 0.005 |
| Percentage purification | 91.9 | 88.0 | 99.2 |

These results, which are the averages of daily analyses, show that the efficient mechanical admixture produced much superior results with a smaller consumption of chlorine.

It is probable that the superior efficiency claimed for "liquid chlorine" is due to the fact that the older plants using bleach have been slow to recognize this essential factor, whilst the plants using "liquid chlorine" have, by various devices, secured more or less efficient admixture, with the consequence that equally satisfactory results have been obtained with a decreased dosage. As shown above, 1.55 p.p.m. of chlorine as bleach gave good results with the Ottawa River water, whilst Harrington (Journ. Amer. Water Works Assoc., Vol. 3, p. 438) stated that 1.50 p.p.m. of available chlorine, as liquid chlorine, was required for the sterilization of the Ottawa River water at Montreal.

During January, 1915, laboratory experiments were made to ascertain what proportion of chlorine would be required when the admixture was as perfect as could be obtained by shaking. The results with a water containing 45 parts per million of color and to which a culture of B. coli was added were as follows:—

| Contact period. | Chlorine, parts per million. 0.30 | 0.40 | 0.55 | 1.21 |
|---|---|---|---|---|
| | Colonies per c.c. | | | |
| Raw water | 380 | 380 | 750 | 750 |
| 1 min. | 140 | 12 | <0.1 | <0.1 |
| 10 min. | 72 | 0.5 | <0.1 | <0.1 |
| 20 min. | 35 | <0.1 | <0.1 | <0.1 |

These figures show that, with satisfactory admixture, 0.4 to 0.5 part per million of available chlorine is sufficient to secure good results, and they led to various changes being made in the pipes delivering the hypochlorite solution at the mouth of the intake, in the direction of securing a still greater efficiency in the mechanical admixture. Up to date this has enabled the quantity to be reduced from 1.3 parts per million to 0.83 part per million, which is equivalent to a saving of $1,400 per annum calculated on the present price of bleach.

**Effect of Temperature.**—During the present winter there have been several periods during which the results obtained with the city supply seemed to indicate that the low temperature had a retarding effect upon the velocity of the reaction, but as these results were somewhat complicated by the length of time that elapsed between sampling and examination, laboratory tests were made to determine this point. The original water contained 45 parts per million of color and was, after seeding with B. coli, treated with 0.51 part per million of available chlorine. The results were as follows:—

| | Temperature, ° F. | | | |
|---|---|---|---|---|
| Initial | 34 | 40 | 52 | 70 |
| Final | 40 | 44 | 55 | 68 |
| | Colonies per c.c. | | | |
| Raw water | 750 | 750 | 750 | 750 |
| Treated water— | | | | |
| After 1 min. | 3.2 | 1.0 | 0.2 | nil |
| After 10 min. | 2.5 | 0.8 | 0.2 | nil |
| After 20 min. | 2.2 | 0.6 | 0.1 | nil |
| After 60 min. | 1.9 | 0.5 | 0.1 | nil |

These results show clearly that the velocity of the reaction is undoubtedly lowered by a reduction of the temperature; a similar conclusion is reached by a study of the rate of absorption of free chlorine as indicated by the starch and iodide reaction.

**Color and Turbidity.**—The organic matter, which is the cause of the color of many waters, undoubtedly increases the amount of chlorine required for the sterilization of such waters, though probably not to the extent that it is usually considered to do. This former hypothesis was based on results obtained with imperfect admixture, when areas of unequal concentration occur, with the consequent loss of chlorine owing to its prolonged localized action upon the organic matter. The point of interest in water purification is not the amount of chlorine a colored water will absorb before showing a free chlorine reaction, but what quantity of organic matter it is necessary to oxidize before the chlorine causes the delicate organic structure of the bacteria to lose its anabolic functions. These two quantities may approach each other when the temperature of the water is near the freezing point and the contact period is short, but with a temperature of 70° F. and a contact period of but 10 minutes the former quantity is approximately three times as great as the latter for the Ottawa River water.

The increase of this factor is a matter of considerable importance to sanitarians, as it involves a decrease in æsthetic objections in addition to an increased economy in working costs.

Increased turbidity also usually decreases the efficiency of the hypochlorite treatment, though the reason for this is by no means clear. If the turbidity is caused by finely divided silt or other mineral matter, no effect should be produced by it, as such matter is inert: the inferior results obtained with such waters are probably due to factors which are introduced concomitantly with the turbidity and by the same cause. When turbidity is caused by the flooding and scouring of cultivated areas, much of the suspended matter is of an organic nature and often encloses masses of bacteria which can only be destroyed by a large increase in the proportion of chlorine. In the case of colored river waters an increased turbidity is usually accompanied by a decreased color, so that these two adverse factors counterbalance each other to some extent.

**Benefits from Treatment with Hypochlorite.**—During the two years immediately preceding the installation of hypochlorite treatment in Ottawa, the typhoid rate averaged 85 deaths per 100,000; after treatment commenced the rate was reduced to 21 the first year and to 13 (4 of which were due to disease contracted outside the city) in the subsequent year. It is only fair to add, however, that this decrease is not entirely due to the chlorine treatment, as the epidemic rates were caused by a leakage of sewage into water intakes which were subsequently replaçed by comparatively water-tight pipes. During 1914, however, a concrete example of the benefits derived from hypochlorite treatment was obtained. In the autumn of 1914 an epidemic of typhoid broke out in a village on the Ottawa River, about 8 miles above the mouth of the Ottawa intake pipe, and in a few weeks about 150 to 200 cases developed. During November and December about 200 cases of typhoid were discovered in Hull, which takes its water supply from the Ottawa River within 400 yards of the Ottawa intake mouth, whilst in Ottawa only 28 cases were reported and of these 60% were due to outside sources. Hull, with the untreated water supply, had a typhoid incidence of 1,000 cases per 100,000 of population, and Ottawa, using a treated supply from the same current of the same river, only 27 cases per 100,000 during the same period. In this example all the factors were favorable to the infection of the Ottawa and Hull supplies, as the temperature and volume of the water were low, thus increasing the viability of the typhoid organisms and decreasing the dilution of the infecting sewage. The enormous volume of the river even at low-water mark (probably about 20,000 cu. ft. per second) alone prevented a still more serious epidemic.

**Material of Construction for Hypochlorite Plants.**—The great difficulty in this connection is to obtain materials which are economical and yet capable of resisting the corrosive action of hypochlorite solutions. For very dilute solutions (0.2% of bleach) this problem presents little difficulty, but the use of solutions of this strength is not good policy on account of the large increase in capacity involved. Two years ago a plant was constructed in Ottawa capable of treating 20 million gallons per day, and consisting of three large, circular, wooden tanks in which the bleach and water were thoroughly mixed by electrical motors connected directly to a shaft to which propeller blades were attached. Two of these tanks were of oak and one of cypress, and it was found that a 1% bleach solution rapidly leached the wood and produced leaks that it was impossible to repair. The inside surfaces of these tanks were then thoroughly washed and painted with several coats of what was claimed to be an acid-resisting mixture. This treatment was efficacious for a time, but after a few months the leakage was as great as ever. The tanks were then lined with a three-inch coat of concrete, the surface of which was painted with asphaltum. This has been comparatively satisfactory and, when a new plant was erected about twelve months ago, was instrumental in deciding to eliminate all wood material and to use concrete painted with asphaltum wherever it was possible. Lead-lined wooden tanks may be used for vessels of small dimensions in which the sheet lead can be placed without joints. In tanks employed for mixing bleach solutions by mechanical methods, the author's experience has shown that cast aluminum blades attached to a bronze shaft produce the best results. After considerable use the aluminum blades become coated with an incrustation which prevents corrosion of the metal. For piping, the Ottawa results show that galvanized iron gives good results when the piping is of generous dimensions and when plugged "T's" are placed at all bends for removing incrustation. In piping systems experience shows that it is incrustation rather than corrosion that produces difficulties, and that the material has but little effect. In valves the converse holds true, as the friction of the various parts prevents the formation of a protective coating and constantly presents fresh surfaces for the action of the solution. Soft brass valves are useless, but gate valves made of hard bronze have been found satisfactory. Vulcanite valves may also be used but are expensive as regards first cost and require careful manipulation to prevent fracture. When gravity systems are used for the introduction of the hypochlorite solution, the ball valve used for maintaining a constant head should be made of bronze with a glass float, and the orifice, of glass. This method of operating with a known head of water on a circular orifice has given perfectly satisfactory results in Ottawa and at many other places. The mixing operations of a hypochlorite plant should be checked by daily analyses of the liquor, so as to prevent wastage and irregular addition.

**Complaints.**—Numerous objections have been raised against the use of water which has been treated with hypochlorite. Some of these have been previously mentioned in connection with the Toronto supply (*loc. cit.*), but these might again be considered, as the water under discussion, being entirely different in character, presents new aspects of this problem. A typical analysis of the Ottawa River water is as follows: Free ammonia, 0.004 part per million; alb. ammonia, 0.096; nitrites, trace; nitrates, 0.055; chlorine, 1.5; total hardness, 37.0; carbonic acid, 1.0; oxygen absorbed in 4 hours at 27° C., 5.50. The physical characteristics are:—

| | Average. | Maximum. | Minimum. |
|---|---|---|---|
| Color | 67 | 90 | 40 |
| Turbidity | 16 | 300 | 3 |
| Alkalinity | 26 | 47 | 14 |

With such variations in color and turbidity it is obvious that the addition of hypochlorite cannot be maintained at a constant rate, but is has been regulated so as to have, whenever possible, no free chlorine, as indicated by the starch and iodide reaction, in the water delivered to the mains at the high-lift pumping station. This has resulted in a comparative absence of complaints regarding the cold water; but there is no doubt that, after heating, the water possesses a peculiar odor, due to chlorine compounds. This odor is not the sharp, acid odor of chlorine, but a fishy one which is possibly caused by such compounds as chloramines.

Complaints regarding the effect on animals have been made, and a number of these have been investigated. It is undoubtedly true that when the amount of free chlorine in water reaches 0.5 part per million, both small and large animals refuse to drink such water entirely or absorb only small quantities. This possibly has had an adverse physiological effect. When the water is capable of absorbing as much as 1.5 parts per million of chlorine without showing free chlorine, naturalists who deal in small animals and fishes state that no effect is observed. Continuous physiological tests on minnows and gold fish confirm this. The Dominion Department of Fisheries has informed the author that free chlorine in the water had a markedly adverse effect on the hatching of the eggs of Atlantic salmon, Great Lake trout, pickerel, and whitefish, but no effect was noticed when free chlorine was absent. The Department has, however, decided to remove all the hatcheries to places where water free from chlorine can be obtained.

The effect of the treated water upon seeds, plants, and flowers has been investigated by the Dominion Department of Agriculture, and Dr. Gussow (Dominion Botanist) and Dr. Shutt (Agricultural Chemist), who were in charge of this work, have reported that water treated with hypochlorite caused no apparent injury to carnations and hybrid roses. Six varieties of wheat seed after soaking in freshly prepared hypochlorite solutions (0.05 to 10 parts per million available chlorine) were all sown on the same day. Germination was found to be uniform throughout and no influence could be detected either as regards the rate of germination or the development of the young plants. Experiments on barley and oats produced similar results. Radishes, turnips, cucumbers, and beans also showed no retardation in development after treatment with the water.

All these experiments were conducted with solutions of bleach in distilled water, but the same results were obtained in a later series when the treated city supply was used. These results prove conclusively that statements alleging damage to plants, flowers, and seeds by the hypochlorite treatment of water are absolutely unfounded and do not merit the slightest consideration.

The author has had, on several occasions during the past year, to investigate cases of alleged corrosion of piping due to the hypochlorite treatment of water, but before discussing these it will be advisable to review briefly the latest work on the corrosion of iron piping by water. The Committee on Water Supplies of the American Public Health Association have reported that, in general, hard waters have given little or no trouble in corroding metal pipes, and that this is apparently due in considerable measure to the formation of protective coatings upon the metal by the water itself. Soft waters do not seem to form such coatings naturally, and allow the carbonic acid in the water to dissolve such metals as iron and to retain the iron in solution. This process is maintained until the whole of the dissolved oxygen has been absorbed.

Jackson and Hale (New York Water Department Report, 1912) found that the first reaction is the solution of iron as bicarbonate by carbonic acid, with the formation of hydrogen. In experiments carried out in the cold, about 20% of the hydrogen formed was oxidized to water by the dissolved oxygen near the surface of the iron. The dissolved oxygen at the same time oxidizes the soluble iron bicarbonate to insoluble red oxide, setting free again carbonic acid. The carbonic acid liberated again dissolves more iron and is again set free until all the dissolved oxygen is exhausted.

These reactions are in accordance with the facts which have been observed in connection with corrosion of piping systems, and account for the rapid corrosion of both domestic and heating hot water systems. Methods which reduce the oxygen content will reduce the corrosion, but it is much more economical to eliminate the catalytic agent which enables the oxygen to produce its deleterious effect.

In view of the alleged corrosion of hot water systems in Ottawa, the author made routine determinations of the amount of free carbonic acid in the raw and treated waters: the average results for the year 1914 are as follows: raw water, 0.8 part free carbonic acid per million; treated water, 1.6 parts. During the early part of the year, when a bleach of high chlorine content was being used, the free carbonic acid in treated water was invariably higher than in the raw water, but the reverse was found later in the year, when the bleach invariably contained free lime. As the total amount found (maximum 2.7 parts per million) is insignificant compared with the 10 to 12 parts per million of half-bound carbonic acid which would be set free during heating, it is inconceivable that the treatment of water with hypochlorite has any effect on the corrosion or erosion of piping systems.

One example of the complaints received is worthy of mention. A large company alleged that hot water pipes had been damaged by the hypochlorite treatment to the extent of $40,000. On investigation it was found that the system had been supplied by the treated city water after passage through a mechanical filtration plant, and finally sterilized by heat. In this plant aluminum sulphate and soda ash were employed, and it was found that a large excess of soda ash was being used. At one time the water passing to the filter showed an alkalinity to phenolphthalein equivalent to 65 parts of sodium carbonate per million. The New York experiments have shown that an excess of lime or soda ash beyond what is sufficient for the neutralization of the free carbonic acid is not only unnecessary but positively injurious, inasmuch as it rapidly attacks the galvanizing coat of pipes. These facts were pointed out to the company, and the suggestion made that a small amount of lime should be substituted for the excess of soda ash. Since then no further complaint has been received.

During 1914 laboratory studies were made as to the effect of water which had been treated with hypochlorite upon galvanized iron pipes, and in these, both hot and cold water were used. Stated shortly, the results show that the effect of the treated Ottawa River water upon galvanized iron pipe of good quality is not appreciable unless the available chlorine exceeds 3 parts per million. The quantity used during 1914 has been invariably less than this amount and averages 40% less. A number of short lengths of pipe, procured for these tests from a firm which is supplied by makers manufacturing most of this class of pipe used in this section of the country, was found to be of very inferior quality. The galvanizing coat was evenly and thoroughly distributed on the outside, but on the inside large patches of bare iron were found in some places and an excess of zinc, which was brittle and easily detached, in others. Such places would undoubtedly act as foci of corrosion, and if the pipes received were at all representative of those ordinarily used, it is surprising that the trouble from this source has not been even greater than it is.

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## TOUR OF WESTERN CANADA BY ENGINEERS FROM SAN FRANCISCO CONGRESS.

THE return trip from the International Engineering Congress in San Francisco afforded many engineers an opportunity of traversing Western Canada and of viewing, in a body, the interesting engineering work within convenient distance of the line of travel. In our issue of September 2nd it was announced that a general committee representative of various branches of the Canadian Society of Civil Engineers and Canadian committees of both the Institution of Civil Engineers of Great Britain and the American Society of Civil Engineers had invited members of the various national engineering societies of the United States to return by the Canadian West and enjoy the hospitality of resident members. Arrangements had been made with the Canadian Pacific and Southern Pacific Railway for special train and steamer facilities for the transportation of the party from San Francisco via Victoria, Vancouver, Banff, Calgary and other points on the way to Chicago. The following abstracts are from an account of the trip which appeared in "Power" for November 2nd, 1915:—

Starting from San Francisco immediately after the adjournment of the congress, September 25th, under the leadership of Capt. C. W. Allen, engineer of the Dominion Water-Power Branch, the party arrived at Victoria about noon, September 27th.

The travellers were met by a delegation of local engineers, headed by F. C. Gamble, president of the Canadian Society of Civil Engineers and chief engineer of the Department of Lands and Works, Victoria, and taken in automobiles for a drive around the city, visiting the observatory and wireless station; then proceeding to Bamberton, about 16 miles from the city, to visit the Tod Inlet Cement Works. Following this inspection the guests were entertained at the home of the cement company's president, Mr. Butchart. In the construction of the house and many of the features in the extensive gardens, cement was most ingeniously used in imitation both of stone and rustic woodwork.

In the evening the engineers were received in the Government Buildings by the Hon. Sir Richard McBride, Prime Minister of British Columbia, and other officials of the province, and were conducted through the various chambers and rooms of this beautiful edifice, and also through the museum, where there is a remarkable collection of mounted specimens of the animal life of British Columbia. Finally, as a much-appreciated souvenir of the occasion, each one was handed, with the compliments of the Premier, a handsome cloth-bound copy of the year-book of the province, replete with all manner of historical, political and other information, including that pertaining to the natural resources and industries. Returning to the Empress Hotel, there was a reception and collation in the ballroom.

A night trip across Puget Sound brought the party to Vancouver, where again it was taken in charge by a committee of local engineers. A special boat was provided, and a sail of nearly two hours was enjoyed up the North Arm of the Burrard Inlet to the Coquitlam-Buntzen power houses of the British Columbia Electric Railway Co. There are two generating stations at a short distance from each other, each under a head of 400 ft., receiving water from Lake Buntzen as the forebay, and Lake Coquitlam, two and a half miles distant, as the main storage reservoir. Power House No. 1 contains four 3,000-h.p. and three 10,500-h.p. units, and Power House No. 2, three 13,500-h.p. units, all driven by Doble-Pelton waterwheels. Both General Electric and Westinghouse type generators are used. Current is generated at 2,300 volts and transformed for transmission to 60,000 volts. The Coquitlam dam is 100 ft. high, 655 ft. wide at the base, 1,200 ft. long, and stores 8,000,000,000 cu. ft. of water, or the equivalent in electrical energy of 57,000,000 kw.-hr.

The local committee was under the chairmanship of G. R. G. Conway, who was the consulting engineer on the hydro-electric work. Others to whom acknowledgment is due for the entertainment here are George Kidd, general manager of the British Columbia Electric Railway Company, and R. F. Hayward, chairman of the local branch of the Canadian Society of Civil Engineers and general manager of the Western Canada Power Co.

The following day there was time for an automobile ride of 25 miles or so through the residential section of Vancouver and along the Marine Drive and finally through Stanley Park, before taking the train in the afternoon on the way to the Glacier, which was reached late in the afternoon.

During the forenoon of the next day, October 1st, most of the members of the party inspected the Roger's Pass Tunnel, now under construction through Mt. Sir Donald, and to be over five miles long. This excursion was made possible through the courtesy of A. C. Dennis, superintendent of construction for the contractors, Foley Bros., Welch & Stewart, and H. C. Barber, resident engineer of the Canadian Pacific Railway. The remainder of the day was spent in sightseeing or tramping the two and a half miles to the edge of the Great Glacier.

Much could be said of the wonders and delights of the next two days, which were spent at Lake Louise and Banff, respectively, but they will be passed over hurriedly as there were no engineering excursions involved. From the station at Laggan there was the interesting trip on a gasoline tram, then the walk along the lake and a tally-ho ride to Lake Moraine, with a splendid view of the Ten Peaks on the way. Also, at Banff there was a tally-ho drive to Tunnel Mountain and Buffalo Park. Omitting any reference to the grandeur of the scenery, which an engineer can enjoy if he cannot describe, this account will jump to the arrival at Calgary on October 4th.

Here again autos were supplied by the local engineers to get the visitors to the principal points of engineering interest with the least loss of time. Stops were made at the pumping plant, where motor-driven centrifugal pumps having a combined capacity of 20,000,000 gal. per 24 hr. deliver the water for the city's supply from the Bow and Elbow Rivers at one of the power substations and at the diversion dam of the Canadian Pacific Railway Co.'s irrigation works. This dam is the design of H. B. Muckleston, of the Department of Natural Resources of the Canadian Pacific Railway Co., who had accompanied the party from San Francisco and at this point became its official conductor. Chief among our hosts in Calgary was G. W. Craig, the city engineer, who with others was responsible for a comprehensive pamphlet, issued for the occasion with the compliments of the city of Calgary and the engineers of Alberta, covering the engineering works and natural resources of Calgary and the Bow River Valley of Alberta.

Returning from this trip to the Palliser Hotel, the engineers were tendered a luncheon at which Mr. Muckleston was the toastmaster, and addresses of welcome were delivered by Doctor Costello, mayor of Calgary; Doctor Blow, a member of Parliament, and Rev. Doctor Kirby, principal of the Royal College at Calgary, and appreciative responses were made by Calvin W. Rice, secretary of the American Society of Mechanical Engineers and chairman of the engineering party en tour, and G. S. Williams, the vice-chairman. F. H. Peters, chairman of the Calgary Branch of the Canadian Society of Civil Engineers; Alderman Frost and J. C. Dennis, assistant to the president of the Canadian Pacific Railway, were others to whom credit is due for the Calgary entertainment.

Taking the train again from Calgary, the party arrived at Bassano about 4.30 p.m., where autos were in readiness for the trip to the Horse Shoe Bend Dam, about four miles from the town of Bassano. The dam consists of a reinforced concrete spillway structure 720 ft. long across the bend of the Bow River and an earthen embankment 7,200 ft. long, keeping a middle line between the heels of the horseshoe. The spillway is an Ambursen dam 40 ft. high, on top of which are 24 sluice gates, each 27 ft. wide, capable of retaining 11 ft. of water. Below the spillway a concrete carpet, or floor, 90 ft. wide, prevents the fall from scouring the bed of the stream. A power plant, installed as part of the structure, supplies current for operating the canal and sluice gates, lighting the interior of the dam and arc lights along the exterior bridge, and lighting and pumping water for the various buildings occupied by the attendants.

Two of the hydro electric plants which there was not opportunity to visit were those of the Calgary Power Co. on the Bow River—one at Horseshoe Falls and the other at Kananaskis Falls. The Horseshoe plant operates under a head of 70 ft., and contains two Wellman-Seaver-Morgan double-runner horizontal turbines of 6,000 h.p. each, two Jens Orten-Boving double-runner horizontal turbines of 3,750 h.p., and two of the latter make single-runner exciter turbines. The generators are Canadian General Electric make, furnishing current at 12,000 volts, 60 cycles, which is transformed to 55,000 volts. The Kananaskis plant contains two 5,800-h.p. single-runner vertical turbines built by the Canadian Allis-Chalmers Co., driving generators built by the Swedish General Electric Co.

In the evening the visitors were given a dinner at the Hunter Hotel as a farewell from the Alberta engineers. The speakers for the hosts were Mr. Muckleston and S. G. Porter and P. M. Sauder, while words of gratitude for the entertainment received were offered by Chairman Rice, Arnold Stucki and F. K. Curtis.

Less than the desired time was possible at Moose Jaw on October 5th, but to show their eagerness to honor the travellers the local engineers met the train with automobiles and gave the visitors a 20-min. whirl around the city while the train waited. Thus ended the formal entertainment at the hands of the Canadians. In passing, it would be remiss not to mention the uniform courtesy that the tourists received throughout from the Canadian Pacific Railway and its attention to the comfort and pleasure of the participants in the trip.

An individual to whom no little credit is due is J. B. Challies, superintendent of the Dominion Water-Power Branch, who had been a Canadian representative at the International Engineering Congress, and the pleasure of whose company with the party was enjoyed while at Vancouver, but his duties prevented him from further participation in the trip. Well as he concealed the fact, it is doubtless fair to say that in his official capacity he was responsible for many of the arrangements of the tour, which had such a happy culmination.

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## AMERICAN ROAD BUILDERS' ASSOCIATION.

The executive committee, acting under the authority granted it by action of the board of directors of the American Road Builders' Association, has decided to accept the invitation of the city of Pittsburgh for its 1916 convention. The annual convention and show will, therefore, be held in that city, February 22-25, 1916.

The change in the time of holding the convention from December to the early part of the year has been under consideration for several years, according to a recent announcement, and was decided upon after the most careful consideration of the question by the directors. The attendance at the conventions is always made up principally of highway officials, engineers and contractors —in other words, those who are engaged in the actual construction and maintenance of highways. It is, of course, desirable that the convention should be held at a time when these road builders can most conveniently attend, and although in December, during which month meetings have been held in the past, work is at an end in many places, it is true also that in not a few parts of the country work is carried on more or less extensively up to the 1st of January. Another point taken into consideration is that the holding of a convention early in the year makes it possible to reach many newly elected officials and engineers who take office at or near the first of the year.

The decision to hold future conventions in January or February having been reached, it was necessary to decide when the plan should be put into operation. Deferring the inauguration of the plan until 1917 meant that the 1916 convention would have to be omitted entirely or else held in the fall of that year, which would bring two American Road Builders' Association conventions within a few months of each other. The board of directors felt that the omission of the 1916 convention was out of the question, and it was decided that the 1916 meeting should be held in January or February, and future meetings annually thereafter at the same time of the year.

The above probably constitutes the association's reply to the statement of Mr. L. W. Page, one of its directors, which appeared in our issue of November 18th in connection with the announcement of his resignation from the directorate.

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Continuity of public highway systems would not mean the centralization of management and control in any body of directors, manifestly; but continuity of such systems would mean simply agreement among the townships, cities, districts and states as to routes, types of road best suited to the traffic, construction, administration and maintenance so that there would be uniformity in design and efficiency in service.

# TORONTO FILTRATION PLANT CONSTRUCTION

## PROGRESS ON THE NEW SIXTY-MILLION-GALLON DRIFTING SAND FILTER PLANT ON TORONTO ISLAND—A NEW TYPE OF FILTER IN CANADA—TO BE IN OPERATION NEXT SPRING.

A FILTRATION plant involving some very unusual and exceedingly interesting features is at present under construction on Toronto Island alongside of the existing slow sand filtration plant which has been for a number of years of insufficient capacity to supply the demands of the rapidly growing city. This new plant is of a type known as the Ransome drifting sand system, and will provide a supply of 60,000,000 gallons per 24 hours, with provision for a 20 per cent. overload for any period of ten hours. The contract for its construction was awarded in 1914 to the John verMehr Engineering Company, Limited, Toronto, engineers, and William Cowlin & Son (Canada), Limited, Toronto, contractors, the price being $1,066,282. The type may be briefly described as a combination of the mechanical and slow sand methods of filtration. The reader is referred to *The Canadian Engineer* for April 23rd, 1914, for a description of its operation, and to our issue of April 8th, 1915, for a report of a 30-day test, carried out by the Toronto Department of Health in 1913, which test resulted in the consideration of this new type among others and figured extensively in its final adoption.

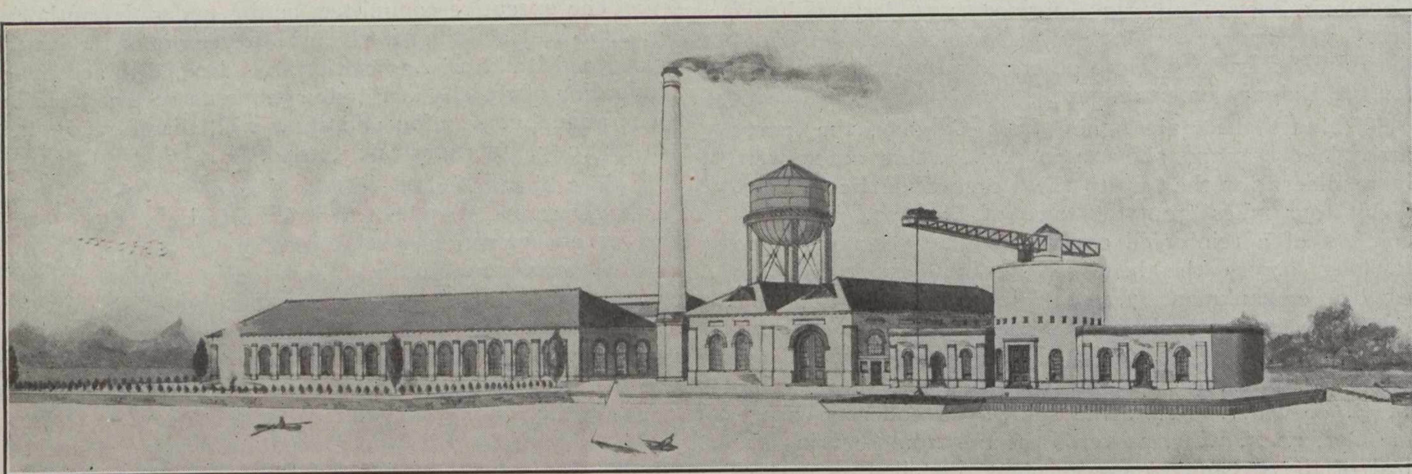

Fig. 1.—General View of Plant as It Will Appear When Completed.

In addition to boiler house, pumping station, chemical building, suction well and storages for coal and chemicals, the plant comprises a filter house containing ten steel cylindrical units each of 50 ft. outside diameter and each including a circular compartment 16 ft. 8 in. in diameter, which accommodates supply piping, etc. As illustrated in Fig. 2, the supply is drawn from two existing 72-inch water mains by steel connecting pipes of like diameter embedded in 12 inches of concrete, into a suction well equipped with a system of double screens, a hydraulically operated gate valve being inserted at the end of each intake. Three 36-inch electrically driven centrifugal pumps convey the supply to the filters through a 72-inch venturi meter which automatically indicates, registers and records the supply. The water leaving the filters dis-

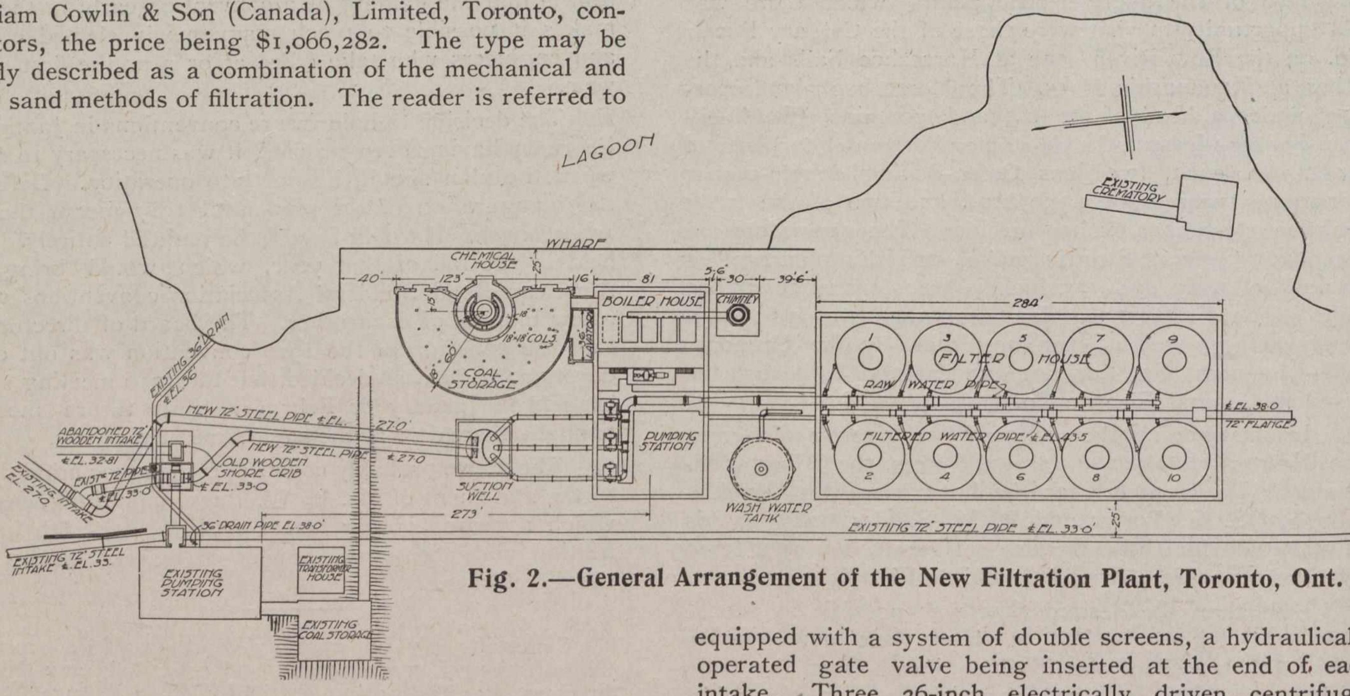


Fig. 2.—General Arrangement of the New Filtration Plant, Toronto, Ont.

charges through a similar venturi meter into the present clear-water reservoir connected with the slow sand filtration plant by a 72-inch conduit now being installed.

Fig. 1 and Fig. 2 give a clear idea of the structures as they will be when completed, and of the connections which the plant will have with the water supply of the city.

Work was commenced in September, 1914, and practically 6 per cent. of the total contract was completed before the close of last year. Operations began again on April 1st and on October 31st, 1915, approximately 65 per cent. of the contract had been completed. During the last four months the rate of progress has amounted to about $100,000 per month. Of the work that remains to be done, about 20 per cent. of the total contract comprises filter equipment. All of the main buildings have been completed with the exception of the suction well and

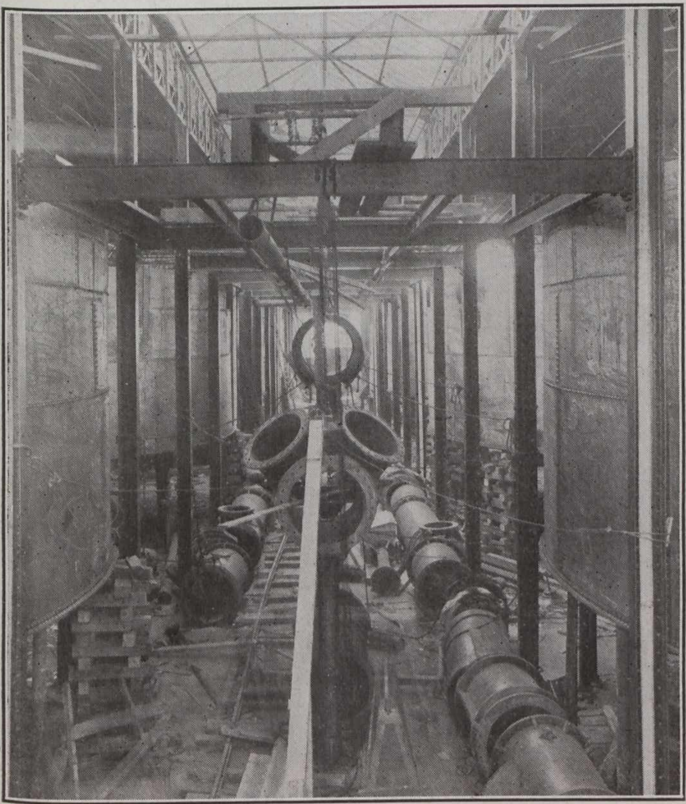

**Fig. 3.—Filter House During Installation of Pipe Connections in Central Gallery. View Looking North.**

the chemical house buildings, and these, it is to be noted, are well under way. At present, the work is at such a stage that the winter weather ahead will not interfere with construction progress, as all the buildings have been covered in and heating apparatus installed. Practically all the material required for its completion is at the site, with the exception of the filter sand. Island sand will not be used for the purpose of filtration, as its content of iron stone makes it unsuitable. The sand which has been selected will come from the pits of the York Sand and Gravel Company, on Kingston Road, east of Toronto. This sand is very suitable and is the sand that was used in the official tests already referred to. As about 6,000 cubic yards of this material are required, and as it must be transported across the Bay, it will be impossible to effect a total delivery before next spring. As the supply of sand to the filters is practically the last operation before completion, the plant is expected to be in full running order early in May, 1916.

Many interesting construction details might be mentioned, one of which is the manner in which materials were transferred to the Island from the mainland. All brick, cement, steel and machinery involved in the con-

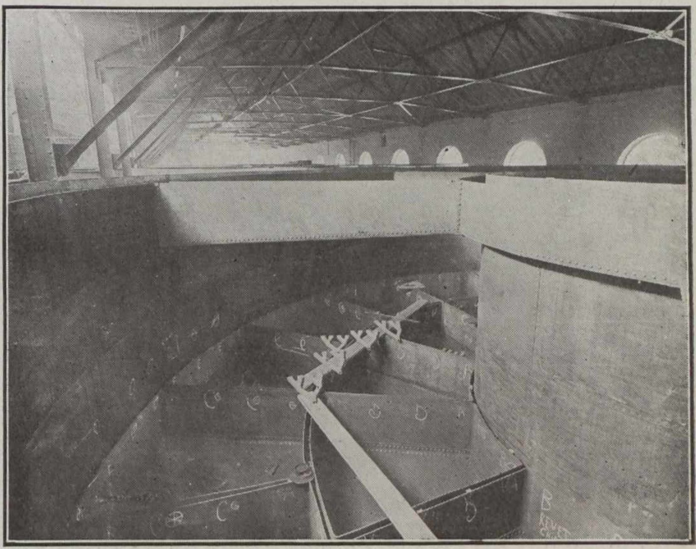

**Fig. 4.—Interior View of Section of Filter Tank.**

struction and equipage of the plant was transferred by scow, and in the case of brick, etc., the freight cars were thereby transported across the Bay and unloaded at the site, thus saving an immense amount of rehandling and deterioration of material.

Fig. 3 is an interesting interior view of the filter house, from the south end. It shows the circular steel filters on each side of the central gallery and gives a general idea of the type of construction used in the building. It also shows some of the pipes and connections to filters. The interior of a portion of a filter tank is shown in Fig. 4.

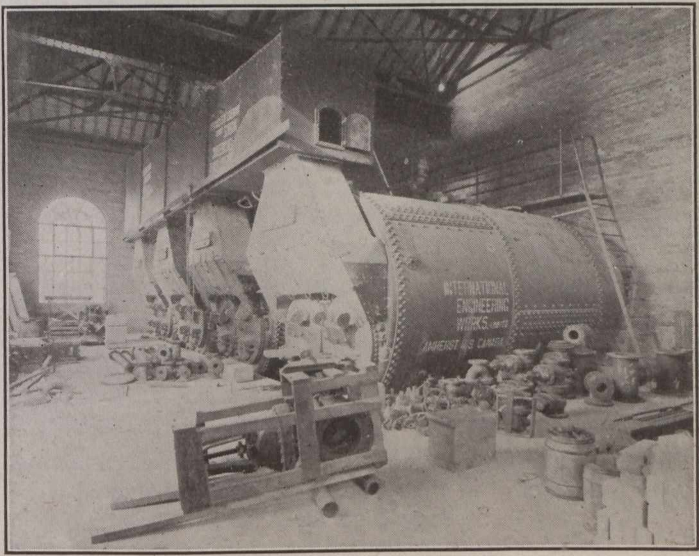

**Fig. 5.—Installation of Boilers in Progress.**

A construction view of the boiler room is shown in Fig. 5. These boilers, supplied by the International Engineering Works, Limited, Amherst, N.S., have each a capacity of 300 horse-power. Fig. 6 is a view of the southern portion of the pumping station with the three centrifugal pumps, direct connected to motors, and the generating unit under installation on an elevated floor in the background.

An interior view of the chemical house during construction is given in Fig. 7, which shows the extensive

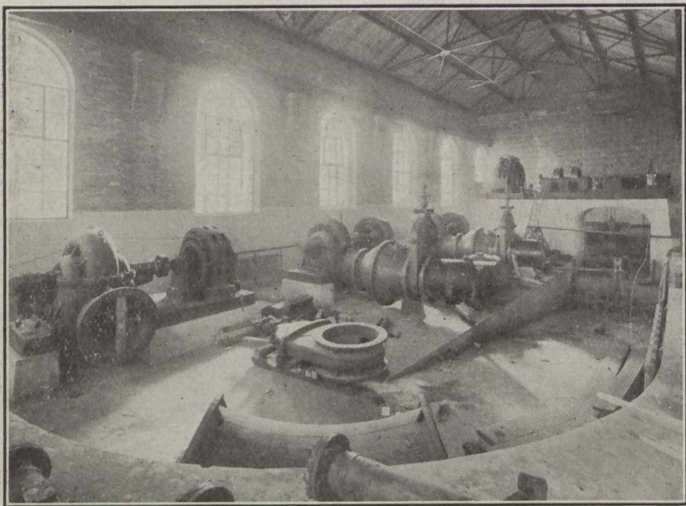

**Fig. 6.—Southern Part of Pumping Station, Showing the Three Pumps with Direct-connected Motors and Generating Unit in Background.**

reinforcing in the bottom of the cone-shaped storage bins for holding the alum. The compartment which is being brought up through the centre of the building, houses the mechanism and supports of a two-ton crane for unloading materials and supplies. This crane will unload direct from the vessels or scows at the wharf. This reinforced concrete wharf supported on timber piling, shown in Fig. 1, has been constructed as part of the plant. In Fig. 8 a

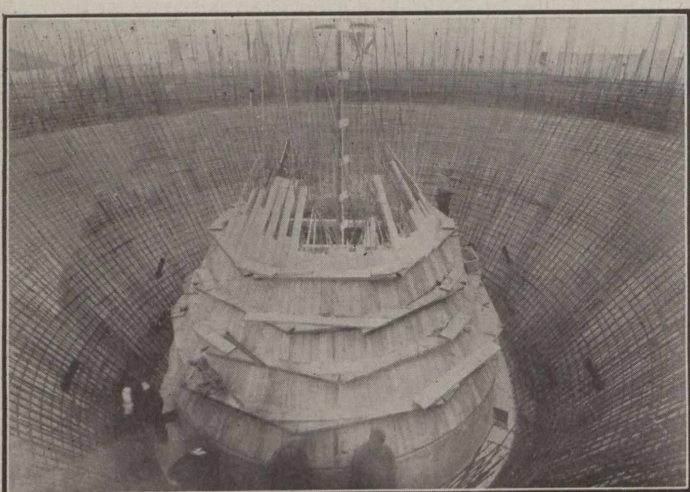

**Fig. 7.—Interior View of Chemical House, Showing Reinforcing in the Bottom of the Cone-shaped Storage Bins for Alum.**

view is shown of the intake pipes and of the commencement of laying two lines of 72-inch steel mains leading to the suction well. The view also shows a portion of the form work for the suction well.

The overhead tank shown in Fig. 1 is used for filter washing and has a capacity of 200,000 Imperial gallons. The tank was built by the Chicago Bridge and Iron Works, Limited. The steel tanks and pipes are being supplied by the Thor Iron Works, Limited, the pumps and generator by the Turbine Equipment Company, the hydraulically operated valves by Glenfield & Kennedy, Limited, the cast iron pipes by the Canada Iron Foundries, Limited, the venturi meters and gauges by the Builders' Iron Foundry, the chimney by the Canadian Custodis Chimney Company, and the switchboard by the Canadian Westinghouse Company.

The whole plant has been designed and supervised by William Gore, M.Inst.C.E., consulting engineer, and William Storrie, A.M.Inst.C.E., A.M.Can.Soc.C.E., chief engineer to the John verMehr Engineering Company,

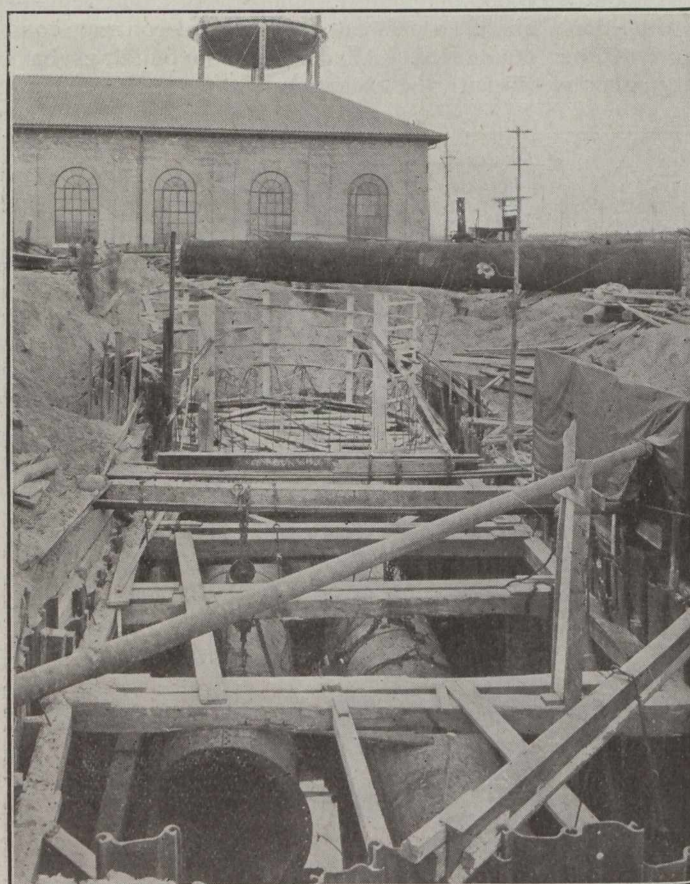

**Fig. 8.—View of Intake Pipe Trench at North End, Showing Commencement of Laying Two Lines of 72-inch Steel Pipes.**

Limited, and Charles A. King, B.Sc., is in charge of the construction work on behalf of the contractors William Cowlin & Son (Canada), Limited. The resident engineer on behalf of the city is A. U. Sanderson, B.A.Sc.

## GERMANY'S COPPER FAMINE.

The municipality of Kiel, Germany, has ordered the abandonment of little-used cable on street cars so that the copper might be obtained for war purposes. The work of tearing up three streets for this purpose has begun and it is estimated that about 3,000 yards of cable weighing approximately seven tons will thus be available. Other lines are expected to be similarly treated in Kiel and other German cities.

A report is also at hand to the effect that copper is being removed from the roofs of churches and other buildings throughout Germany.

# Editorial

## VALUE OF DISCUSSIONS.

The presentation of papers for discussion at engineers' meetings affords the writers splendid opportunities for the dissemination of information which they have acquired in the course of their professional duties. The writing of a paper is also an excellent training in the art of expression of views and facts, and in the assimilation of knowledge which will always be found helpful in professional matters. The main object of reading papers is to elicit discussion, and the more critical that discussion may be, the better is the object attained.

In our issue of November 11th we adverted to the need for a greater communion among engineers for mutual promotion of all that tends to the welfare of the profession as a whole, and one of these elements is that of uniting in the exchange of information. While papers are usually excellent and contain a fund of material for discussion, for some reason or another there is a lack of that cordial unity of purpose among engineers which is so highly desirable in the development of their best interests, for the discussions are far too limited. Among the members of the Canadian Society of Civil Engineers, for example, there are many who could supply a store of information, and there are certainly a much greater number whose contributions would be welcomed.

Papers may be short, terse and full of facts, or they may be elaborate, complete and masterly treatises, but to whichever category any paper belongs it is meant as an incentive to members to criticize, supplement and discuss. Any paper which does not compel the members to participate indicates that they are loth to come into the limelight, that they lack confidence in themselves, or that the paper is such that it does not lend itself to discussion. Few papers, however, are so abstruse or deal with subjects of abstract, scientific nature; they ordinarily are associated with the engineer's daily work and, therefore, offer abundant scope for a lively interchange of opinions.

The discussions are valuable just as they represent the extempore opinions of the members. Some one has said that an engineer who can speak in public must be a freak. Doubtless some may think so still, but we strongly advocate that the freak may be multiplied so that engineers may soon be recognized in society as men who can not only do things but can also express their views on the public platform in a manner which will reflect credit on themselves. To the average engineer the views expressed in a paper, especially when endowed with plausibility, may appear incontrovertible, but when members take part and by virtue of their varied experiences are able to point out that such views are not warranted or are subject to qualifications, then we are able to see how valuable discussion becomes. In the absence of criticism many a bald statement is often accepted at its face value and errors are duplicated, but when someone has force of character and fund of information enough to point out its fallacy, engineers are benefited in a no mean way. The value of a paper is often appreciated by the manner of its reception at the hands of competent critics, perhaps few in number, but endowed with undoubted ability. Each member, however, can become a critic and the writer of a paper will recognize the honor done him, by a fusillade of criticisms. It is a poor reward to a writer to receive only encomiums and platitudes for his trouble. Much would he prefer an energetic controversy against and in support of his views, for then something is done by others as well as by himself to promote the best interests of the profession.

Some engineers may hesitate to write papers if they are to meet with criticisms. It must not be thought that criticisms imply unfriendliness on the part of those who criticize, or a want of knowledge on the part of the writer. We often find friends are more generous in criticism because they know each other, and some of the greatest of engineers have met with different opinions, only to increase in strength by meeting them. It is independence of thought and action that we strongly advocate. We want men to lead, to act, to do things, regardless of criticism. At first a new thought or idea is generally opposed, then it is accepted tentatively, and finally it becomes an integral part of our life; but if its champion were to fail in courage of conviction we would be that much poorer.

Lastly, at some meetings discussions are impossible, because time is inadequate or, in other words, papers are too numerous for an intelligent discussion. This is to be regretted as the principal objects of such meetings are not fully attained. Free and easy discussions often bring out more valuable information than the papers do themselves.

## NEVER AGAIN.

The trials of depression, suspense and bereavement through which we are now passing, give us in our quiet moments time for reflection. We look back and sigh when we think of the happy days of prosperity, the thrill of past busy days and think with satisfaction of the success of completed works.

It is, however, a theme for thankfulness to remember that never a cloud however dark but has had its silver lining, and we have thus determined to fight our cause until this brightness appears.

We have all decided on this. We have put our hand to the plough from which there shall be no turning back.

Well, and what then? Are we to remain as thoughtless, careless and apathetic in our undertakings, in our attention to municipal government, and in the choice of friends as of yore?

No! We have learned our lesson and "Never Again" must be our slogan and watchword.

Never again will we allow our conduct to be slack in the choice of business firms with which we are to deal. No Germans.

Never again will we purchase mathematical instruments, or slide rules, or pencils with "made in Germany" stamped thereon.

Never again will we allow any German engineer to enter our Society, consult with him in practice or in any way help him to hold the same status as before.

Having now decided on this course, then, let us also decide to be more accurate in our daily work, more ready to obtain and impart knowledge to our fellow engineers, more ready to give encouragement and instruction to the juniors in the office, or a word of recognition, good cheer and thanks for kindnesses received.

Yesterday is past. To-morrow's a mystery. To-day is here. Make use of it to keep out and supersede all Germans.

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## DESIGN OF RETAINING WALLS.

THE following practical rules for the design of retaining walls to withstand earth pressure have been deduced from experiment and from observation and experience of existing structures which have withstood, for a considerable period, all the destructive influences. For them we are indebted to "The Surveyor," London.

**Brick Walls.**—In walls constructed of brickwork the following dimensions are extensively adopted: The top of the wall is made 1 ft. 10½ in. in thickness—*i.e.*, 2½ bricks—and at every fifth course downwards, or approximately every 2 ft., the thickness is increased by half a brick, the face of the wall being generally built with a batter of 1 in 6 to 1 in 8. Occasionally a curved batter is adopted. The wall would, of course, be surmounted by a suitable stone coping. Fig. 1 shows a section of a brick retaining wall, 14 ft. high above ground level, with a batter of 1 in 8.

**Concrete Walls.**—Plain mass concrete walls are often built of the same proportions as brick or stone walls, but with this difference, that expansion joints are generally provided every 10 ft. The same rules as apply to masonry walls will therefore be applicable to concrete. For walls 6 ft. to 10 ft. high a thickness of one-fourth of the height of the wall above the natural ground is generally allowed. For walls above 10 ft. the base thickness is taken as one-third of the height above the top of the footings, the back of the wall being vertical, and the face having a batter of 1 in 6 to 1 in 8. Sometimes the method shown in Fig. 2 is adopted. The height of the wall above ground level is divided into three equal portions. The bottom portion is made equal to ⅓ H, the central portion equal to ¼ H, and the top portion equal to ⅛ H. Another method is shown in Fig. 3. The section is first of all calculated with a vertical back, as described above. This is shown by *aa*, *bb*. Bisect the thickness at the top in the point *d*, and also the height of the wall above ground level in the point *c*. From *d* draw through *c* a line to touch ground level at *e*, and from *e* draw the vertical line *ef*. Divide *df* into any convenient number of equal parts, in this case three, and produce the vertical lines to the base *be*. Then divide *fe* into one more equal part than *fd* contains—*i.e*, four—and draw horizontal lines crossing the vertical ones. From the points of division draw the lines forming the offsets, as shown in the figure by the firm lines. The effect of stepping the back of a wall in this fashion increases the friction of the earth against it, giving increased stability, and therefore offering a greater resistance to overturning. The wall contains no more material, and as the offsets are easily formed, it is much better to convert a wall with a vertical back into the above form.

**Surcharged Walls.**—Where a retaining wall is surcharged—*i.e.*, retains a bank which slopes upward to a higher level than the top of the wall—the thickness, according to the foregoing rules, must be increased. This class of wall is principally made use of in cuttings, and in some cases walls of this description are built to retain the toe of an embankment, so saving large quantities of earthwork. Fig. 4 shows how the dimensions for this form of wall are arrived at. The height Y is substituted for H, or the height of the wall from ground level, and is the perpendicular at the end of a line L, equal to H, measured along the slope to be retained. The value of Y will necessarily vary with the slope, the extent of variation being shown in the following table:—

| | | | | |
|---|---|---|---|---|
| Y = | 1.71 H | in slopes of | 1 | to 1 |
| | 1.55 H | " " | 1½ | to 1 |
| | 1.45 H | " " | 2 | to 1 |
| | 1.30 H | " " | 3 | to 1 |
| | 1.24 H | " " | 4 | to 1 |

It will therefore be seen that a wall calculated to retain earth on a level with its top must be increased .71 in thickness to retain a slope of 1 to 1, and so on with the remaining values of Y. The foundations of all walls should be carried down to a sufficient depth to be below the disintegrating effect of frost. From 2 ft. to 4 ft. is considered a safe depth for this purpose. Where the supporting earth is of an unstable character, the area of the foundations may be increased to any desired extent by forming steps beyond the thickness of the wall proper, so that the weight of the structure may be distributed over a large surface. Weep-holes, formed of 2-in. or 3-in. pipes, should be provided to drain off any water which may collect behind the wall, one to every 2 or 3 yds. super. of of wall face; while in the case of brick retaining walls, or walls constructed in masonry, it is much better to have these pointed in cement, as there is a tendency for moisture to find its way into the interior of walls which batter.

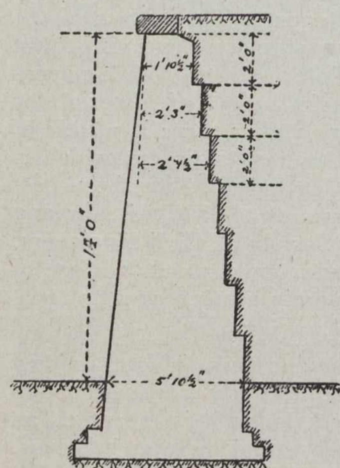


FIG. 1.

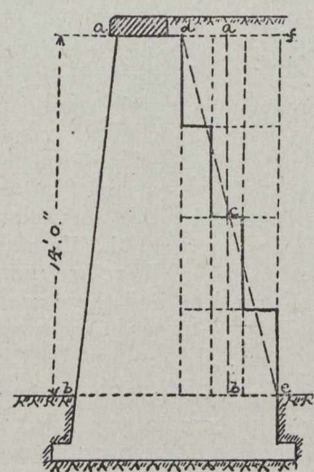


FIG. 3.

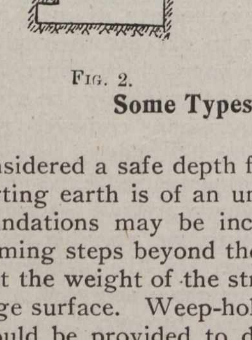


FIG. 2.

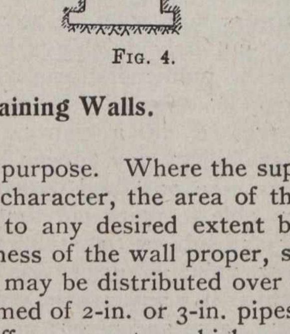


FIG. 4.

**Some Types of Retaining Walls.**

# The Engineer's Library

**Any book reviewed in these columns may be obtained through the Book Department of The Canadian Engineer, 62 Church Street, Toronto.**

## CONTENTS.



## BOOK REVIEWS.

**General Specifications for Concrete Work, as Applied to Building Construction.** By Wilbur J. Watson, Mem.Am.Soc.C.E. Published by McGraw-Hill Book Co., Inc., New York City. Second edition, 1915, 56 pp., diagrams and tables, 8½ x 11 ins. Price, $1.00 net.

This is the second edition of a work published in 1908. Progress in reinforced concrete design and construction during the past seven years has necessitated numerous radical changes in the text of the first edition, and the present general specifications, now up to date, should be of considerable value, as the author, a well-known structural engineer, has been intimately familiar with the development of the art.

The sections covered are as follows: Clauses, Definitions, General Provisions and Uses; General Rules for Computing and Designing; Working Unit Stresses; Formulas; Quantity of Materials for Concrete Work; Proportioning, Mixing and Placing Concrete; Requirements for Placing Reinforcing Steel, Inserts, etc.; Placing Concrete in Cold Weather; Forms and Centers; Surface Finish; Waterproofing; Reinforced Steel Construction; Cast Stone and Blocks; Concrete Piling; Flat Slab Types for Floor Construction; Floor Finish, etc.; Inspection and Tests; General Provisions; and, Designing Tables and Data.

The author justly calls attention to the necessity for careful inspection and competent supervision of work in structural concrete which has developed, in a few years, from an experimental into a standard type of construction. He points out that with conservative design and good materials, with careful supervision and with adequate inspection, practically all failures and accidents can be eliminated.

**Mechanical Drawing.** By Jas. D. Phillips, B.S., and Herbert D. Orth, B.S., both of the University of Wisconsin. Published by Scott, Foresman & Co., Chicago. First edition, 1915. 283 pp., 295 illustrations, 6 x 9, cloth. Price, $1.75.

This volume is intended for use in colleges and universities and is one of a series of text-books for use in the vocational courses that have found a prominent place in educational work. A course in drawing is here presented that bids well to cultivate the habits of observation and perception in the student. Being an elementary course, it goes into considerable detail in presenting the elements of drawing and the authors have been very successful in combining the elements in a manner that is logical and readily followed.

A brief synopsis of the contents of the volume is as follows: Perspective sketching, orthographic sketching, pencil mechanical drawing, tracing and blueprinting, instruments and materials, conventions, lettering, advanced drawing, auxiliary views, isometric and cabinet drawing, tables, etc. A concluding chapter serves as an instructor's guide and outlines a course in mechanical drawing.

Groups of problems have been chosen that ably illustrate the principles underlying the various chapters. They suitably distribute the introduction of theory and the use of the various instruments.

**Surveying Manual.** By William D. Pence, Professor of Railway Engineering, University of Wisconsin, and Milo S. Ketchum, Professor of Civil Engineering, University of Colorado. Published by McGraw-Hill Book Co., New York. Fourth edition, 1915. 388 pp., illustrated, 4 x 7 ins.; flexible leather. Price, $2.00 net.

This is a manual of office and field methods for the use of students in surveying. The subject is one concerning which little new matter can be expected, especially in a book that must necessarily deal extensively with elementary details. Concerning the present volume it can be said, however, that the new edition has materially increased its value as useful tables have been added and the whole work revised, cuts redrawn, and text reset. The size of the book has been increased by about 130 pages.

One distinguishing feature is the variety of practical problems which the authors present, designed to bring the student into immediate familiarity with approved surveying methods. Besides a chapter on general constructions, there are chapters on the chain and tape, compass, level, transit, topographic surveying, land surveying, railroad surveying, errors of surveying, methods of computing, topographic drawing and free-hand lettering. The concluding tables are those indispensible to every handbook of this kind. A notable addition in the present volume are tables for meridian determination by observations on Polaris.

**How to Make a Transformer for Low Pressures.** By F. E. Austin, Professor of Electrical Engineering, Thayer School of Civil Engineering, Hanover, N.H. Published by the author. Second edition, 1915. 18 pp., illustrated, 5 x 7 ins., cloth. Price, 40c. net.

Those interested in transformer construction will find this little book exceedingly interesting and useful. It answers a number of questions pertaining to fundamental principles and solves numerous problems which the amateur transformer maker is likely to meet. The book describes the process of construction step by step.

**The Testing of Machine Tools.** By George W. Burley, Department of Engineering, University of Sheffield. Published by Scott, Greenwood & Son, London. First edition, 1915. 226 pp., 110 illustrations, 5 x 7 ins., cloth. Price, $1.00 net.

This work is published as Volume 18 of the Broadway Series of Engineering Handbooks. The author deals with the various aspects of machine-tool testing in such a way as to make the book of special value to engineer apprentices and students, as well as to superintending engineers. There are eight chapters, the first being introductory, and the others devoted to the following phases of the study: Tests of Machine-tool Elements for Accuracy; Speed and Feed Tests; Mechanical Efficiency Tests; Cutting Force Tests; Output and Power Consumption Tests; Comparative Tool Testing; and, Commercial Machine Tool Testing.

From the above it will be noted that the author has devoted much space strictly to the subject of testing. It it to be pointed out, however, that the descriptions refer to methods and instruments rather than to the consideration of published results of tests, although the latter have by no means been neglected.

The illustrations are clear and uniform and the book is well printed.

**Descriptive Geometry.** By H. W. Miller, M.E. Published by John Wiley & Sons, Inc., New York; Canadian selling agents, Renouf Publishing Co., Montreal. Third edition, 1915. 149 pp., 98 illustrations, 5 x 7 ins., morocco. Price, $1.50 net.

This book explains very clearly all the principles of descriptive geometry, including shades, shadows and perspective.

It has evidently been prepared to fit the courses in descriptive geometry and drawing of the University of Illinois rather than as a text for general use.

The use of abbreviated spelling is a feature of the book which might be criticized.

**The Corrosion of Iron.** By L. C. Wilson. Published by the Engineering Magazine Co., New York City. First edition, 1915. 178 pp., 5 x 7 ins., cloth. Price, $2.00.

This is the latest publication belonging to the Works Management Library in connection with which a great many very useful publications have appeared. The question of corrosion is one which has occasioned a great deal of concern and the present volume, which is essentially a summary of causes and preventive measures, is one which will be found of similarly extensive service. The author has assembled and condensed the most interesting and important studies and facts connected with corrosion, which has received scientific attention for a comparatively few years, and with protective processes which are accordingly new. Special information of practical value concerning processes of materials available for the preservation of iron and steel in large or small shops render the book of interest to a particularly wide field.

Chapter headings are as follows: The Rust Problem; Theories of Corrosion; Protective Measures; Paint Materials; Protective Paints; Influence of Different Elements on the Corrosion of Iron; Corrosion of Wrought Iron and Steel Pipe.

**The Essentials of Descriptive Geometry.** By F. G. Higbee, M.E. Published by John Wiley & Sons, Inc., New York; Canadian selling agents, Renouf Publishing Co., Montreal. First edition, 1915. 210 pp., 173 illustrations, 6 x 9 ins, cloth. Price, $1.80.

This book, as might be expected from the title, discusses all the essential features of descriptive geometry.

It not only explains the typical theoretical problems, but it also shows clearly their practical application, special attention being given to the development of surfaces.

The book contains a very interesting chapter on the making of paper models.

**Simplified Reinforced Concrete Mathematics.** By Melvin D. Casler, B.E. Published by D. VanNostrand Co., New York City. First edition, 1915. 66 pp., illustrated, 5 x 7 ins., cloth. Price, $1.00 net.

This book relates to the derivation of simple, universal formulas and their application to beams, columns and arches. The author has succeeded in presenting many practical working formulas to obviate laborious computations in the design of reinforced concrete members. He refers the existing extensive supply of curves and tables available to the designing engineer as an evidence of theoretically evolved formulas of complex and cumbersome nature, and states his object to simplify these formulas without detracting from their mathematical accuracy.

A chapter is devoted to the derivation of formulas, the use of signs, assumptions, etc., then are presented ten formulas providing for combined stresses, ten others for beams and slabs, and six providing for dead weight of members. Labor-saving devices are considered in Chapter 2, *e.g.*, reinforced concrete slide rule and a table of corresponding values of variables. Illustrative examples are given in Chapter 3, where nine problems are considered relating to beams, columns, arches, etc. In Chapter 4 the author presents general notes on reinforced concrete design with a section on webb reinforcement. The work concludes with a useful nomographic computing device for use in problems of design.

**Directions for Designing, Making and Operating High-Pressure Transformers.** By Prof. F. E. Austin, Thayer School of Engineering, Dartmouth College, Hanover, N.H. Published by the author. First edition, 1914. 46 pp., 20 illustrations, 5 x 7 ins., cloth. Price, 65c.

After describing briefly the essential parts and functions of the transformer and illustrating the general principles underlying its operation, together with a discussion of core and hysteresis losses, power factor, ratio of transformation, etc., the author proceeds to outline step by step the essential features in designing a 3-kw., 20,000-volt transformer. Directions are also given for the construction of a 4,000-volt transformer and considerable data follows that will be found exceedingly useful by the experimenter.

**North Pacific Ports, 1915.** Published by the Terminal Publishing Co., Seattle and San Francisco. 422 pp., 5 x 7 ins., cloth. Price, $2.50 net.

This publication, known as the Pacific Shipping Year Book, provides up-to-date and accurate information concerning pacific ports, charges on shipping and numerous other data of interest and value to everyone in the shipping business. Ports of Alaska, British Columbia, Puget Sound, Washington, Oregon and California are described, their wharves are enumerated, wharfage regulations, charges, storage conditions and elevating facilities, etc., are given in detail.

**Field Engineering.** By William H. Searles, C.E., and Howard C. Ives, C.E. Published by John Wiley & Sons, Inc., New York; Canadian selling agents, Renouf Publishing Co., Montreal. Seventeenth edition, 1915. Vol. 1, comprising text, 323 pp.; Vol. 2, comprising tables, 329 pp.; illustrated, 4 x 6½ ins., morocco. Price, $3.00 net. (Vols. 1 and 2 can be obtained separately, price $2.00 each.)

That this well-known handbook has reached the seventeenth edition speaks well for its value in engineering work. The new publication adds about 150 pages. Volume 1 contains a rearrangement of certain portions, the abridgement of some sections, and the extension of others. Some of the chapters have been entirely rewritten, while others, among which might be mentioned those on reversed curves, earthwork tables, earthwork diagrams, haul and the mass diagram, are nearly or entirely new. The chapter headings are now as follows: Reconnaissance; Preliminary Survey; Theory of Maximum Economy in Grades and Curves; Location; Simple Curves; Compound Curves; Reversed Curves; Turnouts and Crossings; The Spiral Curve; Levelling; Cross Sections; Calculation of Earthwork; Earthwork Tables; Earthwork Diagrams; Haul and the Mass Diagram; Construction; Track Laying; Topographical Sketching; Adjustment of Instruments.

In Volume 2 sixteen new tables have been added, while others have been slightly changed or extended. The volume comprises in the present edition 44 tables with some twenty pages of explanatory text. The authors claim for the new tables the high degree of accuracy which the users of earlier editions have found in the old.

## PUBLICATIONS RECEIVED.

**Highway Engineering.**—Announcement of graduate course at Columbia University, year 1915-16, outlining lectures, laboratory work, etc.

**Climatic and Soil Conditions.**—A report relating to the western section of the irrigation project of the Canadian Pacific Railway, Alberta, prepared by G. N. Houston and Dr. F. T. Shutt. Issued by the Irrigation Branch, Department of the Interior, Ottawa.

**Selby Smelter Commission Report.**—Bulletin 98 of the U.S. Bureau of Mines, containing the report of Messrs. J. A. Holmes, E. C. Franklin and R. A. Gould, and a number of other papers, relating to smelter-smoke problems. 527 pages; 6 x 9 ins.; illustrated.

**Cooling Ponds for Condensing Engines.**—Reprint of a paper by L. H. Parker, president, Spray Engineering Co., Boston, Mass., relating to the use of cooling ponds by manufacturers in order to prevent pollution of river water by waste products from industrial processes. 25 pages; illustrated.

**Belt Slippage.**—Report of a test of properties of wood-split and iron pulleys, prepared by Prof. H. W. Price of the University of Toronto, for the Dodge Manufacturing Co., Toronto, and issued by the latter. The report contains some very interesting curves of belt slips and windage losses.

**Electro-Thermic Smelting of Iron Ores in Sweden.**—By Alfred Stansfield, D.Sc. Published by the Mines Branch, Department of Mines, Canada. 85 pages; 6 x 9 ins.; illustrated. Prof. Stansfield visited the important Swedish works in 1914, and has here presented some new and valuable information concerning the electric smelting of iron ores. He also visited a new steel-making furnace in Sweden and an electric iron smelting plant in Norway, detailed accounts of which are presented. The book contains a review of electric iron smelting in Canada and presents an estimate of the cost of the industry.

## CATALOGUES RECEIVED.

**Oil Engines.**—An illustrated description of type "Y" horizontal oil engine, comprising 24 pages and issued by the Canadian Fairbanks-Morse Co., Limited.

**Barometric Condensers.**—An eight-page illustrated bulletin issued by the Mesta Machine Co., Pittsburgh, Pa., analyzing the economic value of the Mesta condenser.

**Forms for Concrete Culverts.**—An illustrated folder describing the Whalen form for concrete highway culverts. Issued by the Whalen Form Co., Syracuse, N.Y.

**Cut-off Valves.**—Twenty-four pages of illustrated descriptive matter published by the Lagonda Manufacturing Co., Springfield, Ohio, concerning the Lagonda automatic cut-off valves of different classes.

**Finding and Stopping Waste in Modern Boiler Rooms.**—A 68-page publication devoted to the use of Cochrane appliances for measuring and recording. Issued by the Harrison Safety Boiler Works, Philadelphia.

**Oxy-Acetylene Welding and Cutting Apparatus.**—An interesting new catalogue of the loose-leaf type issued by L'Air Liquide Society, Montreal, describing blow pipes, cutters, generators, pressure regulators, and welding supplies.

**Switchboard Panels for Railway Service.**—A useful 12-page bulletin issued by the Canadian General Electric Co., relating to 600 to 1,500-volt d.c. switchboard panels, single polarity for railway service, grounded negative operation.

**Lubricators and Oil Pumps.**—Bulletins 50 and 60 of the Richardson-Phœnix Co., Milwaukee, Wis., describing respectively various models of force-feed lubricators and of model "M" sight feed oil pump; well illustrated and containing interesting notes on manufacture and installation.

## BACK COPIES WANTED.

Five back copies are desired of the issue of *The Canadian Engineer* for August 21st, 1913. We shall be pleased to extend the subscription of any reader an additional 3 months for each of the first five copies of the above issue to reach the Toronto office.

We have a request for a copy of the issue for January 1st, 1914, also, and will similarly extend the subscription of the sender of the first copy bearing this date. Copies received after the order has been filled will be returned if accompanied by name and address.

## REINFORCED CONCRETE BRIDGES.

THE following abstracts from the report of a committee on reinforced concrete bridges of the American Railway Bridge and Building Association will be found of interest and value. The report was presented at the thirty-fifth annual convention, held in Detroit, October 19th to 21st.

In the construction of railway bridges there are three common methods of procedure in placing slabs: (1) Constructing slabs at a central point, hauling them to the bridge site on flat cars, and setting them in place with a derrick or wrecker. (2) Building slabs at the bridge site at the side of their permanent location, and skidding them into place. (3) Where there is sufficient head room, the slabs built at the bridge site are, of course, constructed in place. There is a decided preference for casting slabs at a central point and lifting them into place. Fourteen roads with a mileage of 64,700 follow this method, while eleven roads, with a mileage of 31,000, report building slab at the bridge site.

The conditions governing the use of the first method are (1) the renewal of a bridge on the same alignment, while maintaining traffic on all tracks. Where the span is not too long, a temporary trestle to carry traffic is built to clear the finished structure. The slab is then built under traffic. Where long spans of a new structure prohibit the construction of a trestle, the tracks are shifted temporarily beyond the limits of the structure. (2) The renewal of a bridge on the same alignment with traffic closed on one track: The slab is built on sections 13 ft. wide, under the closed track. This method obtains only on large construction, where the forces can be moved to some other part of the work during the time allowed for the concrete to set. When the concrete under the closed track has set, a different track is closed and its traffic diverted to the track on the finished slab. (3) The renewal of a bridge or new construction on a change of alignment: Such work is generally constructed by contract. Company forces are usually employed where the construction interferes with traffic. The conditions governing the use of the second method are where unit construction is used where traffic must be maintained on all tracks without interruption for any length of time without change of alignment. The methods of handling work trains depend largely on whether the work is being done by company forces or by contract. A large system that does the work by company forces necessarily has its work train service well systematized. When called out, the train is kept busy during the full day. In this class of work the train has little to do beside moving the materials. Wherever possible, material is allowed to accumulate at the nearest station until enough is on hand to make a full day's work for a train. Where this is not practicable, it is handled by the local freight. The material is handled by the men on the job, whether on company work or contract. Where the work train service is for contract work, it is quite a general practice to make a fixed charge for this service. Under this arrangement the contractor can have all the train service he requests, but it will be to his interest to use it only when he actually needs it.

The differences in the work train service on the various roads appear to be due more to the difference in the amount of the service, and to the local conditions, than to any established practice in the handling of such trains.

The question of methods for concreting in cold weather and protection against frost is one on which the southern roads have little to say, but with the roads of the northern states and Canada the question is a live one. Wherever practicable, all concrete work is done during the warm months, but where the winter season is long, it becomes necessary to do considerable concreting in freezing weather. The necessity for heating the ingredients in freezing weather and keeping the concrete warm after it is placed, is generally acknowledged. The methods for accomplishing this vary considerably. The different methods of heating the sand and stone are steam pipes, steam jets and fires in pipes or under grillages laid under piles of material. The protection of the concrete in place is secured either by housing it in and warming with stoves, steam coils, etc., or by covering it with double forms with air spaces, sacks, tarpaulins, hay or anything that will prevent the circulation of air in contact with the forms. Salt is used under certain restrictions, in mass concrete, but, obviously, it cannot be permitted in reinforced concrete on account of the action of salt on the reinforcing steel. The preparation of test pieces during the progress of the work has been recommended frequently. In order to show the condition of the concrete the test pieces must be exposed to the same conditions as the concrete from which they are taken. This test is not recommended as a means for determining the quality of the cement, or other ingredients in the concrete; this must be determined before they are mixed. It has been suggested as a means for determining whether the concrete has hardened sufficiently for the removal of the forms, and has been done more frequently, perhaps, in connection with building work than on bridges.

It is evident from the reports of the roads that the making of test pieces is not by any means general. The replies of twenty-one roads, with a total mileage of 53,500 is "no." Eight roads, with a mileage of 46,500, advise that they make test pieces on certain work, or under special conditions of construction.

The question of the spouting of concrete called for a great variety of answers. Three roads reported that spouting is not permitted on their work under any conditions. Ten roads permit spouting without any specific restrictions as to slope or distance, but subject to the general requirement that the concrete shall be delivered in good condition at the forms. Sixteen roads permit spouting under specific restrictions as to slope, distance, amount of water, etc.

Evidently there is a great deal of dissatisfaction with, or distrust of, this practice. The rules and restrictions under which spouting is permitted on most of the roads reporting indicate that the method will give satisfactory results, provided the work is properly conducted and carefully supervised. On those roads where it is prohibited, the belief evidently prevails that concrete cannot be delivered in good condition by this method, or that the abuse of the method cannot be wholly prevented by their inspection service.

The facility with which concrete can be delivered over a considerable range by spouting makes it desirable to permit the method, provided the work can be supervised so effectively that there will be no abuse of the method. That this is the most general view is shown by the number of roads, and the mileage represented by the roads permitting spouting under specific restrictions.

As to precautions to insure thorough mixing, the belief is apparently quite general that if the mixture is left in the mixer long enough, no other precaution is necessary to secure good mixing. The inspector or supervising foreman is left largely to his own devices on hand-mixing. If he is an experienced and competent man he will get the desired results, but there will undoubtedly be many variations in the methods adopted by different men to obtain the same results.

Machine mixing is generally required on all work of sufficient magnitude to justify a mixer, and batch mixers are quite generally specified. Continuous mixers are apparently not in good standing among the engineers who write the specifications and prescribe the methods. When hand-mixing is done, the manner of mixing is sometimes specified in detail, requiring the sand and cement to be mixed dry, then the stone added with some water, and the mass shovelled until all of it has been turned a specified number of times, water being added during the mixing until the required consistency is obtained.

The cement gun (using compressed air) and the the atomizer (using steam) have been developed within the last few years. They are not intended for use in placing concrete where the ordinary equipment will serve, and where concrete of the usual quality is wanted. The duty required of them is to place the material where it is not practicable to deposit it in forms, and to give a dense and impervious product. The deposited mixture is mortar. The cement gun uses no stone. The atomiser uses stone up to ¾ in. in the mixture, but the stone rebounds from the surface to which it is applied. Its only function is, apparently, to pack and tamp the mortar against the surface to which it is applied.

These machines can be used to good advantage when applied to the kinds of work to which they are adapted. It appears from the reports received, however, that these appliances are in use on only a very few roads, and the engineers in charge of concrete construction cannot speak from personal experience. Twenty-six roads report not having used either kind, but the roads which have used them nearly all report satisfactory results. One road reports that in one instance, at least, the results were unsatisfactory. The kind of work or the nature of the defect was not stated.

It appears to be the common practice to leave it to the engineer in charge to determine the time when forms can be removed safely, without handicapping him with detailed instructions. The weather conditions and the kind of structure enter largely into the considerations. A few roads report tests, such as breaking off exposed portions of the work, or using test pieces that are made at the same time and exposed to the same conditions as the work.

There is a wide range in the time allowed for setting, even under the same weather conditions. This may be accounted for by assuming that structures of entirely different character were in mind when the different replies were written.

A general review leads to the conclusion that in summer weather, mass concrete, such as retaining walls, abutments and piers, should have two to three days, and a little more if the structure is high or massive. When weather is cold, but not freezing, the time should be from one to two weeks. Forms for slabs, arches and culverts should remain in place in warm weather from one to two weeks, and the structure should not be loaded for 30 days. In cold weather the time should be correspondingly longer.

# COAST TO COAST

**Camrose, Alta.**—Canadian Northern Railway is now laying steel on the branch southeast from Camrose to Battle River, a distance of 60 miles.

**Calgary, Alta.**—The annual convention of the Western Canada Irrigation Association had its opening session on November 23rd at Bassano. Hon. R. G. Brett, the new Lieutenant-Governor of the province, conducting the opening ceremony.

**Montreal, Que.**—The council of the Board of Trade has unanimously endorsed the suggestion of the Canadian Society of Civil Engineers relative to a report by independent experts upon the proposed extensions to the waterworks system.

**Grand Forks, B.C.**—The Great Northern Railway has completed a $60,000 bridge across the north fork canyon into the Granby Smelter. The C.P.R. completed a $100,000 bridge over the same canyon a year ago for a similar purpose.

**South Vancouver, B.C.**—Up to the end of October over $43,330 have been spent on sewer construction in the municipality this year. Concrete pipe is being made by the Pacific Lock Joint Pipe Co. and the Dominion Glazed Pipe Co. for the work.

**Guelph, Ont.**—A new concrete reservoir which has been under construction for several months, is now completed. It is 150 ft. x 70 ft. deep and designed to hold 500,000 gallons. The contractors were Messrs. Brennan and Hollingsworth, of Hamilton.

**Winnipeg, Man.**—Good roads enthusiasts are advocating an international thoroughfare from New Orleans to Winnipeg. An organization known as the Jefferson Highway Association has been formed with representatives of the province of Manitoba and 11 Mississippi Valley States.

**Port Arthur, Ont.**—The C.N.R. has practically completed the construction of three coaling stations situated respectively at Capreol, Hornepayne and Rideau Junction, east of Port Arthur. The contractors were the Roberts and Shaver Co., of Chicago, with Mr. E. V. Van Sickle as superintending engineer.

**Victoria, B.C.**—Commencement on the construction of the Rock Bay bridge has been delayed owing to the requirements of the Federal Department of Public Works that a 70-ft. movable span be included. The city submitted plans for a 60-ft. span, but this has been deemed inadequate. It is expected that the bridge will be constructed early next year.

**Vancouver, B.C.**—It is stated that an agreement has been reached regarding the harbor crossing into Vancouver of the Canadian Northern Pacific Railway which has its present terminus at Port Mann, B.C. It is also stated that the company will immediately proceed with the construction of a bridge. Mr. D. O. Lewis is district engineer for the railway.

**Moose Jaw, Sask.**—According to Mr. George D. Mackie, city engineer, repairs have been practically finished to the infiltration pipe at Caron through which the city receives its water supply. A break occurred in the pipe line some four weeks ago. The McManus Construction Co. are making the repairs, and in the meantime the city is receiving its supply through a 60-ft. by-pass.

**Regina, Sask.**—In the report of a board of special auditors into the affairs of the city for the years 1909 to 1914 inclusive, it is stated that no tests have as yet been made to ascertain if the street railway return currents have an electrolytic effect upon the watermains, and also that while the information available points to there being no present danger of this kind, precautionary tests might be made in the near future.

**London, Ont.**—This year's local improvement work has included 28,207 sq. yds. of asphalt pavements costing $85,114; 8,000 lineal ft. of sewers, costing $14,410; 46,350 ft. of cement curbs and gutters, $14,485; 27,940 ft. of cement walks, costing $15,975; 2,670 sq. yds. of vitrified pavements, costing $7,008; 5,120 sq. yds. of concrete pavements, costing $6,975; and 1,576 ft. of gravel roads, costing $2,694, according to a report dated November 2nd, of Mr. H. A. Brazier, city engineer.

**Fredericton, N.B.**—While announcing that Mr. John F. Feeney, of Fredericton, had been permanently appointed Provincial Road Engineer, Hon. John Morrissy, Minister of Public Works, stated that the government had decided to carry on a vigorous policy for providing improved roads in all parts of New Brunswick. Details will shortly be worked out and public meetings will be held during the winter in the interests of better roads. It is also planned to hold a series of conferences of the officials of the Roads Section of the Department of Public Works, in the various counties.

**Three Rivers, Que.**—The Laurentide Co. have made good progress on the construction of the dam across the St. Maurice at Grand Mere. Over 1,000 men are at work, and it is expected that the dam will be completed before the close of 1916. The St. Maurice will then be navigable from Grand Mere to La Tuque, a distance of about 80 miles. The new dam will be 30 ft. in height and will provide for the development of 100,000 h.p. of electrical power, which will meet all the requirements of the Laurentide Co. and provide a surplus which will be taken by the Shawinigan Water and Power Co.

## PERSONAL.

DUNCAN R. CAMPBELL has been appointed superintendent of the Pacific Division of the Canadian Northern Railway, with headquarters at Vancouver.

B. T. CHAPPELL, formerly superintendent of the Canadian Northern Railway at Saskatoon, has recently been appointed superintendent at Kamloops, B.C.

HUGH WATKINS has been appointed quantity surveyor for the Provincial Government of Manitoba, and has arrived in Winnipeg from London, England, to assume duties of office.

Major R. W. COULTHARD, mining engineer, who has been acting as instructor in the use of explosives at the Sarcee Camp, has been authorized by the Department of Militia to organize a tunnelling company for operations at the front.

Hon. T. H. JOHNSON, Minister of Public Works for Manitoba, called together a delegation of steam engineers of the province last week for a rather unusual purpose. He encouraged them to exchange ideas, suggest improvements and foster methods of economy in the use of fuel.

## WATER POWER IN CANADA.

This was the subject of a recent address delivered by Dean Adams, of the Faculty of Science, McGill University, before the McGill Science Undergraduate Society. The speaker dealt with the general principles of power, and touched on the remarkable future possibilities for Canada in this respect.

## OBITUARY.

The death occurred on November 17th of Hon. George J. Coulter, formerly minister of public works for the province of New Brunswick.

A fatality occurred on the new Welland Ship Canal when Mr. Hudson Payne, foreman for Baldry, Yerburgh and Hutchinson, contractors for Section 2, fell from a train of dump cars on the breakwater at Fort Weller. The deceased was 49 years of age.

Reports from the Dardanelles announce the death of Lieut. G. Stafford Boyle, formerly a member of the engineering staff of the Intercolonial Railway. Lieut. Boyle went to England with the first contingent, where he received a commission in the Royal Engineers and proceeded to the Dardanelles. The deceased was a native of Napier, New Zealand.

In one of the casualty lists last week the name appears of Lieut. J. Chester Hughes, killed in action. The deceased, a native of Toronto, and 27 years of age, was a graduate in engineering of the University of Toronto and was a resident engineer on the St. John and Quebec Railway at the time of his enlistment. Previously he was in the employ of the Canadian Pacific Railway as a locating engineer. He went to the front as a member of the Sixth Field Company, Canadian Engineers. He was a nephew of Sir Sam Hughes, minister of militia.

## ENGINEERS' CLUB OF TORONTO.

The Engineers' Club of Toronto is inaugurating a campaign for new members, to fill the vacancies left by those who have gone to the front in the service of the Empire. The Directors have suspended for the remainder of the year the operation of present by-laws relating to entrance fee and new members elected during this period will be required to pay only the net half-yearly dues of $17.50 for resident membership and $7.50 for non-resident membership to June 30th, 1916, and they will be entitled to the privileges of the Club from the time they are elected.

In view of the large numbers of technical men associated with engineering in Toronto there are doubtless many who will be interested in this announcement.

## COMING MEETINGS.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Annual meeting to be held at New York December 7th to 10th. Secretary, Calvin W. Rice, 29 W. 39th Street, New York.

INTERNATIONAL ROAD CONGRESS.—To be held at Worcester, Mass., December 14, 15, 16 and 17, 1915. General Secretary, Herbert N. Davison, Chamber of Commerce, Worcester, Mass.

AMERICAN FORESTRY ASSOCIATION.—Annual meeting to be held at Boston, Mass., January 17th and 18th, 1916. Secretary, P. S. Ridsdale, Washington, D.C.

CANADIAN NATIONAL CLAY PRODUCTS ASSOCIATION.—Fourteenth annual convention to be held at Toronto January 18th to 20th, 1916. Secretary, G. C. Keith, 32 Colborne Street, Toronto.