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THE RED RIVER BRIDGE FOR THE NATIONAL TRANSCONTINENTAL RAILWAY

By D. C. TENNANT, B A., Sc*

PART 2.

The Strauss Bascule span of the National Transcontinental Bridge over the Red River is of the so-called Heel Trunnion type, the Main Trunnion being placed at the heel of the moving leaf. Plate No. 3 shows an elevation of the whole span and Plate No. 4 indicates in a general way the stresses and material of the more important parts.

Relative to the D.L. pier reactions in this type of bridge, it should be noted that since the moving leaf is at all times perfectly balanced, there is no D.L. reaction at the front end, and the weight of the entire structure is, therefore, carried by the two tower piers. Disregarding for the sake of simplicity the weight of the counterweight link and the operating strut. the reactions are due to:

1. The weight of the tower.
2. The weight of the moving leaf.
3. The weight of the counterweight including trusses and bracing.

(1) The reactions due to the weight of the tower are vertical and constant.

Fig. 6.—General View of Bascule.

(2 and 3) The moving leaf and the counterweight are supported on the tower as on a carriage; they do not rest directly on the pier, and if the tower is properly designed, it takes care of all the horizontal forces, the horizontal component of the main trunnion reaction neutralizing the horizontal component of the counterweight trunnion reaction through the tower.

It follows that the pier reactions due to the weight of the moving leaf and the counterweight are vertical. Furthermore, they are constant during the opening and closing of the bridge. Owing to the fact that the four pins, main trunnion, counterweight trunnion and first and second link pins are located in the corners of a parrallelogram, the angular movements of the moving leaf and the counterweight are the same, and as the weight of the moving leaf is as much smaller than that of the counterweight as the lever arm of the latter is smaller than that of the former, it follows that the centre of gravity of the system as a whole is not disturbed during the operation of the bridge, and, therefore, the pier reactions cannot vary. This proved, it can be seen that the D.L. reaction on the main trunnion pier (disregarding the reaction due to the weight of the tower) is equal to the weight of the moving leaf and the D.L. reaction on the counterweight trunnion pier equal to the weight of the counterweight. If, namely, the bridge is open to such an angle (about 90 degrees) that the centre of gravity of the moving leaf falls directly over the main trunnion, then at the same time the centre of gravity of the counterweight falls directly below the counterweight trunnion; the trunnion reactions have no horizontal components and it becomes evident that of the two piers the one carires the moving leaf and the other the counterweight.

In considering the reaction on the main trunnion, we note that the moving leaf is subject to three outside forces only, viz. :—

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NOTE.—The first part of this article was published in *The Canadian Engineer* of April 18th.

1. The weight of the moving leaf, which is a vertical force passing through the centre of gravity of the moving leaf.

2. The link stress (link pin reaction) which passes through the second link pin and which coincides in direction with the counterweight link. Since this pin is connected at both ends and would not be in equilibrium under any other condition.

3. The main trunnion reaction.

Since the bridge is balanced this third force must pass through the point of intersection of the two others. When the bridge is closed this point of intersection falls near the centre of the span and somewhat below the bottom chord and the D.L. main trunnion reaction is, therefore a force which passes through the trunnion and is directed towards the point of intersection, while the moving leaf butts against the trunnion in a direction that is inclined slightly upwards and towards the tower. It follows that according to the design the base (or body) of the main trunnion bearing, which is rivetted to the heel of the bascule truss, will always bear against the trunnion, which is keyed to the tower truss, and that the cap on this bearing might, therefore, be omitted if it were not for practical reasons (lubrication, etc.). This also is shown by analyzing the stress in the truss members. The D.L. stresses in the four members intersecting at the hip point (2nd link pin), including the end post, are all tension. Of the two members intersecting at the main trunnion, the D.L. stress in the end post is tension, as stated, while the D.L. stress in the bottom chord member is compression and the resultant of these two forces is a force inclined slightly upward and acting away from the moving leaf against the tower, which again produces a reaction from the tower, as described above.

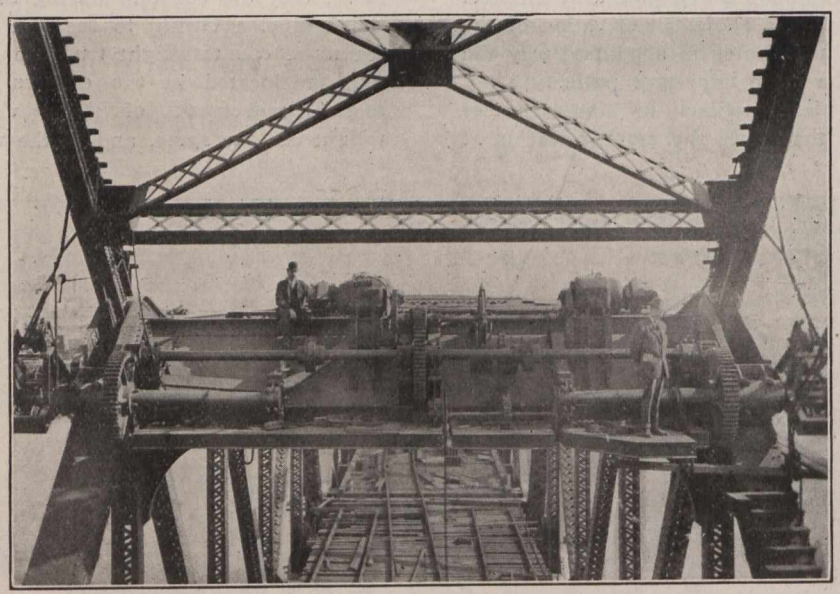

Fig. 2.—Portal and Machinery of Moving Leaf, as Seen from Counterweight Tower.

The L.L. reaction on the trunnions and the L.L. stresses in the truss members are in no way different from those in an ordinary truss. The thrust of a train (breaking load) coming from the trunnion end of the bridge, however, will tend to push the moving leaf away from the trunnion (that is, produce bearing on the cap of the trunnion box and tension in the cap bolts), but in all cases so far investigated, this force has not been sufficient to overcome the D.L. going in the opposite direction, and it could in any event be properly cared for by making the cap sufficiently strong.

In designing the bascule span, the regular Dominion Government stress of 16,000 pounds per square inch for tension was used, but compression stresses were not allowed to exceed 13,000 pounds per square inch, and stresses, either tension or compression with the bridge moving were kept down to 13,000 pounds per square inch.

The moving leaf spans a clear waterway of about 110 feet, and in general outline it resembles the four 150-ft. fixed spans between the east abutment and pier No. 4. The trusses are 32 ft. 8 in. deep centre to centre of chords and are made up of five panels, the one next the main trunnion being 30 ft. 10 in. and the other four 24 ft. 8 in. each, making a length centre to centre of 129 ft. 6 in. The cuts in the floor of the bridge are made at the front end of the bascule and at a point a few feet east of the main trunnion, so that the floor of the moving leaf will in both cases lift from the fixed floor when the bridge is opened. The end floor beam at the trunnion end is set 6 ft. 2 in. east of the trunnion, making a span for the stringers in the end panel of 24 ft. 8 in., or the same as in the other four panels of the moving leaf. The front end of the moving leaf is received when the bridge is closed on two cast steel pedestals securely anchored to pier No. 4. These pedestals have tapered cast steel guides fastened on top of them so that the span descending to its horizontal position is brought into perfect alignment with the rest of the bridge. There is no dead load reaction at this end of the moving leaf so the span is latched to the pedestal to keep it in position. There is a latch on each side attached to the ends of the trusses and operated by an electric motor fastened to the bottom chord. The latches can also be worked by hand.

The moving leaf and the counterweight are supported on a triangular tower spanning between piers No. 5 and No. 6, a distance of 40 feet, which is the horizontal distance between the main trunnion and the counterweight trunnion. The vertical position of the concrete counterweight is governed by the height of 22 ft. 6 in. clear beneath it, necessary for trains when the bridge is closed. The horizontal distance from the counterweight trunnion to the centre of gravity of the counterweight, is governed by the necessity of its swinging clear of the top of the rails when the bridge is open. As the two link pins and the two trunnions form the four corners of a parallelogram the angular motion of the counterweight will be equal to the angular motion of the moving leaf, or 80 deg. 30 min. when the bridge is fully open. The line joining the main trunnion with the centre of gravity of the moving leaf will point slightly upward, therefore the line joining the counterweight trunnion with the centre of gravity of the counterweight must point slightly downward and the weight of the counterweight is greater than that of the moving leaf in proportion as its leverage is less.

As will be seen by referring to Plate No. 3, the trusses of the moving leaf and of the counterweight frame itself are set with their centres 31 ft. 3 in. apart centre to centre transversely. These bear against the main trunnion and counterweight trunnion pins which are at right angles to the centre line of the tracks and span, a distance of 5 ft. 0 in. transversely, their outer ends being supported on the trusses of the main tower, which consequently are spaced 36 ft. 3 in. apart centre to centre. The inner ends of the main trunnions are supported on auxiliary shoes 26 ft. 3 in. apart resting on pier No. 4, and the horizontal component

of the thrust on these shoes is resisted by a girder with horizontal web 9 ft. deep extending from the back of the shoes to the first panel point in the counterweight tower. The inner ends of the counterweight trunnions are supported on auxiliary posts 26 ft. 3 in. centre to centre, carried on a cross truss 7 ft. 9 in. deep centre to centre of chords spanning between the main vertical posts of the counterweight tower. The horizontal component of the thrust on these auxiliary posts is resisted by an inclined truss spanning between the inclined top chords of the tower. The tower is divided into three panels, two of 12 ft. 6 in. and one of 15 ft. 0 in, the long one being next the counterweight trunnion. The vertical distance centre to centre of trunnions and consequently the height of the tower centre to centre is 40 ft. 3½ in. The stringers and floor beams of the floor are similar to those of the moving leaf, but the floor beams are longer owing to the greater width centre to centre of trusses. On account of the great width and short span, together with the presence of the horizontal stiffening girder, no bottom laterals were deemed necessary. The main verticals are stayed against vibration and wind action by a system of wing bracing anchored to the concrete pier 7 ft. 2 in. from the C.L. of the trusses with four 3½-in. anchors running 15 ft. into the masonry. The base of this wing brace rests on a grillage of five 24-in. I's at 100 lbs., 13 ft. long, continuous under the brace and the main post, and this grillage, the anchors for the wing brace and also four 1¾-in. anchors 6 feet long for the main post were set while the masonry was being built, the grillage being embedded in the concrete, flush on top. The main trunnion shoes of the tower trusses and the auxiliary shoes rest on longitudinal shallow girders 15 inches deep, built up of plates and angles with stiffeners, these in turn resting on two grillages, one under each trunnion composed of six 18-in. I's at 65 lbs., 10 feet long, running transversely. Each shoe is anchored with four 1¾-in. bolts running 11 ft. 0 in. into the masonry and the built girders, grillages and anchors were all set in place while the concrete was being built, the tops of the girders being flush with the top of the pier.

The counterweight frame is of the dimensions and material noted on Plate No. 4. The joints at the counterweight trunnion and the first link pin were well reinforced with plates to take the bearing of the pins and the main gusset plates were extended beyond the sides of the main members, the outer edges being reinforced by stiffener angles curved to conform to the outline of the plate. (See Plate No. 3.) This was also done on the main trunnion shoes and on the moving leaf at the second link pin. The weight and position of the concrete in the counterweight was finally carefully calculated from the shipping weights of the various members composing the counterweight frame and the moving leaf. The concrete is composed of one part cement, three parts sand, and five parts gravel, and was found by trial to weigh 141 lbs. per cubic foot when dry. Four large pockets were left which, after the concrete was dry, could be either totally or partially filled with concrete adjusting blocks weighing from 350 to 700 pounds each. As finally calculated, the total weight of concrete necessary was 1,756,000 pounds, so the dimensions were arranged to provide for 1,656,000 pounds and the pockets, if filled, would give 200,000 pounds extra. Thus the bridge would balance with the pockets about half full. Tests on the bridge since completion prove the assumptions to have been substantially correct.

The main trunnions are turned pins 16½ inches dia. They are supported on built shoes and are keyed to cast steel collars which are fastened to the shoes with turned bolts. The thrust from the moving leaf is applied through a cast steel box, bolted between the gusset plates of the moving leaf which in turn are stiffened up with radial diaphragms. The steel box has a cap fastened on with six 2¾-in. studs, and is fitted with a phosphor bronze bushing to take the wear. Lubrication takes place through the counterbore of the trunnion, which is connected with the surface of the pin by these canals, and there are no grease cups in the cap.

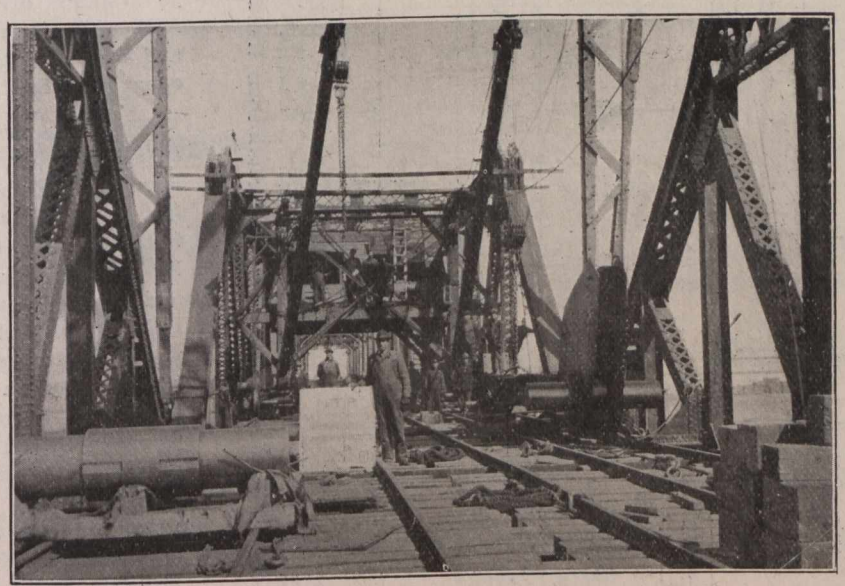

Fig. 3.—Looking from Counterweight Tower Towards Moving Leaf. Showing Erection Traveller About to Raise Counterweight Trunnions to Place.

The counterweight trunnion is a 22-inch turned pin, keyed to the counterweight frame. It is reduced to 18½ inches at the ends where it runs in cast steel boxes resting on the top of the tower. These boxes also have cast steel caps and compression grease cups in the caps.

The stress in the counterweight link will vary from zero when the centres of gravity of the moving leaf and the counterweight are respectively directly above and directly below the trunnions to a maximum when the bridge is closed. The link pins, both first and second, are 8 inches dia. Inside the gusset plates of the trusses the pins are surrounded by cast steel collars 19 inches dia., bolted to the gussets. The link bears on these collars. The ends of the link are fitted with cast steel bearing collars and bronze bushings lubricated from compression grease cups.

The bridge is operated by an operating strut pin connected to the top chord of the tower at one of the intermediate panel points. This strut has bolted to its under side a cast rack which engages a pinion on the moving leaf near the hip joint, the pinion being held in mesh with the rack, by means of a carriage with rollers bearing against the top and bottom flanges of the operating strut. This pinion is driven by means of two 40 h.p. electric motors and a series of gears that are very clearly shown on Photo No. 4. The portal at this end of the moving leaf consists of two girders, one with a vertical web and one with web inclined at the same slope as the post, as shown on Plate 4. From the bottom of these two girders a platform is cantilevered out towards the counterweight tower and the

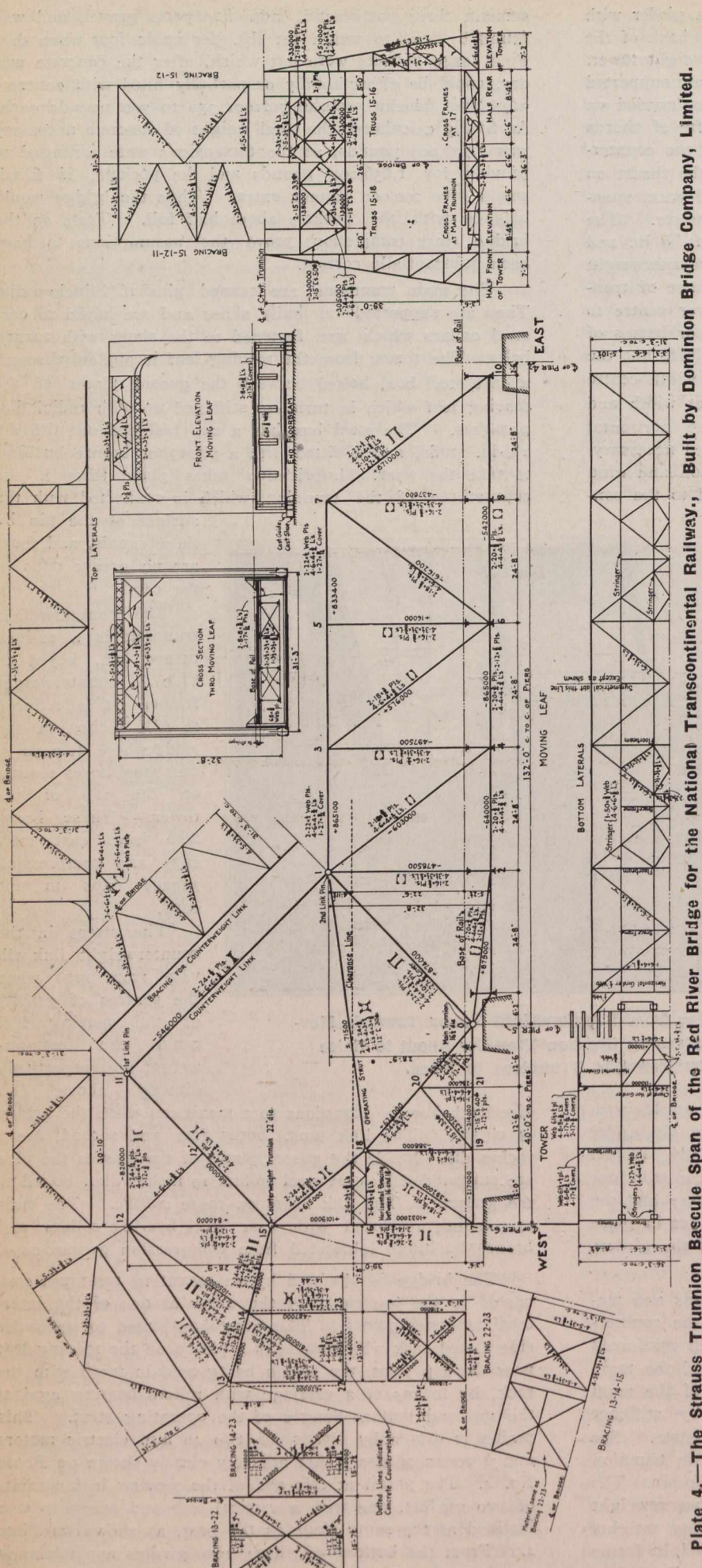

Plate 4.—The Strauss Trunnion Bascule Span of the Red River Bridge for the National Transcontinental Railway., Built by Dominion Bridge Company, Limited.

machinery is carried on this platform and the portal. The lubrication of this machinery was arranged so as to be effective at any position of the bridge. The bridge can also be operated by hand from the lower deck by a chain.

The operator's cabin is situated on the south side of the bridge and rests on brackets that cantilever from the outside of the tower truss almost directly over the main trunnion. It is indicated on Plate No. 3, but has two stories instead of only one, as shown on the plate. The upper story was added to accommodate the storage batteries to operate the electric interlocking signals controlling the approaches to the bridge. It contains the switchboards from which are operated the main driving motors of the bridge, the motor for the latches on the toe of the moving leaf, the brakes, etc. An automatic cut out is arranged to prevent the bridge from opening a greater angle than 80 degrees 30 minutes or the fully open position. Automatic signals indicate for the railway and for navigation, when the bridge is open and when shut.

Since the first four heel trunnion bascules were designed, namely, the Red River bridge, the Cape Cod Canal bascule for the New York, New Haven and Hartford Railway, the Illinois River bridge for the Peoria and Pekin Union Railway, and the Ashtabula Harbor bascule for the Lake Shore and Michigan Southern Railway, a change has been made by the Strauss Co. in the design, putting the tower trusses in line with those of the moving leaf and counterweight frame, thus obviating the necessity of long trunnion pins spanning between two shoes and simplifying the details generally. It might be stated here that the Baltimore and Ohio bridge over the Calumet River, which is a 235-foot double track bascule, and the Canadian Pacific bridge over the Sault Ste. Marie Canal, which is a 336-foot single track span, are respectively the longest double track and single track bascules in the world.

Erection was begun from the east end of the four 150-ft. truss spans and continued westward till the bascule, the viaduct, and the spans over Notre Dame Street and Water Street, were completed, the spans at the east over the Canadian Northern and Tachè Avenue being put in last. The erection scheme will be better understood by referring to Plate No. 1 in the issue of *The Canadian Engineer* of April 18. The material was delivered by rail on the Canadian Northern tracks close to the east shore of the Red River. From the cars it was raised to the level of the Transcontinental tracks as required. The fixed truss spans and the bascule were erected on wooden falsework resting on the river bottom. The special erection traveller that was used is shown in Photo No. 5.

It also appears in Photos No. 2 and No. 3 of the issue of April 18. It was desirable to use the same traveller for the truss spans and the viaduct. It therefore had to be made low enough to go under the sway bracing of the truss spans. As the bridge was double track, the traveller was made as wide as the through trusses would permit, and carried a mast and boom on each side capable of being operated independently. Since the viaduct has quite an appreciable curve the wheels of the traveller were specially arranged to take the curve easily. This was accomplished by placing an ordinary car truck of four wheels at each corner of the traveller. The centres of the four trucks formed a base of 27 ft. 6 in. longitudinally by 18 ft. 0 in. transversely, the traveller running on two tracks of standard gauge with a width of 18 ft. 0 in. centre to centre of tracks. The frame of the traveller was made entirely of wood. The two trucks on each side are 27 ft. 6 in. apart, supported longitudinal wooden trusses 6 ft. 0 in. deep. These each had a vertical mast in front 18 ft. 6 in. high of 12 x 12 timber, the top of each mast being stayed to the bottom chord of the wooden truss at a point over the back truck, by two 1⅜-in. square steel tie rods. The booms were of 12 x 12 timber 35 ft. 0 in. long, and were capable of lifting 10 tons each. Across the tops of the wooden trusses were laid 6 x 12 cross ties 19 feet long, and to these was spiked the floor of the traveller. The engines rested on this platform, being placed over the back trucks in an enclosed cabin. Thus, under the centre of the traveller there was a clear head room of about eight feet under the cross ties or the height of the trucks plus the height of the truss. There was also a clear width underneath of about 12 feet between the trucks. In this space a third track of standard gauge was run along the centre of the bridge and on this track the material was brought on hand trucks from the delivery tracks at the east end of the bridge forward to the front side of the traveller within range of the derricks. This traveller erected all the truss spans and approach girders, except the more elevated members of the tower and counterweight which were put up with a gallows frame. The forms for the concrete of the counterweight were supported on heavy woodwork resting on the most easterly girder span of the long viaduct.

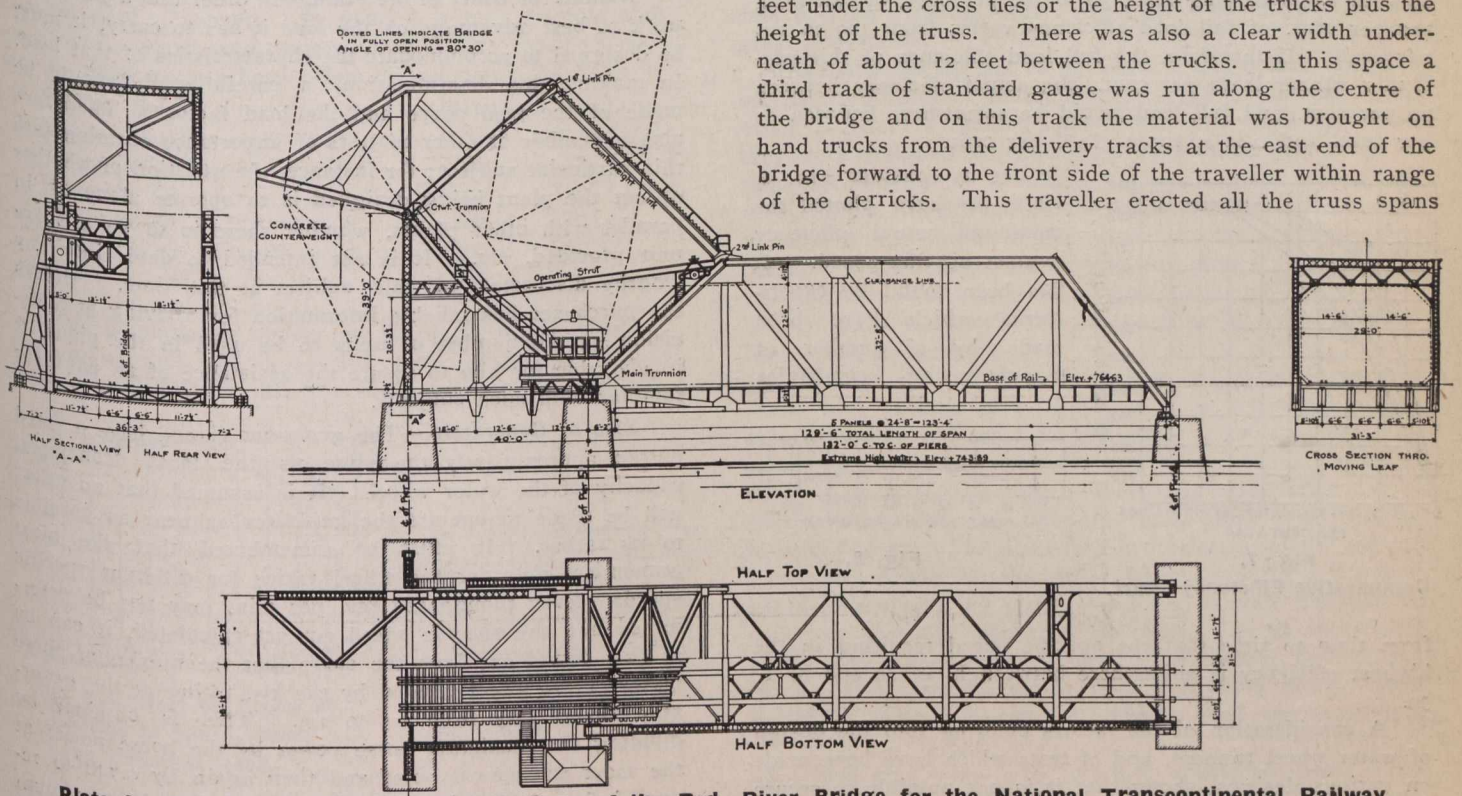

Plate 3.—The Strauss Trunnion Bascule Span of the Red River Bridge for the National Transcontinental Railway. Built by Dominion Bridge Company, Limited.

In conclusion the writer wishes to most heartily thank Mr. Uniacke, the bridge engineer of the Transcontinental Railway, and Mr. Jeppesen, the designing engineer of the Strauss Bascule Bridge Co., for photographs and other information in connection with the bridge; without the co-operation of these gentlemen and also of the Dominion Bridge Co., this paper would not have been possible.

FAREWELL BANQUET IN HONOR OF CITY ENGINEER RUST AT ENGINEERS' CLUB, TORONTO.

Last Friday evening about ninety members of the Engineers' Club of Toronto, representing all phases of the engineering profession, sat down to a complimentary dinner in honor of Mr. C. H. Rust, City Engineer of Toronto, who left this week to assume his new duties as City Engineer of Victoria, B.C.

Mr. Willis Chipman occupied the chair, on the right of whom sat the guest of the evening, Mr. C. H. Rust, and on his left Mayor Geary. Other representatives of the city's life who were present and joined in this testimony to Mr. Rust's worth, character and ability were R. T. Coady, city treasurer; F. S. Spence, vice-chairman of the Harbor Commission; H. L. Drayton, corporation counsel; Alex. C. Lewis, secretary of Toronto Harbor Commission.

Mr. J. G. Sing, resident engineer for Department of Public Works, proposed the toast to the guest of the evening. Mr. Sing referred to the loss not only the engineering profession would suffer by Mr. Rust's removal to the coast, but also the loss to the public life generally. He also spoke of the high character of Mr. Rust's work in Toronto during the past years.

Responding to the toast, Mr. F. S. Spence supplemented Mr. Sing's remarks and paid special tribute to the integrity and uprightness that Mr. Rust had always displayed in his municipal life. Following this Mayor Geary made a few remarks along the same lines to which Mr. Rust responded, and with some feeling referred to the breaking of connections with a city with which he had been so long identified.

At the conclusion of the proceedings Mr. Rust was presented with a bound souvenir menu containing the autographs of all the guests.

SELECTION OF A WATER WHEEL UNIT.*

By C. B. Coldwell.

(Continued from last issue.)

It is interesting to note, from Fig. 7, that where K = 20 with loads varying from 70 to 100 per cent. of full load, the per cent. of full load efficiency varies from 100 to 103 per cent. If therefore, the full load efficiency of this particular runner is 82 per cent., the actual efficiency between 70 per cent. and full load would be somewhere between 82 per cent. and 0.82 × 103 or 84½ per cent.

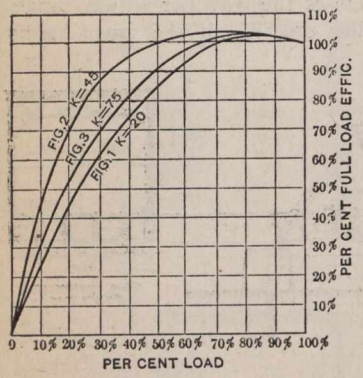

Fig. 7.
Comparative Efficiency Chart.

Let us consider Fig. 8. Here we have plotted the maximum actual efficiency against specific speed. It has been found by experiments which have been made by a number of manufacturing companies

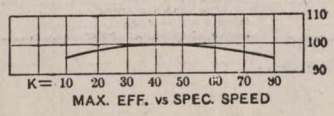

Fig. 8.

from time to time that the specific speed resulting in the highest efficiency is somewhere between K = 40 and K = 50.

A consideration of the factors entering into the design of water wheel runners, and of tests which have been made on various designs, shows that it is not possible to secure as high efficiencies, even though the operating conditions be the most favorable, for specific speeds which are higher or lower than the specific speeds between K = 40 and K = 50. Experiments have also shown that there is a certain best speed for each particular type of runner, which speed gives 100 per cent. power. At all other speeds, either higher or lower, the power is not so great. The variation of power for changes in speed, however, is different in magnitude for different types.

Fig. 9 shows this for two different runners, one where K = 45, the other where K = 75. In this diagram the best speed is shown at the centre ordinate as occuring at 100 per cent. full power, and it will be noted that as the speed is made higher or lower than this best speed, the power drops off for both types of runner. In the case of the runner K = 75, it drops off considerably more than for the type K = 45. For instance, an examination of the charts show that an increase in speed of a Type 2 runner, with K = 45, of 10 per cent. above the best speed, decreases the horse power 4 per cent. while a decrease of 10 per cent. from the best speed decreases the power about 2 per cent. For a runner with K = 75, the horse power is decreased 6 and 4 per cent. respectively.

In Fig. 10 is given a curve showing the relation between variation in head and equivalent variation in speed. This is really a graphical expression of the formula rev. per min. $\propto \sqrt{H}$ or the equivalent expression rev. per min. = (a constant) $\sqrt{H}$. It will be noted by examining this chart that for a variation in head of 20 per cent. there is an equivalent speed variation of 10 per cent. For a variation in head of 40 per cent. there is an equivalent speed variation of nearly 20 per cent. This curve will be of use later on in our discussion.

With information such as the foregoing at hand, we should be able to select the best speeds, power, ratings, etc., for use in any given installation.

Number of Units in the Plant.—In order that a plant may work to best advantage on the load it has to carry, it must be designed to accommodate the characteristics of that load. In making this determination, a careful study should be made of the load curve and the load factor. There are also a number of other matters of importance entering into this particular subject; for instance, the question of whether or not the plant being designed is to operate alone or in parallel with other plants, whether there is to be a spare unit provided, etc. It is not intended to enter into any lengthy discussion of this subject at this time. Unless the purchaser has reliable information for arriving at a decision on the number of units to be used in the plant, it it advisable for him to secure the assistance of an engineer familiar with such subjects.

Size of Generators.—The generator should have a rated output approximately the same as the most economical capacity of the water wheel. It is assumed that an effort will be made to operate the generator as near as possible to its rating. It must be remembered that the most economical point of the wheel varies for different specific speeds. Even though the rev. per min. may not be determined and the specific speed not yet calculated, it can be at once found out from the curve that the maximum horse power of the wheel divided by the kw. rating of the generator should vary from 1.5 to 1.9. This is obtained by dividing the maximum horse power by the horse power at the most economical point and then again by 0.746 to reduce kw. rating. It may thus be said that the maximum horse power of the wheel divided by the kw. rating of the generator will vary from 1.5 to 1.9, depending upon the type of runner to be used. Manufacturers could, therefore, make up a tabulation of the value of this coefficient for their different types of runners. In the first approximation the value of this coefficient might be taken as 1.75, about the average value, and the kw. rating of the generator determined. Later on this could be corrected. The matter of overload should be kept in mind when this point is being worked out.

Standard Speed of Generators.—The electric manufacturing companies can supply tables of speeds for standard generators. Generators with frequencies of 25 and 60 cycles are the most common in use. It is not necessary to give such a table in this paper as it would be altogether too large if it covered all of the standards in use by the electric manufacturing companies. In such a table furnished the writer recently there are to be found for some of the more common sizes of generators met with in modern plants as many as 5 or 6 speeds standardized for each size. For instance, one company has made and is prepared to make a 175-kw. generator of water wheel type for 150, 180, 300, 514, and 600 rev. per min, and for full load voltages of 600 2,300 and 11,000-volts. Several speeds would be considered by the designer before making a choice, and the reasons governing the choice will now be considered.

What Speed of Unit is Based Upon.—The following elements enter into the selection of the speed of the unit: (a) head, (b) characteristic efficiency, (c) runner balancing, (d) speed regulation, (e) variation in head, (f) durability of design. We will discuss these points in order.

(a) Head.—The head is a most important factor in the selection of the speed. Low heads and attendant low

* A paper presented at the Pacific Coast Meeting of the American Institute of Electrical Engineers, Portland, Ore., April 16-20, 1912.

velocities permit of a design of bucket to handle large quantities of water. In such a runner, thin warped buckets of ample size and large openings can be used. These buckets are, relatively speaking, structurally weak. High heads and consequent high velocities make necessary a simple design of bucket, thicker material, and, therefore, relatively small quantities of water. Strength, therefore, must be carefully considered in determining the diameter and speed of a runner. In general it may be said that for proper strength and design, the following specific speeds may be used for any head below the maximum head given.

Specific Speed. K rev. per min.	Maximum Head. feet.	meters.
68 to 75	50	15
50 to 68	100	30
35 to 50	200	61
25 to 35	400	122
10 to 25	600	183

This tabulation is not by any means fixed and is merely given as a guide. If the specific speed figures out for any given head as greater than the values given above, two runners should be used. If two runners are used, the specific speed must again be figured out with a horse power one-half of that used before. If head were the only determining factor, the specific speed could be chosen from the above table and the rev. per min. calculated from the formula.

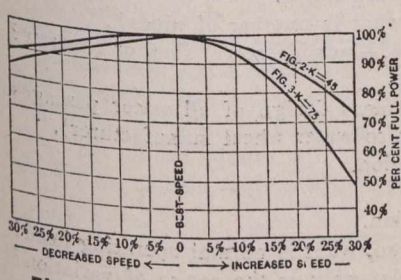

Fig. 9.—Effect on Power of Change of Speed, Based on Constant Head.

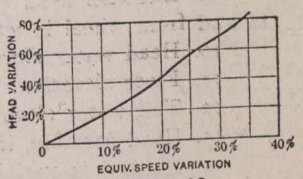

Fig. 10.
(See Fig. 9.)

(b) Characteristic Efficiency.—It has already been shown that different values of K result in a different efficiency characteristic. From our formula it is noted that specific speed varies with rev. per min., hence for any given horse power and head the rev. per min. fixes the specific speed, and the efficiency which is obtained from a runner with this specific speed both for full load and for partial loads. The particular speed characteristic desired, therefore, has much to do with selection of the speed of the runner.

(c) Balancing.—A single runner can be designed so as to balance thrust. This is sometimes desirable. With a single runner we have a lower specific speed and, therefore, consequent large diameter of runner. This should be considered by the designer and used where possible. The question of thrust does not enter into consideration with a pair of runners, as these are placed on a shaft as right and left-hand runners and the thrust of one runner is neutralized by that of the other. It is often found, however, that when a pair of runners is used, other conditions of the design must suffer and perhaps to the disadvantage of the installation. In making a proper selection of speed, therefore, the question of balancing is of importance.

(d) Speed Regulation.—Speed regulation is oftentimes the most important item in fixing the speed. The lower the speed the larger are the diameters and weights of the rotating element and, therefore, the greater flywheel effect of the unit. When the load on the unit is changed the speed varies directly with the flywheel effect. It is therefore often desirable to use a lower speed, fixing this speed by the degree of regulation desired. Extra flywheel effect can be obtained by the use of a flywheel, but this is generally undesirable and if possible should not be considered on account of the danger due to high pressures on bearings, etc.

(e) Variation in Head.—This is a common condition in low head plants. In hydroelectric plants the speed must be kept constant, even though the head does vary. In the case of pulp grinding mills, speed variation is not of so great importance.

We have already shown in Figs. 8 and 9 that different speeds have different characteristics of power and efficiency when the runners operate under heads other than the heads they were designed for, and lower speed than that given in some manufacturers' standard table of speed may oftentimes be used to advantage and might mean a considerable increase in the output of the plant. At the same time the initial cost may be greater and in such cases a proper balance between cost and benefits must be found.

To get a full conception of the effect of variable speed let us take an example:

Example.—A certain water plant has installed in it a water wheel runner of type No. 3, K = 75, which is designed to deliver 1,000 h.p. maximum at 200 rev. per min. when operating at 40-ft. (12 m.) head. This particular plant is so located, however, that the head varies due to floods, and at times the operating head drops down from 40 to 24 ft. (7 m.) The plant is a hydroelectric plant, and the generators driven by the water wheels require a constant speed of 200 rev. per min. in order to operate properly on the electric system connected to them. Let us investigate what will happen under these conditions. One of our fundamental formulas states that the horse power varies as $H^{3}/^{2}$. Therefore, at 24-ft. (7-m.) head our 1,000-h.p. wheel will give $\frac{1{,}000}{\left(\frac{40}{24}\right)^{3/2}}$ = 465 h.p. This calculation, however, is based on the assumption that we allow the wheel to run at the proper speed for 24-ft. (7-m.) head, which speed would be in accordance with the formula: rev. per min. oc $H^{1}/^{2}$. Thus $\frac{200}{\left(\frac{40}{24}\right)^{1/2}}$ = 155 rev. per min.

Now, as a matter of fact, we do not want to allow this change in speed for the reason stated above, and as this is the case, we must sacrifice some of our power. If, therefore, we decrease the head from 40 to 24 ft. (12 m. to 7 m.) which is a drop in head of 16 ft. (5 m.) or a change of 40 per cent. in head, we will have, in accordance with the chart in Fig. 10, a corresponding speed variation of approximately 20 per cent

Referring now to Fig. 9 we note that for an increase of 20 per cent. in speed, there is a corresponding decrease in power for a Type 3 runner of 25 per cent. We would sacrifice, therefore, when operating at these changed conditions, 25 per cent. of the power which the runner operating at its best speed for this head possesses, that is, 25 per cent. of 465 h.p. or 115 h.p. We would have left, therefore, when operating the wheel under these changed conditions as brought about by flood, the difference between 465 h.p. and 115 h.p., or 350 h.p. If a runner of type No. 2 K = 45, should be installed in this plant instead of a runner of Type No. 3, it is readily seen from Fig. 9 that when operating under the changed conditions brought about by the flood, the loss in power, instead of being 25 per cent., would be but 12 per cent., which is a loss of 57.5 h.p. The power,

therefore, of a type No. 2 wheel, if installed in this plant, and operating under the altered conditions, would be 465 h.p. minus 57.5 h.p., or 407.5 h.p.

(f) Durability.—In high head installations particularly, pitting of the runner blades takes place, due to shock of water against the buckets, or high velocity, and the operation of the unit much of the time at other than the most economical point. This being the case, it is quite important to consider durability when making the selection of the proper speed of runners. Let us again consider the formula $v = 52\sqrt{H}\sqrt{\frac{\sin(A+B)}{\sin B \cos A}}$. If we select a value of B = 90 degrees the trigonometrical expression under the radical sign becomes unity, changing the formula into $v = 52\sqrt{H}$ which is the formula for discharge from a simple nozzle. It is found when a value of B = 90 degrees is selected that the pitting is reduced to a minimum. From the above deduction this would be expected.

In the foregoing discussion we have considered a large number of items which enter into the subject of water wheel design and have indicated the desirability of getting some good engineering advice when selecting a unit. We have not, by any means, covered all of the points which enter into this interesting subject, nor would it be possible to do so in the time at our disposal. It is not expected that in general the buyer should acquaint himself with all of the various formulas and curves which have been dwelt upon. It has been necessary, however, to review them in a brief manner in order to lead up to the recommendations to the purchaser selecting a water wheel unit.

General Design of Unit.—The conditions which must be met with in the particular plant where the installation is to be made determine the general make-up of the unit. Water wheels may have but a single runner, may have a pair of runners, or for low heads, four or even six runners to the unit. In some places a vertical design of unit is required, while in others horizontal units best suit the conditions in many instances; it is merely a matter of taste, but in most cases there are features which influence the selection of horizontal or vertical units.

When a pair of wheels is used, it must be determined whether an outward discharge or a bottom centre discharge is the more desirable. Both schemes are used, one involving a single draft tube, the other, two draft tubes.

When low heads are met with, open flumes are possible and a properly arranged open flume may take the place of the closed flume. In high head work it is, of course, necessary to use a closed flume.

The housing enclosing the runners may have various forms. For instance, it can be a scroll case design or a cylindrical design; it can be made out of cast iron, cast steel or steel plate or may even be formed in concrete. The scroll case has high economy on account of the water passages being designed so as to give a proper increase in velocity before the water enters the runners.

There are many other types of flumes, such as the cone shaped type. This type has ordinarily high economy, but has the disadvantage of a bearing which is not readily accessible.

Consideration must be given as to whether the inlet of the unit is to be beneath the floor line or above; the general question of accessibility of the various parts of the unit, the location of the governor, and many other points must be given attention. Racks of ample area must be provided at the intake in order that there may be low velocities through same and little loss of head. The pipe line must have careful consideration and proper velocities must be selected.

In plants with long pipe lines, the speed regulation and the consequent pressure variation is of great importance, as the latter has to do with the strength necessary and, therefore, the design of the pipe line. In some cases, pressure regulators are necessary. Again, surge tanks may be used. The draft tube must have proper attention and the tail-race be such as to give low velocities. If the tail-race is restricted, the total head is affected.

In order that the purchaser and water wheel manufacturer may have at hand when the wheel is being designed data covering all of the points which should enter into the design, it has been thought advisable to give a list of questions which should be filled out as completely as possible by the purchaser and sent to the manufacturing company for use when making his wheel.

Data to be Given to Water Wheel Manufacturer.

1. Number of units.
2. Horse power of water wheels.
3. Kw. of generator.
4. Total head.
5. Open flume or closed flume.
6. If closed flume, what is number of pipes?
7. What kind of pipe?—wooden stave, steel or concrete?
8. Diameter of pipes.
9. Effective head (unless design of all water passages to and from wheel is left to water wheel manufacturer).
10. Head water elevation.
11. Floor elevation.
12. Tail water elevation.
13. Head variable, if so, what is normal operating head?
14. If head is variable, what is the range of variation?
15. How important is power and economy at lowest head?
16. Speed of generator, if already decided.
17. If speed of generator is not decided, name speeds which seem to purchaser most desirable, and ask recommendations.
18. Flywheel effect of generator.
19. What speed regulation is desired for different load changes?
20. Will units run in parallel with other plants? If so, give general characteristics of such plants.
21. If running in parallel with other plants, can these plants be used to regulate the system?
22. What is the character of load factor?
23. What is the nature of water (silty or clear)?
24. What date shipment of material is desired?
25. Advise if it is expected that manufacturer shall furnish governor.
26. Give sketches of power plant site.
27. Give information as to what is to be expected in the way of guarantees.
28. Give any other information which you think would influence the design of the wheel.

It will not be attempted here to outline the specifications which should be made out to cover the purchase of the water wheel unit, but a list of data which should be supplied by the water wheel company is offered.

Data to be Supplied to Purchaser by Water Wheel Manufacturer.

1. A check of the calculation on effective head.
2. Horse power guarantee at normal head.
3. Guarantee at other heads, if head is variable.
4. Speed guarantee, including runaway speed.
5. Recommendation for best speed if same has not been determined.
6. Speed regulation guarantees.

7. Efficiency guarantees at full load, ¾ load and ½ load.

8. Point of greatest efficiency of wheel and value of same in per cent.

9. Efficiency guarantees for available head conditions.

10. If water wheel manufacturer furnishes governor, give information as to the type, make, power required to operate same, also what variation in speed will not be exceeded before the governor will begin to readjust gates to meet a change of load, either gradual or sudden.

In what time will governor completely open or close gates?

Within how many seconds will the speed of the unit be restored to normal?

11. Complete drawings showing machinery proposed.

12. Complete description of machinery proposed.

13. Guarantee of durability.

14. Guarantee of shipment.

Conclusion.—In submitting for your consideration the foregoing, I have endeavored to impress upon you the importance of giving careful attention to a number of principles which enter into the selection of a water wheel unit. It is quite possible that the ideas of the writer on a number of points which have entered into this discussion may not altogether agree with those entertained by others. He has, however, laid stress upon points which in practice he has found of value in selecting water wheels. It is hoped that the subject matter will form the basis of a beneficial discussion of this most interesting subject.

VISIT OF BRITISH CAPITALISTS.

A recent report from Ottawa states that arrangements have been completed for the visit to Canada of from 50 to 60 British capitalists, business men and manufacturers, representing, all told, something like two hundred millions. Conferences have taken place between Hon. George Foster and Mr. Leonard Palmer, of London, the originator of the trip. The party will include representatives of the London Chamber of Commence, several British Boards of Trade, Vickers, Limited, Birmingham Small Arms Co., Commill, Laird and Co., and other big British industries.

They will sail from Liverpool on the "Empress of Britain" on May 31st, and will arrive on June 6th at Quebec, where they will be officially welcomed to the Dominion. After a brief stay in the ancient capital they will proceed to the Maritime Provinces, where a week will be spent in inspecting the resources of that portion of the country. Arriving at Montreal about June 15th, they will afterwards proceed to Ottawa, where the visitors will be given an official welcome by the Dominion Government. They will subsequently visit Toronto and the chief points in Ontario, including Niagara and the Cobalt camp. Then, proceeding west, the party will make an extensive tour of the western provinces and of British Columbia. The visitors will again be in Montreal about July 19, and will sail for Liverpool, where they are due to arrive about July 27, after a tour of 42 days in Canada. The various Boards of Trade as well as the civic authorities throughout the Dominion have already taken steps towards giving the visitors a welcome.

The Quebec Harbor Commission has decided on building an elevator of one million bushels' capacity, of concrete and steel structure, with links that can be extended and developed so as to store two million bushels of grain, together with the construction of two piers on the Louise Embankment.

OIL-BURNING LOCOMOTIVES.*

By R. Godfrey Aston, of Rincón Antonio, Oax., Mexico.

The object of this paper is to give an account of liquid-fuel burning in the locomotives of the Tehuantepec National Railway, showing some of its advantages over coal, and giving a general description of facilities for handling and storing this fuel-oil, the methods of burning it, and a few results gained, which are taken from the monthly performance of locomotives. The author does not intend to deal fully with costs, &c., as it is too large a subject for so short a paper, but will confine himself to a more practical point of view.

The Tehuantepec Railway is a trans-continental line of standard gauge (4 ft. 8½ in.), 304 km. (189 miles) long, running across the Mexican Isthmus of Tehuantepec from the port of Puerto Mexico (Coatzacoalcos) on the Atlantic, to the port of Salina Cruz on the Pacific, with grades varying from level to 2.15 per cent., and abounding in curves up to 11 deg. 28 sec., or 100.10 metres radius, and where the speed of trains is limited to 24 km. (15 miles) per hour.

Storage Facilities.—All fuel-oil for the company is received at the terminal of Puerto Mexico, where the main storage tanks are situated; these comprise three cylindrical steel tanks, each composed of six tiers of steel plates riveted together and a light steel roof, with three manholes, and a ventilator in the middle, through which gases arising from the oil can escape. Two of these tanks are 95ft. in diameter and 37 ft. 6 in. deep, each with a capacity of 46,996 barrels of 42 U.S. gallons (35 British gallons).† The third tank is 92 ft. in diameter and 29 ft. 9 in. deep, and has a capacity of 35,138 U.S. barrels.

These tanks are all enclosed in separate earthen embankments and are connected together by an 8-in. pipe-line, which enters the tanks 1 ft. 6 in. from the bottom, this space being required for water, &c., settling out of the oil, and which can be drawn off through a 3-in. valve at the bottom of the tank. The pipe-line runs down to the wharf, where it is fitted with an 8-in. check-valve, and it is from there that vessels delivering cargoes of oil can pump straight into any tank, the two largest tanks being about 2 km. (1¼ miles) from the wharf. At convenient places in the pipe-line near to the round-house are stand-columns for filling engine-tanks, tank-cars, &c., and near the round-house is also a supply-tank of 28,000 U.S. gallons capacity, erected upon a structural steel frame, also used for giving oil to engines, &c.

The terminal of Salina Cruz is laid out in the same manner, except that there are only two storage-tanks, 95 ft. diameter and 37 ft. 6 in. deep, of 46,996 barrels capacity. The capacity of all these storage-tanks has been calculated out in U.S. barrels of 42 gallons for every 6 in. of depth, allowance being made for all internal stays, supports, &c. The fuel-oil is shipped from Puerto Mexico to the other fuel-stations in specially constructed double-truck steel-frame tank-cars of 6,600 U.S. gallons capacity, the gallons per inch of depth of these cars being known, so that the exact amount contained in each car can be credited to the station to which it is shipped.

Fuel-Oil.—The fuel-oil used by this company is purchased from the Texas Company, of Port Arthur, Texas, at

* Paper read before the Institution of Mechanical Engineers.

† 1 U.S. gallon = 231 cub. in. 1 British gallon = 277.27 cub. in. U.S. gallon = 5/6 British Imperial gallon. The value of the Mexican dollar is assumed throughout this paper to be 2s.

about 97½ cents gold per barrel of 42 U.S. gallons, delivered at Puerto Mexico and pumped into the railway company's tanks by the delivering vessel. This fuel-oil is generally delivered in tank steamers, sometimes towing barges, which come right up alongside the railway company's wharf; the coupling between the vessel and the company's land-pipe line is made with a flexible rubber or steel hose, which is supplied by the vessel.

This fuel-oil is quite thin and flows readily through pipes of any diameter; it is sometimes nearly black in color, and sometimes a dark brown with a green fluorescence. The railway company stipulates in its contracts with the Texas Company that the flash-point (closed) shall not be under 110 deg. Fahr., as a lower flash-point than this is liable to be dangerous, on account of the volatile gases and fumes which arise from the oil at comparatively low temperatures, and the author has seen the oil catch fire from a torch which was some 10 ft. or 12 ft. away from it. Some oils may be used in the crude state as fuel, while others have to be passed through the refinery; after the lighter oils, &c., have been taken off, the by-product or residuum is used in a satisfactory manner as fuel, and as such has been, and is, used in Mexico. Fuel-oil contains no power of spontaneous combustion, and, unlike coal, does not deteriorate if stored in tanks or reservoirs.

The specific gravity of this oil varies from 0.790 to about 0.942, and its weight per U.S. gallon from 6.4 lb. to 7.75 lb. The British thermal units vary from 17,000 to 20,000, the average being from 19,500 to 19,800, and between this and the best steam coal there is a very great difference. The analysis of two samples of the oil as used by this company for fuel is as follows:—

	No. 1.	No. 2.
Specific gravity at 60 deg. Fahr.	0.931	0.881
Baume Gravity at 60 deg. Fahr.	20.5 deg.	29 deg.
Flash-point (closed)	130 deg. F.	135 deg. F.
Flash-point (open)	160 "	160 "
Fire test	220 deg. Fahr.	224 deg. Fahr.
Setting point	3 "	20 "
Viscosity at 100 deg. F.	200 seconds (Redwood)	78 seconds (Redwood)
Sulphur	0.77 per cent.	0.26 per cent.
Calorific value	10,688 calories	11,000 calories
Color	Dark brown	Dark brown
Water and dirt	1 per cent.	0.25 per cent.

The standard temperature for the measurement of fuel-oil is 60 deg. Fahr., and expansion is allowed for at the rate of 1 per cent. for every 20 deg. Fahr. increase in temperature above 60 deg. Fahr., and contraction at the same rate for decrease in temperature below 60 deg. Fahr.

Locomotives.—The locomotives in use on this road are of the Baldwin consolidation type, the main dimensions of which are:—

Cylinders	20 in. by 26 in.
Wheel (drivers)	53 in. diameter on tread
Fire-box	Length inside, 108in.; width inside, 33½ in.
Flues	239 of 2 in. outside diameter
Grate area	24.94 sq. ft.
Heating surface	Fire-box, 147 sq. ft.; flues, 1,700 sq. ft. Total, 1,847 sq. ft.
Boiler pressure	170 lb. per sq. in.

The oil-tank is fitted into the coal-space of the tender, and its contents calculated for every ½ in. of depth. Most oil-tanks have a capacity of 2,000 gallons, and the oil is fed from the tank to the burner or atomizer through suitable connections and flexible brass ball-joints.

Fire-Box Arrangement.—The company's practice, after trying various types of burners and atomizers, is to use what is called a "front-end burner," that is, the burner-mouth points towards the back of the fire-box or fire-box door-plate; the burner is placed, in a 9-ft. fire-box, 4 ft. 2 in. from the flue-sheet, the flame playing against a brick wall built up to the level of the fire-box door opening. Between this brick wall and the fire-box back-plate is a 4 in. air-space extending the whole width of the fire-box and right up to the top of the brick wall. Brick walls are built up on each side of the fire-box from the height of the brick wall at the back, gradually sloping downwards; the floor of the grate or ash-pan is laid all over with fire-brick. No brick arch or baffle-plate is used.

As mentioned in the preceding paragraph, the burner is placed 4 ft. 2 in. from the flue-sheet, and midway between the sides of the fire-box, so that both in front and behind the burner or atomizer there is a flat bricked-over area of fire-grate; and as the burner is placed parallel to the lower grate, there is a 4-in. space between the front and back grates, this 4-in. space being left open to admit air, extending from one side of the fire-box to the other.

Brickwork.—This should be of the very best material and workmanship, as it is subject to a much greater heat than from a coal fire; if this is not done, the walls will not stand, and engine failures will occur; moreover, the failure of only one brick will perhaps necessitate new brickwork throughout, thus needlessly running up expenses. There is no reason why the brickwork should not stand from four to six months, and perhaps longer, if due care be taken from the start.

A good brick should contain about 80 to 85 per cent. of silica and from 20 to 15 per cent. of alumina, and should be as free as possible from alkalis, which cause fluxing. A good brick becomes surface-glazed though remaining rough and porous; it should be perfectly dry when built up in a fire-box, otherwise the heat will cause it to crack; if possible, the fire-bricks should be fired at a temperature as high as that to which they will be exposed when in use.

Burner or Atomizer.—There are many and various kinds of hydro-carbon burners, and after a trial of various types, including the Baldwin and "Best" burners, this company is using with considerable success a burner which is made in their own shops, and which is really an inverted "Best" burner. It is a simple device, which allows the oil to fall from an orifice 3 in. wide by 9/16 in. deep over the top of a flat steam-jet 3 in. wide and 1/32 in. deep, the steam picking up the oil and sending it into the fire-box in the form of a spray; the underneath jet of steam delivers the spray of oil at an angle so that it strikes the brick wall in the middle, instead of shooting out from the burner parallel with the bottom of the ash-pan. This burner may be called an outside atomizer, and although it is in general use, it has its drawbacks; but it has been found to be more efficient than any other they have used.

The most essential points about a burner or atomizer are:—

1. Its atomizing capacity. All fuel-oil is heavy, and will burn in the form of a vapor or spray only when mixed with air. The object should be to fill the fire-box with a soft and voluminous flame, and not to impinge it in any one place.

2. Its facility for keeping clean and free from clogging.

3. Its adjustability in giving the right direction to the flame or spray, and regulating the proper proportion of oil and the agent, either steam or air, used for atomizing.

A burner which will vaporize or atomize the oil at the point of expansion of the agent used for that purpose, and

which is easily handled, and which will atomize the greatest amount of fuel with the least possible energy, is the highest and most efficient that can be designed. On this railway steam is used as the atomizing agent, because, after various experiments, it was found to be superior to air. The steam to a very great extent heats the oil as it flows into the burner before delivery in the form of a vapor spray. The flame from the burner should not be too long, or it will pass into the flues and become extinguished. Gases which are only partly consumed will re-light in the smoke-box.

Lighting up an Oil-Burning Engine.—In each round-house of this company is a stationary boiler, always in steam, used for the washout and other pumps, as well as for lighting up dead engines. From this boiler is laid a 2-in. steam-line to points between each engine road or stall. From there a connection can be made to a locomotive through a three-way cock or T-piece in the steam-pipe leading from the steam-stand on top of the fire-box to the burner; by use of this steam the burner can be started and kept going until the boiler has generated enough steam to keep the burner going itself. A piece of oily waste is lighted and thrown into the fire-box just in front of the burner from which the spray ignites. Connections can be made to any other engine all ready in steam should the stationary boiler not be available for any reason.

Firing and Cleaning Flues on Road.—With an oil-burning engine there is always a fire of equal intensity and one which never gets dirty, so that good steaming is practically ensured. It is a popular idea that it is a very easy matter to fire an oil-burning engine, but this is not the case, as both skill and care are required, so that the author thinks it best to lay down a few of the most important rules:—

1. See that the oil-tank is full, and if heaters are used, that they are in operation, and that the temperature of the oil is as it should be.

2. See that the sand-box on the foot-plate is full, and that the scoop is in its place.

3. Before starting the fire see if the temperature of the fire-box is below igniting point, which is a dull red, and if so, open dampers (if used), start the blower, and open the atomizer-valve fairly hard; then put a piece of saturated oily waste on the bottom of the grate after setting it alight, close the dampers (if used) and fire-box door, and turn on the oil very light. When the oil has ignited, reduce the blower and atomizer to a light feed, also the oil until the chimney is quite clear of smoke.

4. See that the fire is burning brightly, and that there is no oil on the bottom of the pan, also that the brickwork is in good condition, and that no bricks or any other obstructions are on the bottom of the grate or pan so as to obstruct the flame or jet on its way from the burner to the brick wall.

5. As regards cleaning flues on road, it is best to sand frequently if the engine is being worked hard—say every 15 km. or 20 km. (9 or 12½ miles); but if the engine is being worked light, every 50 km. or 60 km. (31 or 37 miles) will be sufficient.

6. Having attained a fair rate of speed, fill the scoop with about a quart of sand, close dampers (if used), and put reverse-lever near full stroke, then open regulator wide, insert the end of the scoop in the round hole in the fire-box door, and allow the sand to be drawn out of the scoop through the fire-box and flues and out of the chimney; sanding is best done when the engine is working hard up a grade.

7. Black smoke shows incomplete combustion, and should never be allowed to be emitted from the chimney, as it only fills up the flues with carbon, besides being a non-conductor of heat, and it is also a great waste of fuel. If a bluish-colored smoke or fumes are seen coming from the chimney, it is a sign that the burner is cut down too fine.

8. When putting out the fire the oil-valve should always be closed first, then the atomizer-valve (in their case steam), then the blower. The oil-valve is always the last to be turned on and the first to be turned off.

9. Never go near an open tank with a lighted lamp or torch, as at any time an explosion may occur, especially if the oil used has a low flash-point.

Round-House or Shed Work.—An oil-burning engine has a great many advantages over a coal-burner, but this is specially noticed in the round-house or shed when squaring up an engine after a day's run; there are no fires to be raked out, no flues or smoke-box to be cleaned (the smoke-box door of an oil-burning engine need be opened only once every three or four months for cleaning purposes); there is no coal to be sacked, weighed, or otherwise handled, and oil-burning engines do not carry fire-rakes, prickers, flue-brushes, shovels, or picks, so that all these things, besides other minor details, represent a great saving in engine equipment.

Among other advantages are the rapidity with which steam can be raised, and the facility with which the boiler can be forced when greater calls are made; the author has in a special case of necessity raised steam in a dead engine to a pressure of 130 lb. per sq. in. in 50 minutes from cold water, without any serious effects on the boiler, whereas in in a coal-burner from 2 to 3½ hours is needed to raise steam if no jet from a live engine is used.

Another very great advantage is in switching, or shunting, or standing pilot, when engines frequently have to stand in steam for hours at a time. The burner can then be cut down or extinguished, thus effecting a great saving in fuel, as an engine will always retain a sufficient amount of steam to start the burner or atomizer again; and any danger of the fire-box or crown-sheet being injured through the water getting too low is entirely obviated. The heat lost while standing is the same whether coal-fired or oil-fired.

Effects of Oil-Burning on Fire-Box, Flues, &c.—Oil-burning is no more injurious to a fire-box or flues, &c., if ordinary care be used, than coal-burning; in fact, from the author's experience, it is not so hard on a fire-box as coal-burning, for it is quite noticeable in the fire-boxes of coal-burning engines that stay-heads, plate-edges, flue-ends, and crown bolt-heads show signs of wear, corrosion, or burning, but in their oldest oil-burning engine not any of these signs are noticeable, everything being clean and in good condition.

This company uses steel boxes with wrought-iron tubes and copper ferrules. A set of tubes will last, and remain perfectly tight, from 2½ to 3½ years, when they may have to be taken out to be re-ended; some of the engines are working to-day with tubes over four years old, many of which are as tight as they were on the day they were put in. Some of the wrought-iron tubes are being replaced by mild steel, because, after the holes in the tube-sheet get worn, tubes of steel stand the expanding better; but at present those that are in service have not been in use long enough for one to form an opinion of them as compared with wrought iron.

Some people are of the opinion that more than 2 per cent. of sulphur in fuel-oil is injurious to the fire-box, but as the amount of sulphur in the Texas oil the company has been using is below 0.75 per cent., no ill-effects have been noticed; but as there are coals which show as high as 3.5 per cent. of sulphur, the author does not see why sulphur should be more injurious in oil than in coal.

Engine Performance.—Although the engine tonnage has practically doubled since 1908, the author gives the following statistics for each month from January, 1907, to August, 1911:—

(1) Cost of fuel-oil per barrel of 42 gallons (Mexican currency);

(2) Cost per kilometre for fuel (Mexican currency); and

(3) Kilometres run per barrel of oil;

but it must be understood that since about the middle of 1909 all engines are loaded down to their capacity, single trains averaging 750 to 800 tons behind the draw-bar. As the road-bed is by no means level, helper engines are used over certain sections where the grades are long and heavy, so that this will explain the decrease in kilometres run per barrel of oil between 1908, 1909, 1910, 1911, as the tonnage per engine has been increased to the maximum.

Oil-Fuel. Monthly Averages.

During.	Cost of Oil per Barrel.		Cost for Fuel.		Distance Run per Barrel.	
	Dollars (Mexican).	Shillings.	Cents per Km.	Pence per Mile.	Km.	Miles.
1907	2.585	5.17	28.476	10.99	9.546	5.928
1908	2.957	5.91	27.151	10.48	11.04	6.855
1909	2.502	5.01	25.19	9.73	9.999	6.209
1910	2.356	4.71	25.02	9.66	9.41	5.843
1911 (8 months).	1.990	3.98	22.23	8.58	8.89	5.520

The cost of fuel-oil per barrel of 42 U.S. gallons (231 cub. in.) as charged out every month is made up of the following items, and also depends upon whether there is any shortage or overage when the inventory is taken at midnight on the last day of each month; this accounts for the variation in prices:—

1. Price of oil per barrel f.o.b. in ships' tanks at delivering port (Puerto Mexico).

2. Commission to purchasing agents in United States.

3. Consular invoices.

4. Inspection fees for inspecting cargo in ships' tanks at shipping point.

5. Stamps.

Items 2, 3, and 4 only refer to oil purchased out of Mexico.

Based on tests which have been made, the company reckons 3½ barrels, or 147 U.S. gallons, of oil as being equal to 1 ton of coal or 1,000 kg., or 2,204 lb. or 3½ barrels of oil equal one unit of fuel.

The author is unable at this time to give any reliable data of fuel consumption on a tonnage basis, as no records are kept of the company's freight hauled over the road, although it is considerable; but the average loaded passenger and freight cars hauled 1 kilometre per unit of fuel from January 1 to December 31, 1910, was 330.89, and from January 1 to June 30, 1911, 333.60. The average loading weight of freight-cars is approximately 30 tons.

In August this year (1911) the company received the first cargo of a native or Mexican fuel-oil, under a contract with the Campania Mexicana de Petroleo, El Aguila, S.A., at a price of 1.75 dols. (Mexican) (3s. 6d.) per barrel of 42 U.S. gallons delivered into railway company's tanks at Puerto Mexico. This oil, which is used in its crude state as fuel, is jet black in color, thick, and has a heavy asphalt base, and although the company has not used it sufficiently long to be able to compare it with the Texas oil, it may be of interest to state a few of the difficulties met with when first they began to use it.

As this oil is thicker than Texas oil, heaters have to be used in the engine-tanks, but it has been found that if this oil is heated up to about 150 deg. Fahr. (which can be done with Texas oil), great difficulty is experienced in getting the burner spray to light, and the oil settled very thickly at the bottom of the tank; it would not run through the pipes to the burner, and could only be burned effectively by mixing a fresh supply of oil with it. In order to burn this Mexican native oil successfully, it requires to be only just warmed. When using this, a large piece of carbon or coke-like substance is formed in the fire-box, and grows up from the bottom of the pan or grate directly under the burner-mouth. This may vary from 6 in. by 4 in. by 4 in. to 12 in. by 10 in. by 8 in. in size, growing up in such a manner as almost to smother the burner-mouth. The analysis of this substance is as follows:—

	Per cent.
Ash	1.25
Sulphur	7.89
Carbon	90.86
Asphalt	nil

It shows to a certain extent, that there is incomplete combustion, which can be remedied by admitting more air; but this cannot very well be done without affecting the steaming qualities of the engines. However, by raising the burner slightly, these lumps of carbon have decreased in size, and it is hoped eventually to adjust things in such a manner as to prevent their forming at all.

The analysis of two cargoes of this Mexican crude fuel-oil is as follows:—

	No. 1.	No. 2.
Specific gravity at 60 deg. Fahr.	0.944	0.942
Baume gravity at 60 deg. Fahr.	18.4 deg.	18.8 deg.
Flash-point (closed)	78 deg. Fahr.	102 deg. Fahr.
Flash-point (open)	104 "	120 "
Fire test	165 "	180 "
Viscosity at 100 deg. Fahr.	1080 seconds (Redwood)	920 seconds (Redwood)
Sulphur	3.44 per cent.	3.35 per cent.
Calorific value	10,971 calories	10,610 calories
Color	Black	Black
Water	Nil	0.5 per cent.
Asphalt	—	37 "
Carbon (coke)	—	12 "

It may be explained that the 37 per cent. asphalt is obtained by distilling off the distillates from the crude until only 37 per cent. residue is left, which consists of asphalt. The 12 per cent. coke is obtained by distilling this 37 per cent. down to 12 per cent. residue (on the crude); so that if they get 37 per cent. asphalt, they do not get the 12 per cent. coke; and if they get the 12 per cent. coke, they do not get the 37 per cent. asphalt.

The author regrets that at this time he is unable to go deeper into this subject, but he hopes that what little information he has been able to give with regard to oil-fuel burning in the Tehuantepec locomotives will be of interest to others working in the same direction.

The Port Colborne and St. Lawrence Navigation Co., Limited, has purchased the SS. "Algonquin" and "Cataract" as the nucleus for a new lake line of wheat and flour carriers. The former will take flour, for which her capacity is 2,700 tons, from the Maple Leaf milling plant at Port Colborne to Montreal. The "Cataract" will be used, for a time at least, in Montreal as a barge. We understand more boats will be built or purchased. This enterprise is looked upon as the carrying out of Mr. Hedley Shaw's intimation at the time of the opening of the big mill at Port Colborne that the Maple Leaf Flour Milling Co. might do well to establish its own line of boats, owing to the discrimination in rates made by the railways against shipments of flour compared with wheat. The management of the navigation company is largely identical with that of the milling company, Hedley Shaw being president, John Carrick secretary, and Cawthra Mulock, W. D. Robertson, C. W. Band and E. H. Laschinger being directors.

CHICAGO CANAL WATER DIVERSION.

The Great Lakes, which constitute the mose extensive navigable inland waterway in the world, have already had their levels permanently lowered to an extent which has resulted in serious loss to navigation and other interests. These changes in levels have occurred because waters which under natural conditions, would have reached the sea by way of the St. Lawrence River, have, instead, been diverted through an artificially constructed channel at Chicago, and, thereby, made to reach the sea by way of the Mississippi valley.

This loss in levels is a matter of national concern both in the Dominion of Canada and in the United States. As it is one of momentous importance to citizens of both countries, an intelligent understanding should be had of the facts relating to the whole matter. The Department of Marine and Fisheries of Canada has sent out a brochure entitled "Papers Relating to the Application of the Sanitary District of Chicago for Permission to Divert 10,000 cu. ft. per sec." A short abstract of the pamphlet is given here.

The need for conserving the integrity of the levels of the Great Lakes has long been appreciated and, in 1909, was made the subject of treaty between Great Britain and the United States. This treaty, known as the Boundary Waters Treaty, provides that no diversion from the boundary waters between Canada and the United States shall be made without the express authority of the governments of both countries, and corresponding provision is also made in the treaty respecting the diversion of other waters which materially affect the levels or flow of boundary waters. The present diversion of water through the Mississippi Valley, is one which materially affects the level and flow of boundary waters and, consequently, has become a subject for international consideration.

The diversion under discussion, had its origin in the sanitary needs of the city of Chicago. Chicago was confronted with the urgent necessity of disposing of her sewage in a manner that would prevent contamination of her water supply.

Two sluggish streams, the North branch and the South branch of the Chicago River flow through the city approximately parallel to the shore of Lake Michigan, to the main Chicago River which—since the diversion—flows westward from Lake Michigan. For many years, the sewage of the city was discharged into these streams, and, at least as early as 1860, the offensive condition of the South branch attracted official attention. The first complaints arose, not on account of contamination of the water supply, but on account of the offensive odor. In 1862, high water in the river, and lowering of the lake level by wind, resulted in arousing complaints respecting the foul smell and taste of the water supply.

In 1871, the situation was partly relieved by cutting down the summit level of the Illinois and Michigan canal—connecting the Chicago and Desplaines Rivers—and drawing the water for the canal from Lake Michigan. Later, it was found necessary to install pumping machinery, at Bridgeport, to maintain a current westward through the South branch and the Illinois and Michigan Canal. In 1874-80, another pumping plant was constructed to pump water from the lake, through the Fullerton Avenue conduit, into the upper waters of the North branch.

In 1880, after twenty-five years of struggling to get rid of her sewage and prevent contamination of her water supply Chicago was still looking for some means of purifying the river from its filth, and preventing a repetition of the great epidemics of 1848 and 1854, which had led to the construction of the first system of sewers.

To meet these conditions, Chicago, in 1889, decided to adopt an extensive sewage scheme employing what is known as the dilution method. This method was selected because it was believed that, if sufficient water could be readily and cheaply obtained, this method would be an economical one for Chicago. The dilution method consists essentially of diluting sewage effluent with sufficient water to render it inoffensive. In the case of the Sanitary District of Chicago, this proportion has been established by a State law which fixes it at one cubic foot of water per second for each 300 of population. On this basis, a population of 3,000,000 would require 10,000 cubic feet per second—an enormous amount of water and comparable to the mean quantity passing over the American fall at Niagara. Lake Michigan—an integral part of the Great Lakes system—and practically a unit with Lake Huron and Georgian Bay—afforded a possible source of supply and was tapped by Chicago.

A corporation, known as the Sanitary District of Chicago, was formed under a special Act of the State of Illinois, and empowered to undertake the construction and operation of the works necessary for the new projects. The enabling Act, entitled "An Act to create sanitary districts and to remove obstructions in the Desplaines and Illinois Rivers," was passed May 29, 1889, and came in force July 1st of the same year. The Sanitary District comprises an area of 358 square miles.

One of the first works to be constructed was a large artificial channel, known as the Chicago Drainage Canal, extending from Robey Street in Chicago, to Lockport, Ill., a distance of 32 miles. By means of this channel, water from Lake Michigan flows westward through the Chicago River—whose flow has been reversed—to the canal, and is discharged into the Desplaines River at Lockport. The canal was designed to carry 10,000 cubic feet of water per second, but was constructed to carry 14,000 c.f.s.

The canal was opened on January 17, 1900. Water from Lake Michigan then flowed through Chicago by way of the Sanitary canal into the Mississippi. As a high-water cycle in the Great Lakes followed the diversion, the injurious effects were not, at first, apparent. In 1909, a low-water cycle commenced and, in 1911, the level was only a few inches above the level of 1895—which, with the exception of 1819, is the lowest water ever recorded. The knowledge that a part of the loss then experienced, was due to the diversion at Chicago, effectually aroused navigation and the allied interests who were thus injuriously affected by the selfishness of Chicago.

The United States Secretary of War is vested with jurisdiction over, and discretionary powers appertaining to, the navigable waters of the United States. As the new flowage of water through the Chicago River affected navigation at the port of Chicago, it became necessary for the Sanitary District to apply to him for permission to divert the waters it proposed to use. The secretary authorized the diversion of a certain quantity of water and, after subsequent modifications, a permit was issued, fixing the amount authorized for diversion at 4,167 cubic feet per second. The Sanitary District, however, did not confine its use of water to the quantity authorized by the Secretary of War. A special board of engineers, under the chairmanship of Brig. Gen. W. H. Bixby, chief of engineers, was appointed to report upon the effect upon navigation of diversion at Chicago. The special board reported that the Sanitary District was diverting some 7,000 cubic feet of water per second, thus exceeding the authorized amount by 3,000 c.f.s.

It was proposed, in connection with the Chicago drainage canal, to construct a navigable waterway from Chicago,

by way of the Mississippi Valley, to the Gulf of Mexico. General Bixby has reported that 1,000 cubic feet of water per second would be ample for purposes of navigation.

A large amount of power can be developed from waters diverted by the drainage canal, and along the course of the proposed navigation route. The development, and sale, of this power would create a large revenue, and, in connection with this project, the Sanitary District and other interested parties, have entertained the hope, and expressed the expectation, that profits derived from the sale of hydro-electric energy, developed by means of waters diverted through the canal, would meet the whole expenditure on the Lakes-to-the-Gulf Deep Waterway.

It will be recognized, therefore, that this development of cheap power, coupled with the method of sewage disposal, has been a very strong incentive for Chicago interests to obtain all the water possible.

On the 5th February, 1912, the Sanitary District requested permission from the Secretary of War "to withdraw from Lake Michigan through the Chicago and Calumet Rivers—not to exceed 10,000 cubic feet of water per second". The Government of Canada was notified that the Hon. Henry L. Stimson, U.S. Secretary of War, would hold a hearing at which those interested might make statements relating to the effect which the proposed increased diversion of water at Chicago would have upon their respective interests. In accordance with this notification, the Hon. J. D. Hazen, Minister of Marine and Fisheries, Canada, appointed a special committee to prepare a case on behalf of the Dominion of Canada. This committee, consisting of Messrs. Daniel Mullin, K.C., A. St. Laurent, W. J. Stewart, V. W. Forneret and John Kennedy, was appointed by Order in Council dated March 27th, 1912. The report and recommendations of this special committee are embodied in the brief and counter-brief which have been submitted to the U.S. Secretary of War on behalf of Canada.

At the first hearing, held at Washington on February 28, 1912, representations for, and against, the application were made by citizens of the United States. A second hearing was held, also at Washington, before the Secretary of War, on March 27, 1912, when protests were made on behalf of the Government of Canada, the Commission of Conservation, the Dominion Marine Association, the Montreal Board of Trade, the Montreal Harbor Commission, the Toronto Harbor Commission and others.

A request was made on behalf of the Government of Canada that the application of the Sanitary District of Chicago to increase its diversion from Lake Michigan be not granted and, that any abstraction of water from Lake Michigan be limited to such quantity as shall not injuriously affect navigation and other interests on the Canadian side of the boundary.

After the hearing of March 27, 1912, the Secretary of War announced that seven days would be allowed the trustees of the Sanitary District to file their brief—the Dominion of Canada to file its counter-brief, not later than April 16th.

The argument for Canada, together with the brief for Canada, and the brief of Mr. J. C. Williams, counsel on behalf of the trustees of the Sanitary District of Chicago, and also the counter-brief for Canada, all as submitted at the respective hearings, are given below in full. The memoranda and statements made by various organizations represented at the hearings, including that of the Commission of Conservation of Canada, are also published herewith.

As a result of carefully weighing all the testimony of the navigation and other interests which have been adversely affected by the lowering of the levels of the Great Lakes, and the testimony adduced before the Secretary of War, and, also, the other available data bearing on the subject, the special committee appointed by the government of Canada unanimously reached the following conclusions:

(1) That there is no imperative necessity for such a large diversion of water from Lake Michigan for sanitary purposes, as is requested in the application.

(2) That the historical facts presented in this brief show conclusively that the sanitary canal can not be considered as the outgrowth and development of a scheme which has received recognition by the United States government, or that of the Dominion of Canada.

(3) That the claim that the Sanitary District is entitled, as a matter of right, to the use of so much of the waters of Lake Michigan as may be necessary for sanitary and domestic purposes, cannot be entertained in so far as it relates to the extraordinary and wasteful use proposed.

(4) It has been shown that very substantial injuries have been made, and are being suffered by navigation interests. Fears for future and more extensive damages, by reason of increased diversion, are exceedingly well founded, and justify the demand that some improved method of sewage disposal, which shall not require the abstraction of any considerable quantity of water from Lake Michigan nor the diversion of other outlets of water which would naturally flow into it, be adopted.

(5) That the Dominion of Canada has the right to a voice in the disposition of the waters of Lake Michigan for sanitary purposes in so far as such diversion injuriously affects navigation, because her citizens are accorded, by treaty, the right of free navigation in that lake, and, in that no diversion can be made without injuriously affecting her harbors, channels and canals.

(6) It having been shown that the sewage of Chicago can be so treated and disposed of by other means than the present dilution methods, by which great quantities of water are withdrawn from Lake Michigan and discharged through the Drainage canal into the Illinois River, it is contended on behalf of Canada, that the abstraction of water from Lake Michigan shall be limited to such quantity as shall not injuriously affect navigation interests on the Canadian side of the boundary, and, that such limitations shall take effect at the end of such time, as, in your judgment, may be reasonably necessary for the Sanitary District to instal, and put into use, the works which may be required for disposing of the sewage by other means than by the dilution method now in use.

(7) That, in view of the fact that the Sanitary District claims that permits hitherto issued deal only with the flow through the lower portion of the Chicago River, and that it has the right to take any amount of water, without permission, through the canal, provided it is supplied through other feeders, it is respectfully requested that all permits be only for such limited quantity of water as shall not injuriously affect navigation on the lakes and the St. Lawrence River, and be so worded as to state the total quantity which the Sanitary District of Chicago may be permitted to withdraw for domestic and sanitary purposes from the drainage basin of Lake Michigan.

We feel confident that the interests of humanity at Chicago, and the levels of the Great Lakes, and of the St. Lawrence River, can best be protected by the installation of a modern system of sewage disposal, rather than by using a method which has been shown to be injurious to the navigation and commerce of both nations, and, further, that the interests of the public generally will, thus, be protected and their welfare promoted.

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CONTENTS OF THIS ISSUE.

THE APPOINTMENT OF A HEALTH COMMISSIONER.

"A vacancy will soon exist in the position of chairman of the Board of Health of the city of Boston.

The duties of the chairman and his two associates are various and responsible. They embrace the control of contagious diseases, including bacteriological tests, disinfection, and preventive measures; the inspection of milk, vinegar, provisions, tenements, slaughter houses, stables and occupations and conditions dangerous to health; the medical inspection of the schools, containing more than 100,000 pupils; the management of a smallpox hospital and a quarantine station; the control of convenience stations throughout the city; the compilation and publication of vital statistics, and other miscellaneous duties. The department has over two hundred employees.

The mayor will consider applications from physicians, sanitary engineers, or other persons experienced in this field, who are American citizens."

Attention is called to the last paragraph of the above. Applications for the position of Health Commissioner for the city of Boston are being invited, and the above is clipped from the notice calling for applications. It is nearly time for our Canadian municipalities, when openings in civic positions occur, to include a paragraph similar to the above, with the change of "Canadian" for "American." In many municipal appointments made recently in our Canadian cities foreign engineers have received the positions. We have stated before in these columns our feeling that just as able men can be secured from the ranks of the Canadian engineering profession as elsewhere. Evidently, our neighbors across the line feel likewise concerning their own appointments, and have taken measures to ensure the appointment of citizens of the country. The sooner their example is followed in this matter, the better it will be for both the cities concerned and the engineering profession.

THE CONSULTING ENGINEER AND THE MANUFACTURER.

Of late years a practice has prevailed among contractors and manufacturing establishments of gratuitously preparing plans, furnishing estimates and giving advice on engineering work. This has been the cause of considerable adverse comment on the part of the engineer, for it interferes with his legitimate practice. At the last annual meeting of the American Institute of Consulting Engineers a discussion of this practice arose, and the consensus of opinion was that something should be done to stop it, as it was certainly unfair and detrimental, not only to the engineer, but also to the manufacturer and contractor. A number of interesting points were brought out during the discussion. Mr. C. C. Schneider stated that a few years ago, in tendering on steel work, the prevailing practice of making designs on speculation had it demoralizing influence, which did not seem to be sufficiently appreciated by purchasers of structural work, they being led to believe that the contractor did this work gratuitously. A moment's reflection, however, will show the fallacy of such an assump-

tion. The fact is that the manufacturer has to pay for making designs, not only once, but many times over, as only once in a number of cases is he the successful bidder. This extra expense must be paid by the purchaser. Now, however, it is becoming more and more the practice to let contracts for bridges and other structures on designs prepared by engineers employed by the purchaser.

Nevertheless, it is true that a great deal of work is done by the manufacturer which should logically come to the consulting and constructing engineer. The result is that the actual purchaser of the company's product is compelled to pay the expense of investigating other people's projects which are never carried out. At the present time the reinforced concrete practice is in about the same condition as that of structural steel work some years ago. It will only be by the co-operation of the engineering profession that this condition of affairs can be ameliorated. It was suggested at the meeting mentioned above that the different engineering societies whose members undertake consulting work should adopt a schedule of minimum charges, and that the companies manufacturing apparatus, in furnishing estimates, plans and specifications should regard themselves as consulting engineers, and invariably should exact for the service rendered at least the minimum charge recommended. This would, no doubt, help to kill the practice. It is to be hoped that some concerted movement will be taken with regard to this matter.

SELECTION OF A WATER-WHEEL.

At various times we have referred to the increased precision now obtained by the water-power engineer in the design and installation of water-power development. A number of factors have contributed towards this result. One of the most important of these factors is that more thought is being given to the application of precise methods in selecting the water-wheel unit. By a gradual process of development the water-wheels themselves have been brought to a very high state of efficiency for operation under various conditions of installation. Theory has begun to play a large part in the design of units for special conditions of head and amount of water, until now a highly specialized branch of engineering service has been reached.

With the more general use of electric power and the perfection of high voltage of transmission, many developments of Hydro-Electric power have become possible. These include very low-head plants and very high-head plants, with a wide range in the quantity of water available. Regulation demands are becoming more rigid. Expensive storage dams, with large reservoir sites, compel economy in the use of water.

These factors have aided in forcing the water-wheel manufacturer to furnish wheels for particular cases, and not from stock patterns. In order to furnish a wheel which will give the best results under the required conditions of service the designer must know certain facts. Mr. O. B. Coldwell, in a paper given recently to the American Institute of Electrical Engineers, and published in the last two issues of *The Canadian Engineer*, discusses the features entering into the particular design of water-wheel which will best reach the conditions for which it is intended, and points out the information which should be furnished by the purchaser to the water-wheel designer to enable him to plan the most efficient unit.

EDITORIAL COMMENT.

In this issue of *The Canadian Engineer* will be found the second part of the article describing the Red River Bridge for the National Transcontinental Railway. This is a bascule bridge of a new form, known as the "Heel Trunnion," and is a modification of the earlier form of bascule. This is the first description of the "Heel Trunnion" type that has as yet appeared in the technical journals, and will, therefore, be of considerable interest to our readers.

* * * *

Members of the engineering profession resident in Toronto will much regret City Engineer Rust's removal to Victoria, B.C. The integrity and uprightness which has marked his career throughout his municipal life has done much towards setting a proper standard for the engineering profession in Canada. At the same time we feel sure that the work of the Canadian Society of Civil Engineers and its influence in the West will receive an added impetus with the presence of the immediate past-president of the organization in Victoria. We wish Mr. Rust every success in his new sphere of action.

* * * *

We drew attention through our editorial columns recently to the application of the Sanitary District of Chicago for permission to divert an increased amount of water. The Canadian Government have very rightly taken a strong interest in the application, knowing the evil results that will accrue to Canada as the result of the granting of the application. To secure an intelligent understanding of the facts underlying and concerning the application, the Department of Marine and Fisheries has sent out a pamphlet giving the facts as known. An abstract of the pamphlet will be found in this issue.

GENERAL NOTES.

Precipitation was very generally in excess of the average in Canada during April, but in Vancouver Island and the Kamloops District of British Columbia, Saskatchewan and Nova Scotia, the usual amount was not recorded. The excess was pronounced in Alberta, where the fall was almost twice the normal in many localities.

At the close of the month the ground was bare of snow in most places, but in the bush region of Upper Ontario there was a depth of from four to twelve inches, and in the Gaspé Peninsula of Quebec about four inches.

The table shows for fifteen stations, included in the report of the Meteorological Office, Toronto, the total precipitation of these stations for April, 1912:

	Depth in inches.	Departure from the average of twenty years.
Calgary, Alta.	2.00	+1.41
Edmonton, Alta.	1.60	+0.76
Swift Current, Sask.	0.4	—0.35
Winnipeg, Man.	2.20	+0.66
Port Stanley, Ont.	3.50	+0.92
Toronto, Ont.	2.74	+6.34
Parry Sound, Ont.	2.34	+0.20
Ottawa, Ont.	3.14	+1.26
Kingston, Ont.	3.27	+1.28
Montreal, Que.	3.20	+0.88
Quebec, Que.	3.13	+1.10
Chatham, N.B.	3.20	+0.45
Halifax, N.S.	3.90	—0.62
Victoria. B.C.	1.30	—0.50
Kamloops, B.C.	1.30	—0.52

A FLOWING WELL.

The illustration given herewith shows No. 2 borehole which was sunk at Boggy Creek for the purpose of supplying water for Regina, Sask. Mr. R. O. Wynne-Roberts, the consulting engineer, after a study of the geological formation, decided that there should be water at this point, and on sinking a well, a gusher was located. This well is 75 ft. deep, 5 inches in diameter, and at 8½ ft. above ground it is now discharging 440,000 gallons a day. At 8 ft. below ground it is expected to yield about 700,000 gallons daily.

View of Well Showing Measuring Weir.

A few months ago Regina had only a supply of one million gallons per day; now there are 2,750,000 gallons ready for the city, and it is hoped to increase this to a still larger quantity from Boggy Creek. The next well to be sunk will be 7¼ inches in diameter and it is expected to yield a greater quantity than the 5 inch well. The photo is of interest because it is rare that such powerful artesian wells are to be found in the glacial formation. These wells should place Regina in an excellent position with regard to industries and financial operations. The view shows a temporary V-notch weir installed to measure the flow of the well.

ELECTRIC SMELTING OF IRON ORE IN SWEDEN.

The Stora Kopparbergs Bergslags Aktiebolag, at Falun, who are the owners of the Domnarfvets Ironworks, at which works the first large electric smelting furnace was erected, are now going to build a new electric furnace with a capacity of 12,000 h.p. The earlier furnace was constructed according to the designs of the Elektrometals Company. The new furnace, however, is to be constructed in accordance with the patents of Dr. A. Helfenstein, of Vienna, and a contract with the inventor has already been signed by the company. The Helfenstein furnace, which is fitted with vertically adjustable electrodes, has been adopted in several places in Germany and France in the carbide industry, and is also used for the production of ferro-alloys, the size and capacity of the furnaces varying from 6,000 to 12,000 h.p. This is stated to be the first time, however, that the furnace is to be used in connection with the iron industry. Among the advantages claimed for it is the fact that the capital expenditure per h.p. is small, and further, that it is simple in design, and the cost of operation is low. It can also be adapted to a varying supply of energy, which is of particular importance to works depending for their energy supply upon rivers and waterfalls. It is expected that the new furnace will be completed in the autumn, and possibly results will be available before the end of the year.

CENTENARY OF GAS LIGHTING.

The year 1912 marks the one hundredth anniversary of civic street illumination by means of gas and its importance, even in 1812, may be readily noticed from the fact that its application to street lighting followed its first public demonstration by just nine years. Mr. Samuel Gleg, the first business manager of the National Light and Heat Company (London), improved the art to a great extent by the introduction of the hydraulic main, the wet lime purifier and the wet gas meter. With these improvements gas rapidly spread over the civilized world as an illuminant, and Baltimore had the honor of being the first city on the American continent to use it for street lighting purposes. This was in 1821. Boston followed the next year, and by 1827 gas lighting had become common in New York City.

At first no attempt was made by the gas producing companies to secure any other product from the coal than the gas, but later on it was discovered that there were several valuable by-products. The products of gas distillation contain vapors of tar and naphtha together with steam impregnated with carbonate of ammonia and sulphide of ammonia. These vapors condense in the pipes and clog them up. Instead of being considered a nuisance it is now recognized that they have a value, and add considerably to the assets of the gas companies. Sulphide of ammonia amounts to one per cent. of the coal treated, although some thirty per cent. of this amount is lost. However, it is worth nearly twenty dollars a ton as a fertilizer, and gas companies in regions where fertilizer is most in demand find a ready market for all the sulphide they can produce.

When electricity began to come into use as an illuminant it was predicted on every hand that the gas companies would soon become bankrupt, and that gas would be driven out of the market. These prophecies have been falsified, for gas companies are more prosperous than ever. They are concentrating much of their energy in popularizing gas as a heating agent, for up to the present time electric heaters are more expensive, and have proved economical only in such small articles as irons. In a few years electricity may be much cheaper, and then it may drive its older rival from the field. At the present time, however, gas for heating purposes is firmly entrenched, and there are many who prefer it as an illuminant to electricity, for the reason that it is not so hard on the eyes as the fierce white glare of the electric light.

AN UNUSUAL COMBINATION OF REINFORCED CONCRETE AND CONCRETE BLOCKS.

The E. E. Woodward Building at Rockford, Ill., is notable in that the construction is a combination of reinforced concrete and concrete blocks. The entire frame, including columns, floors and stairways, is of reinforced concrete, while the walls and partitions are constructed of concrete blocks. No wood is used except for window frames. It is interesting to note that the blocks carry none of the load of the building and contents except their own weight. The building is 143 by 70 feet, five stories high with basement. The concrete used was proportioned 1:2-½:4. The Simpson Construction Co., of Chicago, were the contractors for the concrete work, while the building was designed by Francis M. Barton of the same city.

APPLICANTS FOR PUBLIC APPOINTMENTS.

To anyone who has had occasion to advertise for applicants to fill a position the following comments by a borough surveyor, in a recent issue of The Surveyor, will be of interest. It would be well for all applicants for positions to note carefully the remarks.

Only a very few of those of us who enter the municipal or local government service can hope to progress very far in our career without undergoing the ordeal of becoming a candidate in open competition for a higher position.

Again, only those who have entered the arena time after time without success can appreciate fully the dreadful sense of discouragement that comes over one on receiving quite a number of polite little circulars informing us that Mr. So-and-So of somewhere else has been successful.

Of course, in the public service, of whatever branch, the stress of competition, as in every other walk of life, grows keener day by day, and disappointments must be expected, if only from a study of the numbers one sees from time to time as having applied for this or that post.

Still, one often wonders just why the successful candidate should have been selected in preference to oneself. He does not come from as good an office as our own, he is younger, and does not appear to have nearly as good qualifications. "Luck," perhaps; well, very often it is just that and nothing more, or at any rate that intangible factor has entered very largely into the result. And yet if you were behind the scenes you would very often see clearly the why and wherefore. For while it is true, no doubt, that such things as "local influence" and "personal canvassing" are still potent powers in the land, I think it must be conceded that in nine cases out of ten nothing more or less than first of all a smart application ensuring a place on the selected list, followed by a favorable impression at the personal interview before the committee or council, has brought about the result. It surely behoves us, then, to put our very best effort into our application, recognizing that nothing but this has the slightest chance among so many aspirants, and always remembering that from this short document alone those who have the selection have to form an estimate not only of our qualifications, but, from internal evidence contained therein, our personal character.

It has been my duty to open, analyze and tabulate the applications received on several occasions, and quite recently to prepare a select list for a junior appointment in my own office. On completing my task I stood contemplating the heaped-up pile of human effort, wondering if I really had selected the the best six, or whether lying buried amidst the number of unsuccessful applications was some undiscovered gem of sterling worth.

This would, with every care on my part, have been quite possible, from the fact that so many of the applications bore evidence of want of training and method in preparation, and thus it may be that a candidate having really good points had quite failed to bring them to my notice. Let it be recognized, more especially by younger members of the service, that an application, to stand out from its fellows, must be prepared with that object, and be such as immediately to command attention.

Everything counts, right from the very envelope in which the application is sent to the testimonials it encloses. Handwriting, good paper, legibility, the marshalling of facts in clear chronological order of training and experience, general style and appearance—all lend their weight.

The first point, perhaps, that I can recommend is a very careful study of the advertisement, and having made this, consideration if you are in every way eligible. It is of no use blinking facts to oneself. Competition is so severe that unless you are competent from training and experience, or, for example, are not within the limits of age, it is useless to waste your own and other people's time by applying. Do not think from this that I wish to damp anybody's laudable desire to get on, and, of course, "luck" might come your way. Really, though, there are already so many people who cumber up the candidates' list and who by no possible chance can hope to succeed, that they cause themselves a deal of unnecessary trouble, expense and disappointment. Do not imagine I mean that, supposing a borough surveyor has a vacancy for a qualified "General Assistant," you are eligible because you have just completed your articles with an architect in private practice, or that for a public library requiring a librarian you are just the man because you are in a town clerk's office. You have not had the specialized training required, and fifty of the others who apply will have. Take any hint, also, contained in the public announcement of the vacancy, such as "preference given to candidates holding the certificate of the Surveyors' Institution." If you have not this diploma, its equivalent or something better, do not apply. Modern practice all tends towards specialization in greater or less degree. No, choose your department, and get every qualification you can that it requires, then sail ahead when opportunity offers and "Try, try again." Quite 30 per cent. of the applications I referred to a little while since were received from persons having no possible qualifications for the post, and this is no solitary example.

Having decided, then, to become a candidate, let us return once more to the advertisement. Follow its directions implicitly down to the smallest detail. If it asks for everything to be in the candidate's handwriting, do not, for instance, type or print your copies of the testimonials. If it asks for two testimonials, do not send in three, or any like foolishness.

It would be impossible here to do more than indicate generally the lines your application should follow, as the circumstance will vary in some degree with the class of appointment offered. You will, however, have already gathered the care and attention I advise you to pay to many things. As I have already said, you must remember that it will not only be from the subject-matter of your application that you will be judged, but an opinion will be formed of your general character from the internal evidence it contains. For instance, a man who makes careless mistakes there will be likely to make them elsewhere. If you attempt to deceive by palpable exaggeration there you are not likely to be reliable in your everyday dealings in your new post. If you do not produce a neat and businesslike document now, with so much depending upon it for your own advancement, are you likely to exert yourself to turn out good work in your employer's interest? Make the very best of your own goods —that's what you must do to succeed. But, on the other hand, do not state anything that will not bear investigation should it come to the test.

Among other small matters, address your application direct to the persons having the power of appointment, as, for example: "To the Mayor, Aldermen and Councillors of the Kirkhampton Town Council," or "To the Chairman and Members of the Wallsend Urban District Council," "Gentlemen." Then go right to the point. Do not say, as nine out of every ten candidates will: "Having noticed your advertisement in this week's Local Government Gazette for a general assistant in your surveyor's office, I beg, etc." Never mind how you got to know there was a vacancy. Say: "I beg to offer myself as a candidate for the position now vacant of general assistant to your borough surveyor."

Then give your true age on your last birthday. Do not quibble in order to make yourself appear a little older by saying "I am in my twenty-sixth year." If it is the end of February now, of course you can, if you wish, say "I was twenty-six years of age on March 14th last."

Then particularize your present appointment and qualifications, and go on to show (guided, of course, by the nature of the appointment) how your education, your having served your articles of apprenticeship, your subsequent appointments, the examinations you have passed, and your experience generally fit you in every way for the position offered; and, if a junior, impress them with the fact that you will prove a real assistant to your new chief if appointed.

Of course I can do no more than indicate that there are ways, by using your brains a little, of helping you considerably so to frame your application as to meet exactly the requirements of the situation. For example, let us suppose that a bald advertisement appears stating that the council of some seaside resort requires a new borough surveyor. You have never been there, and do not know the town a bit. Well, make it your job to find out everything there is to know of the class of place it is, and what special matters (like waterworks, public baths, or other projects, just a little outside the usual run, perhaps) will be under your control. Or, again, make a special point of enquiring what new large works, if any, are contemplated in the near future, such as an extension of the sewage system, or a new sea-defence wall and parade. Having gleamed what you require, it is easy to emphasize in your application that part of your experience bearing on the points in question. Obviously, for instance, on the other hand, it is no use to indite long paragraphs setting forth your special knowledge of sewage farms if the sewage is discharged direct into the sea. Need I say more? The advertisement will often give you general information, but frequently it is easy to gather a little particular knowledge of the greatest service. Before leaving this part of our subject, just a word more to the juniors—and that is, "Do not exaggerate." I have before me an application for a junior appointment from a boy in a borough engineer's office—a veritable prodigy if all he states is true, for he claims to have a thorough knowledge of surveying and levelling in all its branches, is an experienced draughtsman, with special knowledge of architectural work, and sewage and drainage, road making, private street works, waterworks and tramways, and yet makes at least two mistakes in spelling. Believe me, the man who is going to look through through your application will not expect all these things of you before you are twenty-one. He is more likely to be content with a genuine statement that during your articles your chief has been carrying out works of the comprehensive nature set forth above; that you have got some satisfactory knowledge of office routine, can make an accurate survey, produce a neat drawing, have passed a preliminary examination, or can produce a certificate or two from the Science and Art Department of the Board of Education in building construction or the like. I declare it to be an absolute fact that out of six selected candidates for a junior appointment who appeared before a committee here, and all of whom had stated in their application that they were competent surveyors, only one could read an angle set up on a theodolite standing in the council chamber, and four of the six were not able to make any attempt at all. Be warned, therefore, and do not hope to deceive by claiming to be able to run while still "in arms," for you would only be miserably unhappy if by any chance you managed to secure the position and were found wanting.

And now as to testimonials. I am afraid at this date, while they are still the fashion, their value has been considerably discounted owing to experience common to us all. Let them at any rate have some bearing and be a little varied. By that I mean get them from people competent to form a judgment. To produce one from your schoolmaster when you are twenty-five has only a limited value. He cannot judge but generally of your professional ability. Suppose, for instance, three are required; get two that speak of your professional qualifications, and let one go to show something of your personal character.

Your application is now ready for dispatch, printed it may be, and neatly bound up in narrow green ribbon for an important post, typed or neatly written for others, but always with an outside title page setting forth tersely its contents. Send it off then in good time; do not wait until the very last day or post. There are such things as accidents; and do not forget to put the endorsement on the outside of the envelope.

On the much-debated question of convassing I shall say but little. In many instances this is now strictly forbidden, but in others "personal" canvassing only is tabooed, and it is still permissible to send a copy of your application and testimonials to the members of the local authority or committee. The names you can easily obtain, as a rule, on application, or from the local newspaper people. Do not forget that you must spare no legitimate effort to make your name stand out from the ruck in some way or other—even if it is only by using blue foolscap instead of white. As to any personal influence you may be able to bring to bear, I can only leave that to your own good sense and taste; but always remember that frequently more harm than good is done by the people who pester on behalf of candidates of whom they have no real personal knowledge whatever.

Now only remains the fateful interview. Our application has done the work required of it, and we have been requested to present ourselves as one of a selected number for inspection. Here, of course, a man's personality counts for a very great deal, and it is everything to create a good impression. I am afraid it is of little use to tell the nervous man, who positively dreads it, not to be afraid, but one can warn the very cocksure of going to the other extreme.

All things count, dress and general appearance, of course. Do not overdress, but, at any rate, go looking, as it were, worth your money. Perhaps, however, the one great tip is contained in the words "Speak up." There are sometimes quite a number on the committee or council, and there are certain to be some who cannot hear well; but anyhow it gives a general impression of confidence.

You must be on the alert for opportunities to bring out your strong points. Do not worry by anticipating that they are going to ask you too much or questions you may not be able to answer. They will not; for, as a matter of fact, unless the interview has been arranged beforehand by the chairman or head permanent official, you will be surprised at the somewhat inane things that will be asked of you, or find that you are being merely required to confirm a few points in your application. You will not often get a chance to say much to the point unless you are quick to make the opportunity for yourself as you go along. In conclusion, I wonder if I shall be understood if I tell you never to say "No" to anything.

Reading over the foregoing I very much doubt if I am competent to give you all the advice I should like to give. Certainly I myself have made very nearly all the errors I am asking you to avoid, but if I have succeeded in helping any of those who are coming after me to put up a little better show on the next occasion they enter the list my efforts will not have been entirely in vain.

CIVIC STREET ILLUMINATION.

The many and important changes brought about in the matter of street lighting are becoming noticeable throughout the streets and thoroughfares of nearly every Canadian municipality. The changes have not been so noticeable in the method of supply but in the means of light distribution and the method of fixture treatment along the streets.

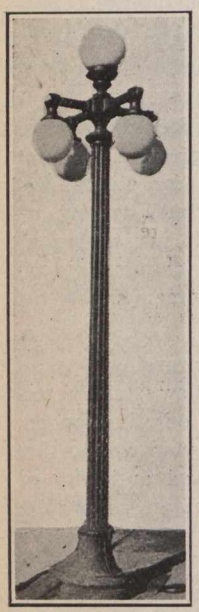


Fig. 1.

In the lower portion of the province of Ontario the policy of the Hydro-Electric Commission has been a potent factor in the furthering of new systems of street illuminations, but that this policy is not alone responsible for these changes is exemplified by the large number of municipalities who have discarded the arc flame system for the incandescent standards and still rely on steam driven dynamos for their current.

In many cases the design of the supporting columns has been carried out to an advanced state of perfection with the result that the appearance of the highway has been greatly improved and enhanced.

There are many advantages attending the use of these incandescent standards over the use of the arc lamp, and among these may be mentioned the even distribution of light, the reduced cost of maintenance, and the civic beautification.

The city of Toronto, Ont., lays claim to being among the first cities in Canada to entertain and carry out a progressive system of municipal street lighting.

In the execution of this work two types of lamp standard were employed; one consisting of an ornamental cast iron, circular base carrying five globes (four inverted and one upright); the other a reinforced concrete pole carrying one lamp in a cylindrical iron and glass support over the sidewalk. These latter standards are used on the residential streets and sections; the use of the former being confined to the heart of the business section.

As a general rule, the designers of these ornamental standards have allowed facilities for five globes; four being supported on cross arms and the fifth projecting from the end of the supporting column. Figure 1 gives an idea of the appearance of the large standards in the city of Toronto.

Aside from the necessity of careful planning and engineering there appears to be one important factor which must be considered before the system is a success, and that is, the nature and manufacture of the glass globes that surround the incandescent lamps. The Macbeth-Evans Glass Company, of Pittsburg, Pa., have made a study of this phase of the problem and have advanced the art to such an extent that they have received orders from many large and important municipal councils in this country. All the globes appearing in the illustrations accompanying this article were supplied by the above mentioned firm.

Figure 2 represents the appearance of a residential street in Toronto that was among the first to receive treatment from the Hydro-Electric Department. This street branches from the main thoroughfare and extends for a distance of about two long city blocks. As may be noticed from the posts in the foreground, two iron rings painted dead black support the ground glass globe and a metal crown on the top completes the make-up of the fixture.

The treatment of the down town sections is illustrated in Figure 3, which shows up under exceptional circumstances owing to the almost entire absence of other poles or posts. It will be noticed that the iron standards receive their operating current from wires buried underground, while the concrete standards are fed from top wires carried by the pole itself. In a few cases the iron fixtures attached to the con-

Fig. 2.

crete standards have been placed on tall wooden poles in certain sections of the city, but these poles are used to carry feed mains other than those used for supplying the lighting standards only.

The following table gives the more important specifications and figures of the lighting system of Toronto and Buffalo, N.Y. It affords a practical basis for cost estimation of similar equipment.

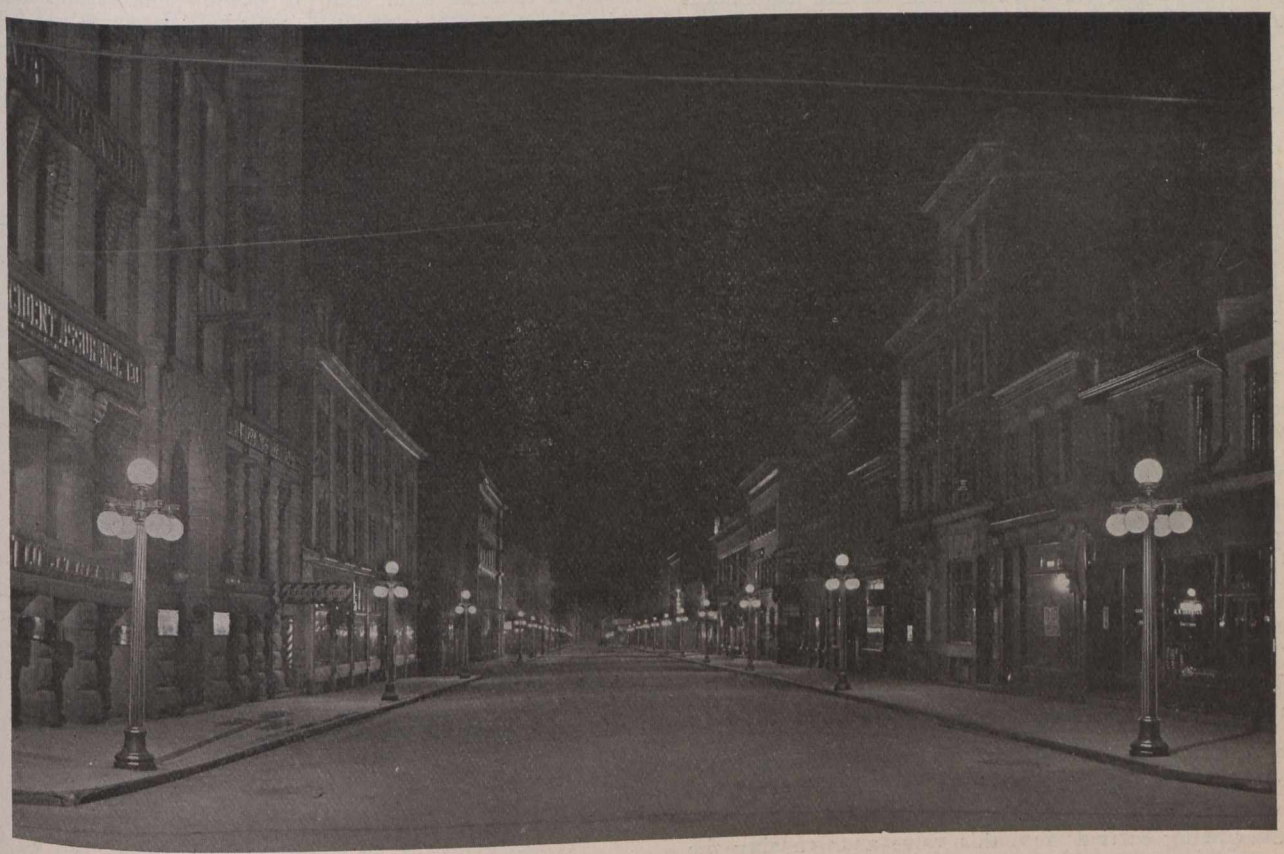


Fig. 3.

	Toronto, Ont.	Buffalo, N.Y.
No. of posts in installation	450	86
Typical street width	42′ 0″	60′ 0″
Post spacing	80′ to 100′	105′ to 125′ staggered
Height of post	10′ 8″ 13′ 0″	10′ 6″ 12′ 6″
Lamp arrangement	1 upright 4 pendent	1 upright 4 pendent
Size of lamps	5 100-watt	5 60-watt
Size of globes	(12″ x 6″) (14″ x 7″)	(12″ x 6″) (16″ x 8″)
Methods of wiring	5 Multiple lamps in series on 550V power circuit	Multiple
Kind of current	Alternating	Part direct and part alternating
Location of wiring	Underground	Underground
Time of burning	All lamps burn all night	All lamps burn all night

Some manufacturers of dairy machinery are now using monel metal for those parts subject to corrosion, experiments having shown the chemical resistance of this metal, and also its particular suitability for making pails, pans, ice cream freezers and the like.

MAINTENANCE OF THE DIESEL ENGINE.

The following notes published in a recent issue of The Electrical Review, of London, will be of interest to Canadian engineers, for a number of Diesel engines are now being installed in this country.

After two years' experience of this class of engine, the writer has no hesitation in saying that such engines are quite reliable for central-station work; any trouble experienced at first was entirely due to lack of experience on the part of those in charge.

Unless the valves, &c., are kept in practically perfect condition trouble will be experienced in starting, as the engine depends entirely on the compression for firing the charge; some engineers will consider this an advantage, but it is a serious matter for a supply station should an engine fail to start when the load is rushing on.

Where one engine only is installed, the question of the starting air is of great importance, and a small compressor, driven independently of the engine, is almost a necessity. Where there are more engines than one, it is not likely that all will be out of order at the same time, and the supply of air is practically assured.

The engine most likely to fail to start is the single-cylinder type, the multi-cylinder engine being almost certain to run on one cylinder unless allowed to get into a very bad state. Therefore, the question of the supply of air is not so serious in this case.

In a residential district the noise of the exhaust may be objected to; while it is by no means excessive, the persistent rap is objectionable, especially at night.

In a case with which the author is familiar this was overcome by taking the exhaust into a pit, 10 ft. by 6 ft. by 6 ft deep, which was available, the outlet being through the silencer supplied with the engine, and it is now almost im-

possible to tell when the engine is running. In addition to the reduction of noise the back pressure on the engine was considerably reduced.

The engine ran for some time without trouble, the first failure to start being due to the exhaust valve buckling slightly, making is impossible to get the compression high enough for ignition.

The exhaust valve casing worked loose several times, and when it was tightened down hard the casing itself buckled; each of these events meant failure to start and loss of air. In one case the air pressure was as low as 200 lb. in one starting receiver and 450 lb. in the reserve, while there was 650 lb. in the blast receiver; even with this low pressure it was possible to start up on pure paraffin.

This trouble was overcome by having the shoulder of the valve casing turned down a little from the top of the seating.

The exhaust valve soon gets pitted and scored, and it requires grinding in about every three months on an engine running six or seven hours per day. It is only a matter of a quarter of an hour to change this valve, a spare valve and casing being supplied with the engine and a split lever allowing this to be removed without disturbing the other valve gear.

The air valve has given very little trouble, although it requires occasional grinding in, and once was badly "gummed up" with imperfectly consumed fuel; the cause of this is mentioned later.

As regards the fuel valve, the makers appear to consider that it requires more attention than other parts, but during two years' working this valve has given no trouble. It has been regularly cleaned and rubbed in once or twice with knife powder when overhauling the engine.

The starting valve stuck open several times when starting up and completely emptied one of the air receivers. This was found to be due to an accumulation of moisture in the receiver being carried into this valve and causing the spindle to rust and stick in its casing. The trouble was overcome by giving careful attention to the draining of the interccoler while the engine is running, and regularly draining the air receivers each day.

The lubrication of the compressor gave some trouble at first, because of the high-pressure valves occasionally sticking and causing a shut-down owing to the falling of the blast pressure, and the air pipe from compressor to intercooler becoming blocked by carbonized oil; the makers recommended that the oil supply to the high-pressure piston should be discontinued altogether, except for a few minutes after starting up, and this was found quite sufficient for lubrication and completely overcame the trouble.

The lubrication of the engine has given no trouble except for the piston, which requires careful attention. In most vertical type engines the oil is pumped into an annular space round the cylinder and reaches the piston through some six very small holes in the cylinder liner; these appear to be very liable to get blocked up and as it is necessary to dismantle the whole of the valve gear and draw the piston, to enable an inspection to be made, they are liable to be overlooked.

The piston has run dry twice in the two years, although drawn every six months for inspection, and in each case two of the holes were found blocked up. Fortunately the driver noticed the trouble before any damage was done to the piston.

The fuel pump valves require careful attention, and particularly the suction valve as any leakage past this will prevent the engine developing full power. Failure to start has resulted more than once through the suction valve casing working loose on its seat; this was not an easy fault to locate the first time is occurred.

The cooling water must be carefully watched, and it is suggested that the circulating pump, driven from the engine, is not sufficient, but that a supply should be available to continue a flush of water through the engine for about fifteen minutes after shutting down. The reason advanced is that the heat of the piston and cylinder walls is sufficient to bake any sediment left by the water into a hard scale. This assumes that the water runs out of the engine when the pump is stopped.

A cracked cylinder cover was another unexpected trouble, and the writer believes that this has occurred on more than one engine of this type. The only reason which has been suggested for this is that the engine must have been seriously overloaded or that scale had formed in the water passages, and the latter point will be definitely settled by opening up the damaged cover.

The crack was so slight that some difficulty was found in locating the trouble. The engine failed to start and the usual examination was made, all valves were ground in and rocker lever clearances set. The engines started up sluggishly on pure paraffin and ran as usual, but refused to start on ordinary fuel oil.

Indicator diagrams were taken (the engine again being started on paraffin) and the compression was found to be very low. A careful examination revealed a tiny crack on the seating for the exhaust valve casing, extending through to the seating of the fuel valve casing. On one side of the crack the seating was slightly raised, preventing the exhaust valve casing from bedding properly.

During the few hours the engine was running on this low compression, the whole of the valves and cylinder head were gummed up with imperfectly burned oil.

It will generally be found that the engine will be somewhat sluggish in starting when anything is getting out of order, it is therefore a simple matter to get things right before a failure to start occurs. Naturally one must have practical experience of the peculiarities of Diesel engines to ensure their absolute reliability.

Th freedom from accumulation of carbonized material of valves, piston, and cylider, is remarkable, and very little trouble is experienced in cleaning up when overhauling. The maintainance cost is also low, and is chiefly confined to the pipes and valves dealing with the compressed air. The high pressures used cut the valves at a rather serious rate.

There has been no falling off in efficiency, and the ease with which the exact cost per unit can be ascertained each day is very different to the practically guesswork method of the smaller steam power stations.

More lubricating oil is required than with a steam engine only, but if the auxiliaries of the steam plant are included, there is little difference; it will be found better not to depend too much on oil filters, as they do not appear to separate out the carbon properly.

The writer cannot speak from experience of long non-stop runs, the longest coming under his personal observation being of 120-hours duration. There is no reason to doubt that very long runs are possible, the only limit being the length of time the exhaust valve would remain good enough to retain the high compression necessary.

No mention has been made of fuel costs, as these are so well known, and it is sufficient to say that the maker's guaranteed figures are still maintained under working conditions.

WATERPROOFING ENGINEERING STRUCTURES.*

By W. H. Finley.†

My attention was first directed to the necessity for some method of waterproofing engineering structures by the number of limstone masonry arches that were slowly but surely deteriorating, due to the infiltration of water. Investigation disclosed that very little had been attempted along this line, and no definite information could be obtained regarding methods or materials. The waterproofing of a masonry arch presents no very difficult features, and my earlier attempts in this direction met with a fair degree of success. However, since the extensive introduction of the elimination of grade crossings in cities by the elevation of railways, the problem of waterproofing has been greatly complicated by the necessity for making the subway bridges water tight.

This has caused very rapid development in both methods and materials for waterproofing, until now you can get all sorts of information as to how it should be done and what materials to employ, and yet the problem is far from being satisfactorily solved. Engineers have received some very rude shocks in this line of work, causing them, at times, to doubt whether it was possible to do a satisfactory job of waterproofing. The rapid expansion in this field has

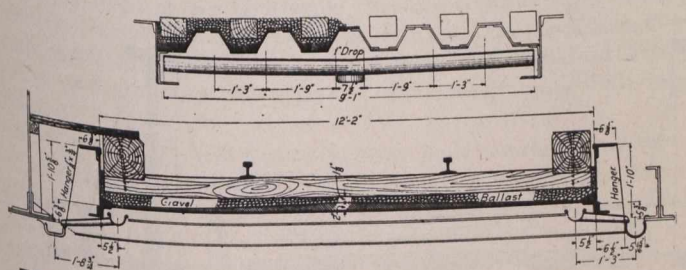


Fig 1—Section of Bridge Over Main Street Rockford, Ill.

brought into existence the waterproofing "expert," who takes his place along with the paint expert, who has for years periodically offered us a paint that would at last prevent the corrosion of metal structures; and yet the corrosion of metal structures still goes on.

While listening to the rival claims of advocates of different methods of waterproofing, the engineer must not lose sight of the fact that waterproofing, at best, is but an expedient, and will not take the place of proper designing, or correct poor construction. Water is a universal dissolvent, and if not gotten rid of in time will seep through the ordinary materials of construction. The first requisite in the designing of any structure that must be water tight is to provide means of getting rid of the water as directly and quickly as possible. In the numerous track elevation bridges around Chicago, whatever the type of construction, the usual practice has been to slope the floor from the centre to each end, carrying the water away back of the abutments, and right here is where much trouble has developed. Although one may place broken stone filling and tile drains back of the abutments, when the surface ice and snow melts in the springtime and the filling back of the abutments is still in a frozen condition, the water does not escape freely, but piles up and eventually seeps through at the end of the bridge and flows over the face of the abutment. In bridges having supports on curb lines and in the middle of the street, whether of flat slab construction or metal troughs filled with concrete, cracks are likely to appear where joints are not provided for over these supports, and where joints are provided for, trouble is likely to be experienced in preventing the seepage of water.

I will now take up, in a general way, the different methods and materials in use, and will first mention what is called the integral method. This method consists in adding a paste, powder, or lixivating water to the concrete, mixing it with the cement, the mass of concrete as a whole or with the water. While there is no doubt that any of these methods will make concrete impervious to water, as indeed can be done with ordinary concrete by careful proportioning and selection of aggregates, with subsequent care in placing, yet we know that monolithic concrete is apt to develop cracks from a variety of causes, and when that occurs you are likely to have seepage of water through the mass. For that reason I have always preferred for waterproofing engineering structures what has come to be called the membrane method.

When I first took up the question of a suitable material for waterproofing engineering structures, I investigated the respective merits of asphalt and coal tar pitch. The only instance of the use of the latter with which I was familiar had not proved very satisfactory, and I decided to use asphalt. At that time there were very few, if any, artificial asphalts on the market, and I necessarily used a natural asphalt. The structures then waterproofed are still in good condition. Since that time there has been an extensive development of artificial asphalts from petroleum oils. In nearly all cases it is claimed that the artificial asphalts offered for waterproofing purposes have a Gilsonite base. Gilsonite is described by G. H. Eldridge in his article on "The Asphalt and Bituminous Rock Deposit of the United States," as "a black, tarry-looking substance of most brilliant lustre, normally of absolutely homogeneous texture and exceedingly brittle." It is found in the Minta basin, Utah, and takes its trade name from S. H. Gilson, an early prospector. It occurs in vertical veins in enclosing sandstone, and the veins vary from a knife edge to 30 in. in thickness. It is generally conceded that the origin of Gilsonite and other hydrocarbons may be traced to petroleum. Inasmuch as the sandstone in which Gilsonite occurs contains no trace of petroleum, it is evident that it was forced up from a great depth by an enormous pressure. Gilsonite is a very pure form of hydrocarbon, and is used in a variety of ways in the arts and trades. It is used in varnishes and baking Japans, insulating materials in electrical work, and for making mineral rubber, as well as in the artificial asphalts. Taking the amount of waterproofing asphalts that are turned out every year I was interested in learning the total production of Gilsonite. I found from a reliable source that the total production last year was in the neighborhood of 30,000 tons, and the previous year somewhat less. I am afraid that the Gilsonite base of our artificial waterproofing asphalt is a very thin one. Petroleum oil is not a uniform product, varying very much at different places, and for that reason I have always been fearful that in asphalts made from petroleum oil we would not get a uniform product. However, I have had tested a number of artificial asphalts and found them to fill the following specifications very easily.

Material.—1. (a) Asphalt shall be used which is of the best grade, free from coal tar or any of its products, and which will not volatilize more than ½ of 1 per cent. under a temperature of 325 deg. F. for seven hours. (b) It must not be affected by a 20 per cent. solution of ammonia, a 25 per cent solution of sulphuric acid, and a 35 per cent. solu-

*Abstract of a paper before the Western Society of Engineers, March 18, 1912.

†Assistant Chief Engineer, Chicago & North-Western.

tion of muriatic acid, nor by a saturated solution of sodium chloride. It should show no hydrolytic decomposition when subject, for a period of ten hours, to hourly immersions in water with alternate rapid drying by warm air currents.

Range of Temperature.—2. (a) For metallic structures, exposed to the direct rays of the sun, the asphalt must not flow under 212 deg. F., nor become brittle at o deg. F. when spread thin on glass. (b) For structures underground, such as masonry arches, abutments, retaining walls, foundation walls of buildings, subways, etc., a flow point of 185 deg. F., and a brittle point of o deg F. will be required. (c) A mastic made from either grade of asphalt by mixing it with sand in the proportion of one of asphalt to four of sand, must not perceptibly indent, when at a temperature of 130 deg. F. under a load of 20 lbs. per sq. in. It must also remain pliable at a temperature of o deg. F.

In asphalting a metal surface it is imperative that the metal be cleaned of all rust, loose scale and dirt, and if previously coated with oil this must be burned off with benzine or by other suitable means. The metal surface must be warm to enable the asphalt to adhere to it, and the warming is best accomplished by covering it with heated sand, which should be swept back as the hot asphalt is applied. When waterproofing concrete structures it is very necessary that the surface be thoroughly brushed with wire brushes to remove all loose particles and get rid, as far as possible, of what the French call "laitance." It should then be coated with a liquid asphalt primer, and I believe that better results will be obtained if, just ahead of the application of this primer coat, the surface is swabbed with gasolene.

I am not an advocate of felts or burlaps for ordinary waterproofing. I believe that any ordinary concrete surface, whether in a slab bridge or an arch, needs nothing but an application of a primer coat of asphalt and then a coat of liquid asphalt, after which a hot sand mastic, composed of one part of asphalt to four of sand, can be applied with hot smoothing irons. On top of this it has been my practice to put on a swabbing coat of hot asphalt and then to cover the whole surface with washed gravel, particularly where rock ballast was to be used. Over joints and ends of bridges it may be necessary to use burlaps for the added strength they give the asphalt in taking care of any slight movement. However, in cases of expansion joints, where any defined amount of movement is to take place, I believe that special means, such as copper flash joints, should be used. Burlap is a vegetable fibre and if used should be thoroughly saturated in a bath of hot asphalt of such temperature that it will not char or destroy the fibre. To apply asphalt to raw burlap in the field I think is wrong. If the asphalt is hot enough to penetrate the fibre it is likely to be so hot that it will char or destroy it, and if the asphalt is not hot enough one gets only a surface coat.

I would like to repeat what I have previously said about the necessity for so designing your structure that the water can be disposed of as directly as possible. If more care were taken in designing, elaborate or expensive forms of waterproofing would be unnecessary.

Asphalt has no affinity for water, and all surfaces that are to be coated with asphalt should be as dry and clean as possible.

The methods I have used in preparing the asphalts are as follows:

The asphalt should be heated in a suitable kettle to a temperature not exceeding 450 deg. F. If this is exceeded it may result in "pitching" the asphalt. Before the "pitching" point is reached the vapor from the kettle is of a bluish tinge which changes to a yellowish tinge after the danger point is passed. If this occurs the material should be tempered by the addition of fresh asphalt. The asphalt has been cooked sufficiently when a piece of wood can be put in and withdrawn without the asphalt clinging to it. Care should always be taken not to prolong the heat to such an extent as to pitch the asphalt. Should it become necessary to hold the kettle for any length of time, bank or draw the fire, and introduce into the kettle a quantity of fresh asphalt to reduce the temperature.

There is a wide difference between the requiremnts for damp proofing waterproofing to take care of ordinary rainy weather and waterproofing where it is necessary to take care of the hydrostatic pressure of a head of water. In the latter case felt, and burlap mat properly reinforced with concrete, will be necessary.

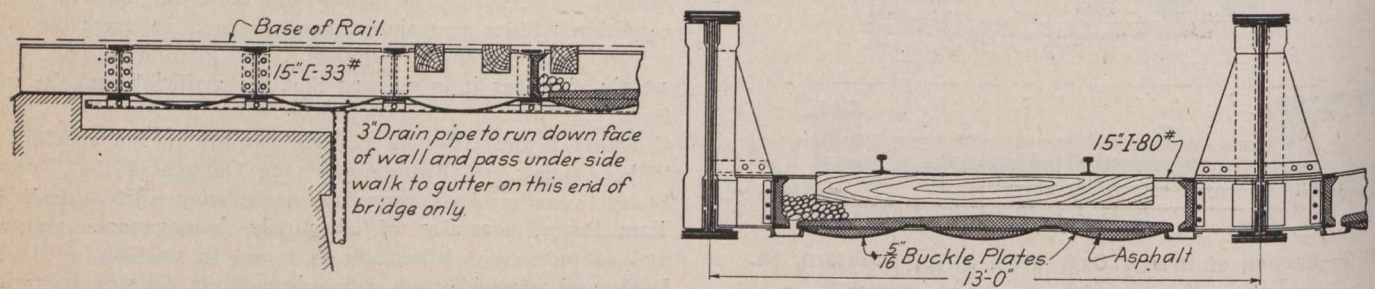


Fig. 2—Shallow Ballasted Floor Bridge in Highland Park, Ill.

One of the early applications of waterproofing was made on a stone arch bridge over Turtle Creek near Shopiere, Wis., on the Chicago North Western. This bridge consists of five 50-ft. arches, and was built in 1869 of Joliet and local limestones. The seepage of water through the ring and parapet walls reached such a stage that it seriously threatened the life of the structure. In 1887 this arch was uncovered and the top thoroughly waterproofed with California asphalt. Three years ago I removed the filling and took up some of this natural asphalt, finding it in first-class condition. The waterproofing of this arch at this time prevented any further leakage, and unquestionably prolonged the life of the structure. I have waterproofed a number of old stone arches that were showing signs of disintegration due to the lack of drainage. In 1896 a couple of 30 ft. arches over streets in the town of Janesville, Wis., were in such condition that it was a question whether they should be rebuilt or not. These arches had been built in 1864 of limestone with lime mortar. Inasmuch as the double tracking of this portion of the road some time in the near future was completed, it was desirable to carry these arches as long as possible. They were uncovered and thoroughly waterproofed with asphalt. This prevented any further deterioration from the seepage of water, and in 1906, over ten years after the waterproofing was applied, these arches were replaced by double track concrete arches. The asphalt was found to be in excellent condition and a part of it was used in waterproofing the new arches.

Fig. 1 is a view of a three-track bridge over Main Street, Rockford, Ill. This bridge was built in 1893, and waterproofed with California natural asphalt. During the 18 years it has been in place there has been no complaint regarding the dripping of water or leakage from the bridge, although it is over the principal street in Rockford. I attribute this largely to the fact that the water is drained from each floor trough into drainage troughs and carried by pipes through the abutment and outside of the dump. This is one instance of getting rid of water as directly and as quickly as possible. It avoids the trouble that is usually experienced at the end of the bridge where the drainage is carried from the centre to each end. The only trouble experienced with these troughs is from birds building their nests in the same during extended dry spells. These troughs have been renewed once since they were first installed. In later work troughs for a similar purpose were made of a much heavier material. The locomotive stands on this bridge while discharging and taking on passengers at the Rockford station, and I have seen locomotives with their waste water cocks open pouring large quantities of water on this floor, which was carried off directly and without any trouble.

Figure 2 shows a very shallow ballasted floor bridge over Vine Avenue, Highland Park, Ill. It was necessary to provide a water tight floor at this point, and this type of floor was adopted. It has troughs, and instead of carrying any of the water back of the abutments it is actually carried down in front of the abutment through troughs and down spouts. These troughs can be so arranged that it would be impossible for any trouble to occur from birds building their nests and stopping the troughs. This bridge was built in 1902.

Figure 3 is a view of a subway on what is called the Kinzie street track elevation, Chicago. You will note in this case the water is carried from the centre of the subway to each end. A somewhat different method than I usually employ was used in waterproofing this bridge. The asphalt is imported mastic fluxed with Trinidad and Bermuda, and the asphalt mastic is covered by a layer of reinforced con-

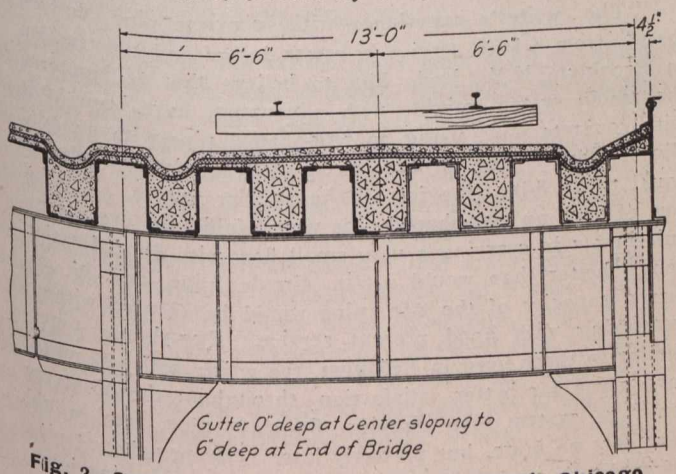


Fig. 3—Section of Subway Over Kinzie Street, Chicago.

crete. This work was done in 1905, and has proved very satisfactory, with the exception that there is some seepage of water at the ends of the bridge over the abutments. The method employed in sealing for the end, as shown in this view, did not seem to be completely satisfactory.

Figure 4 shows a proposed treatment of the ends of city subways to prevent the possibility of water getting through and flowing down the face of the abutment. This is an attempt to seal it off completely by the use of a burlap mat instead of the usual bent plate method that we have previously used.

The bridge over Wauwautosa Avenue in the town of West Allis, Wis., is similar in construction to the Vine Avenue structure. Last fall it was necessary to remove this bridge to make way for improvements at that point, and I was very much gratified to see how thoroughly the iron had been protected by the asphalt mastic. A bridge of this type with such a shallow floor is subject to more or less vibration and deflection that would, under ordinary conditions,

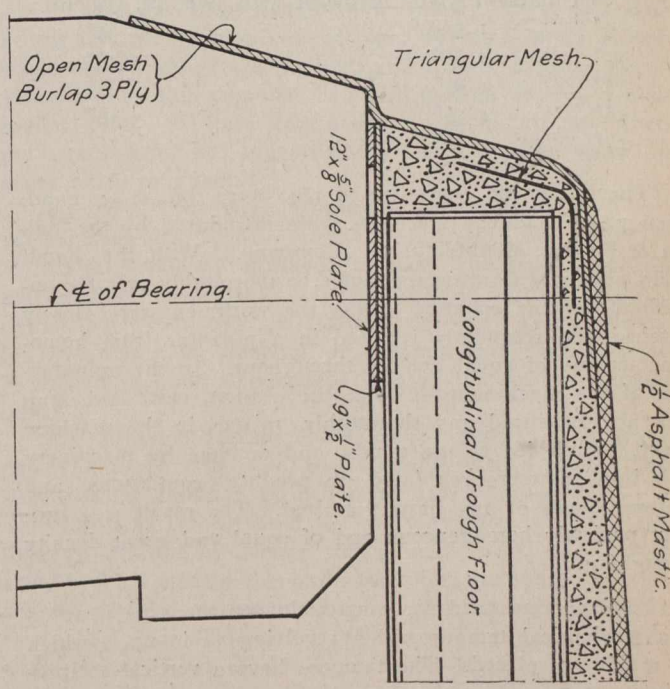


Fig. 4—Proposed Treatment of the Ends of Subways.

make it very difficult to waterproof. However, in this case, when the bridge was taken apart and the asphalt removed there was no indication of any rust or seepage of water through or under the asphalt.

CEMENT SEWER PIPE.*

By Gustave Kaufman, C.E.

The matter brought out in this paper is based upon the experience gained from the use of concrete sewer pipe in Brooklyn. As is generally known, about 400 miles of such pipe, below 24" in diameter, have been laid and is in use there. It can be truly said that this pipe has given eminent satisfaction to the authorities and has been maintained at a lower cost, per mile, than vitrified clay pipe of the highest grade.

Before starting upon the real subject of this paper a description of this pipe and method of its manufacture, is here given.

Pipe are made in 6-inch, 9-inch, 12-inch, 15-inch, 18-inch and 24-inch equivalent capacity. The 6-inch and 9-inch are plain round pipe; they are all three feet in length, with hub joint, with the exception of the 6-inch which is two and one-quarter feet. The 12-inch pipe is round with flat base, and the 15-inch, 18-inch and 24-inch pipe are egg-shaped, with flat base. The thickness of the walls are as follows:—

*Presented at the Eighth Annual Convention of the National Association of Cement Users, Philadelphia, Pa.

6-inch	¾″
9-inch	⅞″
12-inch	1 1/16″
15-inch	1 ⅜″
18-inch	1 ⅝″
24-inch	2″

The collars are as follows:—

6″	collars—	1 5/16″	in depth	with	joint of	⅛″
9″	"	1 5/16″	"	"	"	⅛″
12″	"	1 ⅜″	"	"	"	3/16″
15″	"	1 ⅝″	"	"	"	⅛″
18″	"	1 ⅝″	"	"	"	3/16″
24″	"	1 ¾″	"	"	"	¼″

These cement pipe up to 1890 were made by hand, when pipe made by machines were introduced by the Wilson & Baillis Manufacturing Company. With the hand-made pipe it was always difficult to thoroughly mix the ingredients of the concrete unless the workmen were closely watched and frequently resulted in a pipe far from homogeneous and of equal density throughout. In the manufacture of the machine-made pipe the cement, sand and trap rock are measured and thoroughly mixed in the machine mixer, evenly fed to the molds, and rammed by machinery with iron rammers regulated to produce continuous and uniform blows of any impact desired. The result is a product perfectly homogeneous and of equal and great density throughout.

The machine used for manufacturing the pipe consists of a mechanical tamper and a revolving table upon which the molds are placed. The tampers have a vertical reciprocating motion and at the same time move outward and inward rapidly so as to conform to the line of the travel of the mold which owing to its oval form, presents, at each revolution, varying diameters to the successive tamping bars. There are eight tampers made of the best tool steel, running two hundred tamps a minute each. Only one rammer is down at a time. The head, which consists of the actuating machinery for the tampers, is counter-balanced upwards as the mold is being filled with concrete. The head is raised by the density of the concrete and in this way an even and regular product is obtained which is impossible to achieve by hand. The force of the blow of each rammer is about one inch square.

The proportions, which have been used in later years, are one and one-half parts of the best grade of Portland cement, one part of sand and three parts of trap rock screenings, containing twenty per cent. of stone dust. The percentage of water used to the whole bulk varies from ten per cent. to fifteen per cent., according to the condition of the ballast. The mix when dumped on the floor is apparently dry, but will ball in the hand with some pressure. An extra mix is used in forming the collar for the reason that as the rammers do not exert a direct blow on the material in the offset compression of the material must be depended upon.

The mixed concrete is delivered to the machines in barrows and it is fed into the hoppers by two men, one on either side. As soon as the flask is full, and the core automatically lifted clear, the flask is taken up by a pipe truck and wheeled into the stripping rooms where it is allowed to stand usually thirty minutes when it is stripped. After the pipe have set over night a spray of water is turned on and the pipe kept damp until at the expiration of six days they are removed from under cover and placed in the yard. The pipe, at the expiration of thirty days, are set sufficiently to be handled in the work.

Spurs for house connections are connected on the pipe. A hole is cut at the proper point on the side of the pipe and a mold is placed in the interior. Cement mortar is then spread over the mold and the connection piece is bedded in place and a heavy band of mortar is wiped around the joint on the outside. After the mortar is removed the inside joint is finished with a trowel. This method has been found to be entirely satisfactory.

The main advantages of cement or concrete pipe over vitrified clay pipe, are:—

First—They can be constructed so as to give them an oval or egg shape.

Second—They can be made with practically no variation in size.

Third—They can be constructed with a flat broad and level base.

Fourth—The joints can be made so that the pipe are self-centring, and so that the joints will fit so closely that a continuous smooth bore can be obtained.

Fifth—They can be made in many localities where the cost of vitrified pipe is prohibitive.

Oval or egg-shaped pipe are very desirable where the flow of sewerage is variable and where the gradient is very slight. The small invert will permit the flow of small quantities of sewerage with minimum friction on account of the wetted perimeter being less than in the circular pipe.

Pipe of such shape are thoroughly self-securing whenever there is an increase in the flow of the sewerage and besides will effect a decided saving in flushing water. Pipe of this shape cannot be made of vitrified clay due to the wrapping in burning.

In the transactions of the American Society of Civil Engineers, June, 1911, Mr. Geo. T. Hammond, of Brooklyn, while discussing the paper on Monterry Water Works and Sewerage, strongly advocated the use of the egg-shaped pipe, even as small as 8″ in diameter. In the Monterry system, eight-inch vitrified pipe was used, but its capacity was much greater than necessary at present. Mr. Hammond says:—

"The writer's experience with concrete pipe derived mainly from a long service in sewer design and construction in Brooklyn, N.Y., leads him to believe that at Monterry the whole system might, with advantage, have been built with concrete pipe, using an egg-shaped pipe with an area slightly larger than an 8-in. circle designed for a discharge equal to an 8-in. pipe for all the smaller sewers. The invert of such an egg-shaped pipe would fulfill the present requirements in carrying a very small flow with good flotation depth, better than would a 6-in. circular pipe, and the reserved capacity of the 8-in. pipe would be secured without interfering with good present service. Egg-shaped pipes, similar to those used in Brooklyn, the writer believes, would have given far better satisfaction throughout the Monterry sewerage system than circular fire-clay pipe, and would have cost no more, but probably less. The egg-shaped pipe referred to is made with a flat base and a self-centering joint, thus insuring perfect alignment, and a smoother interior surface than can be obtained with fire-clay pipes."

Cement pipe, in curing, retain accurately the shape given them by the molds. Vitrified clay pipe pipe, especially in sizes from 15″ and up, are considerably warped, due to the burning.

In Brooklyn and many parts of Europe concrete sewer pipes are molded with a flat level base. Such a base permits the pipe to rest on a flat foundation, either earth or plank, and thus permits of better back filling. Improper back filling is the cause of much breakage in circular pipe, not supplied with a flat base.

The joints of cement pipe should be so designed that the hub and socket will accurately centre themselves. This can be done in cement pipe by making the socket with slightly flaring ends thus causing the hub, when driven home, to cone to its proper position. The vitrified pipe, on account of the warping in burning, must have wide sockets. Such wide sockets are the cause of the offsetting at each joint wherever they are laid. These jogs, or off-sets, collect solid matter in a sewer, and, of course, retard the flow very much. When small openings are used, such as can be made with cement pipe, this difficulty is entirely eliminated and a close and smooth joint is the result. In many places no cement at all is required in the joint as the slit in the sewage quickly fills up the small opening.

In many sections of the country vitrified pipe can only be shipped at great expense, and, wherever under such conditions, concrete materials can be obtained, it is far cheaper to make sewer pipe of cement. In many places of Europe, where there are no clay deposits, concrete sewer pipe has been used for years without any question whatever as to its suitability for sewer purposes.

Durability.—In 1877, when Julius W. Adams, Past-President of the Am. Soc. of C. E., was chief engineer of the city of Brooklyn, there was a proposal made that the use of earthenware pipe should be resumed. This proposal was adversely reported upon by Mr. Adams. The following are some quotations from his report:—

"Last winter there were careful inspections made of our pipe sewers. In one sub-division the grades of streets are over two-and-a-half feet to the one hundred, and a special examination was made of the pipe in this sub-division. There is no sign of disintegration or wearing away of the cement pipe. These pipe have been laid over five years. On the 25th of March, 1873, this department took up a cement pipe that had been laid in Fleet Street in the year 1861, and the pipe was found, in every particular, as good as when laid." . . . "The fact remains, however, that the renewals of sewer pipe in Brooklyn, on account of breakage or collapse, have been relatively less in the case of concrete than in that of earthenware pipe."

Since the above was written many more miles of cement pipe have been laid, and, as stated earlier in this paper, over 400 miles of cement pipe are in use in Brooklyn. The experience of Mr. Adams has been confirmed since that time. The cost of maintaining concrete sewer pipe has been proven to be less than that of vitrified pipe. This includes renewals, due to breakage, action of acids, and so on. It might be of interest to note that a few years ago, during the construction of the subway in Fulton Street, Brooklyn, more of the Fleet Street sewer pipe, referred to by Mr. Adams, was taken up and was found that it would be still good for a long time. The sewer was then about 50 years old. A few lengths of this pipe are in our possession. It is manufactured of natural cement, Cow Bay sand and gravel.

The main argument against the use of concrete pipe is that it cannot withstand the effect of sewerage, nor resist the action of acids. In Brooklyn but two cases have been called to our attention where there has been a failure of cement pipe, due to concentrated acids being admitted in the sewers. Inasmuch as such sewers have been existence for so many years, the percentage destroyed is entirely negligible. The author desires, at this point, to make the statement, as an engineer, that if it is desirable to install a sewer which is to take concentrated acid discharges from manufacturing concerns, he would not advocate the use of cement pipe; but would suggest, for such conditions, vitrified pipe of the best quality, with joints of some asphaltic or acid resisting nature and that manholes be built of some other material than brick, laid in cement, because strong acids effect only cement, not bricks. It seems to be folly to dwell upon such a contingency. No manufacturer is going to be so extravagant as to permit highly concentrated acids to be wasted. They are too valuable.

Mr. Adams, in his report of 1877, says:—

"There has been considerable written about the acids acting injuriously upon cement pipe, but these acids in sewerage matter are greatly diluted, and I am convinced by the experience in this city that they will seldom destroy a good cement pipe. We have known of no case in this city where the street sewer has been disintegrated or eaten away by sewer acids or gases."

Mr. A. J. Provost in "Municipal Journal and Engineer," vol 20, page 388, says:—

"The argument advanced against concrete sewers is still confined to possible disintegration by acids. The fact remains, however, that the renewals of sewer pipe in Brooklyn on account of breakage or collapse have been relatively less in the case of concrete than in that of earthenware pipe."

Mr. Rudolph Hering, consulting engineer, in a report dated February 15th, 1908, to Honorable Bird S. Coler, President of the Borough of Brooklyn, says.—

"Portland cement used for the manufacture of concrete pipes is attached by certain strong acids, such as sulphuric acid, which converts the carbonate into sulphate of lime, otherwise called gypsum, which is comparatively soft and easily corroded. Therefore, cement pipe cannot be used where strong acids are known to enter the sewers.

"Vitrified pipe will stand the effect of most acids. When the joints are made of cement these will, of course, be acted upon by acids as readily as the cement pipes.

"It should be added that the acid question should be viewed in a reasonable light. When the dilution of sewage is sufficient the discharge of a small amount of even the strong acid will not cause objectional effects as evidenced by European cities where the use of concrete sewers is almost exclusive in some cities, as Paris and Vienna. In England concrete sewers are also very common. Strong acids attack not only cement, but brick. Yet bricks are extensively used both in America and in Europe for building large sewers, where naturally any acid would be very dilute.

"The greasy substance which is usually found to coat the perimeter of a sewer under the water-line tends to protect the cement from the action of acids to some extent.

"It should be added that just as it is objectionable to discharge exhaust steam into sewers and the waste from gas works, which many cities prohibit, so it should be prohibited to discharge strong acid waste into the same."

The Joint Committee on Concrete and Reinforced Concrete of the American Society of Civil Engineers, American Society for Testing Materials, American Railroad Engineering and Maintenance of Way Association, and the Asociation of American Portland Cement Manufacturers, in its report presented at the annual meeting of the American Society of Civil Engineers, January 20, 1909, says:—

"Concrete of first-class quality, thoroughly hardened, is affected appreciably only by strong acids which seriously injure other materials. A substance like manure, because of the acid in its composition, is injurious to green concrete, but after the concrete has thoroughly hardened, it satisfactorily resists such action."

Much more could be written about the advantages and durability of cement pipe, but it would be largely reiterating what has been already written about it by others and

enumerating the many places both in Europe and America where cement pipe has been in use for many years.

The author has positive knowledge that over 400 miles of such pipe laid during a period of over 50 years are giving eminent satisfaction in Brooklyn and in his opinion all arguments against its suitability for sewers are answered by that fact.

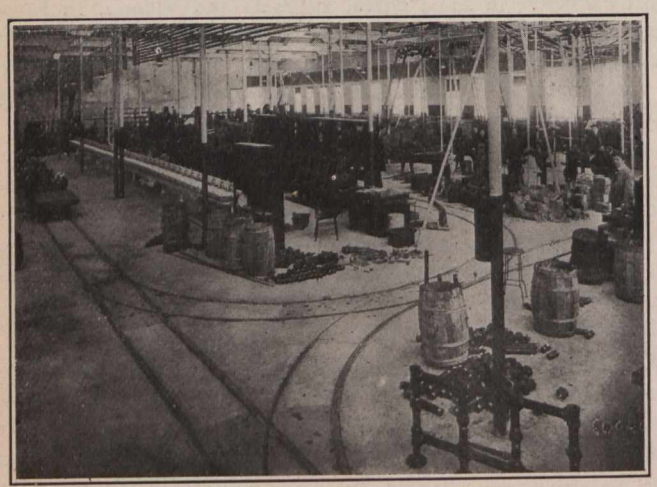
NARROW GAUGE RAILWAY INSTALLATIONS.

Narrow gauge railway systems are applicable to every industry and service where the reliable movement of material is essential and where large initial loads are moved irregularly and intermittently.

Such a system, as a production factor, can and should be judged in much the same manner as the productive tools and machines; that is, by balancing the time and labor saving, general convenience and efficiency increase on other tools against maintenance expense and interest on original investment.

The economies obtainable are best evidenced by use and continued extension of such systems in many power plants, foundries, machine shops, paper mills, textile mills, fertilizer works, chemical works, quarries, steel mills, gas works, powder mills, railroad yards, smelters, mines, coaling stations, brick works, wood shops, warehouses, etc.

A shop railway system without provision for power on the cars can be profitably applied almost wherever the movement of material, either finished or raw, or both, is done by hand truck or wheelbarrows, and averages three or more tons per day. One man, for instance, with a shop car, should easily be able to move on level track, a one-ton load that could not be handled in the same time with wheelbarrows by five men. With cars operated electrically from storage batteries, trolley or third rail, the loads that can be carried are limited only by the strength of the cars and track.



System Using Flat Top Cars in Machine Shop and Shipping Department. Utica Drop Forge and Tool Co., Utica, N.Y.

The loads on cars can generally be apportioned according to requirements up to a maximum car load of about 10 tons, a load distribution of one to three tons per car, under average conditions being very effective.

A railway system involves no expense when not in use, and is immediately available for peak loads. The car platforms can be adapted in size and height to best suit the carrying conditions as well as for ease of loading and unloading. Where desirable, the material may be kept on the car during manufacturing processes, the car being used as a platform and thus saving the labor of rehandling. Accurate weight of material while on the cars is easily obtainable by putting platform scales at any convenient point in the track system.

That a system of cars and tracks can be a profitable investment, is easily computed for any given conditions. As a rule, the labor saving alone justifies the installation.

Tip Car for Handling Ashes, Etc., Stevens and Thompson, Hoosick Falls, N.Y.

Suppose, for instance, the railway in a factory saved the wages of a boy at seventy-five cents a day. This saving of $225.00 per year alone would pay fifteen per cent. interest on an investment of $1,500.00. It would be hard to imagine a place where so large an expenditure could be made for a system of cars and tracks without effecting much greater net savings.

It is not uncommon for a shop railway system to save its entire first cost during the first year of its operation, and it would be a most unusual case where the direct saving each year would not equal one-third of the entire cost of the installation.

Not only is a direct saving of labor accomplished, but the facilitated manufacturing operations do much toward hastening deliveries, and frequently a more economical shop lay-out is made possible.

A narrow gauge railway system can be laid out by the shop manager, superintendent or anyone familiar with the points to be reached. There is seldom any part of a plant or building to which the tracks cannot be extended, and if the system is properly laid out there should be no inconvenience in getting the cars from any one point to any other on the lines. The track can usually be laid on any form of floor or road bed, and can be run across or between standard gauge railway tracks without cutting the rail heads. Any requirement of easily crossing rails with hand trucks or other vehicles can be met by filling in around or inside the tracks with concrete, boards, etc.

The illustrations show a few practical applications to various industries based upon the Hunt Industrial System, the parts of which are manufactured by the G. W. Hunt Company, West New Brighton, N.Y. In this system, the standard gauge of track is 21½ inches measured from outside to outside of rail heads and loaded cars of standard width require a passage of four feet clearance. Track and cars of other gauge are, of course, usable, as the conditions

may demand. The track sections, switches, frogs, cross-overs, etc., are made up on the interchangeable sectional unit plan, much the same as are modern filing cabinets. Any workman of ordinary intelligence can put the sections together and get the whole system ready for use. Should the movement of material change or extensions be required, this unit system of construction lends itself in a most flexible way to such changes or additions. Equipment of cars can also be made standard and interchangeable, which effects great convenience and economy.

A valuable feature of the Hunt System is the employment of a flexible running gear and outside flanged wheels on the cars and a special construction on the outer rail of curves, by means of which, as claimed by the manufacturers, a loaded car runs around a curve of as small a radius as 18 feet, as safely and requiring as little power as on straight-way. It is evident that with such flexibility of the system, the cars of a narrow gauge railway can reach any point that could be reached by trucks and wheelbarrows, including the movement of cars to different floors by elevators.

THE CHEMIST AS AN AID TO EFFICIENCY.

The industrial chemist points the way to great increases in efficiency, particularly in the item of buying supplies, according to Mr. Arthur D. Little, president of the American Chemical Society. In a paper on "The Chemist in Manufacturing," he says:

Chemistry points out the only proper way to buy supplies, which is on the basis of their industrial efficiency by means of specifications defining the quality desired and rigid tests to make sure that quality is secured. Independent estimates by those in exceptional positions to know place the efficiency value of supplies as purchased and used by American manufacturers at 60 per cent. of what it should be.

.. ..

Similarly the industrial chemist has a large control over the efficiency of labor. He may increase this efficiency, that is, the output of the individual laborer, by supplying more efficient processes, as Bessemer did in case of steel, Tennant in case of bleaching, or Le Blanc and Solvay in the manufacturing of alkali. He may raise the efficiency of the laborer through education, as when firemen are instructed in proper firing methods or when cooks in the sulphite pulp mill are given boiling schedules; in one instance within our knowledge such schedules raised the efficiency, not of the cooks alone, but of the entire plant as well, over 50 per cent.

Nowhere has the industrial chemist greater scope for the effective exercise of his trained and organized common sense than in the control of processes and the elimination of wastes, and nowhere are the results he has already obtained more valuable. Their influence upon productive industry has been dramatic and profound. One need only point out that the whole art of modern steel-making is under the strictest chemical control, and quote Carnegie to the effect that it has been revolutionized thereby. No industry affords a better example of the value of such control or furnishes more striking instances of the profitable utilization of wastes. The conversion of slag to cement and fertilizer, the development of 10,000 horse power from the waste gases of a single furnace, are but steps in the development which will soon make pig iron the by-product of the furnace which derives its chief revenue from the waste of yesterday. With the open-hearth furnace still utilizing less than 10 per cent. of the energy of its fuel, let no chemist think the door of opportunity has closed.

WATER-POWER BRANCH.

The Canadian Engineer learns of a recent change in the organization of the Department of the Interior at Ottawa, of particular interest to engineers—the creation of a water power branch and the appointment of Mr. J. B. Challies as superintendent. The new branch is charged with the responsibility of all matters connected with the administration of water powers in Manitoba, Saskatchewan and Alberta, and also of all matters relating to irrigation, reclamation and power in the railway belt of British Columbia. In addition to a head office organization at Ottawa, the new branch comprises an extensive corps of experienced field engineers, having headquarters at Winnipeg, Man.; Calgary, Alta., and Kamloops, B.C., engaged in reporting on water power projects and the investigation of the water resources of the west, with particular reference to power. These investigations are being carried on under the advice of prominent consulting engineers, and when completed will be furnished the profession in the form of blue books. *The Canadian Engineer* hopes to publish a full account of these investigations in subsequent issues.

The superintendent of this work is a graduate of the School of Practical Science, class 1903, and an associate member of the Canadian Society of Civil Engineers. Mr. Challies' many friends will be glad to learn of his selection for this important work.

PERSONALS.

MR. JOHN W. EBER has been appointed superintendent of the Toronto, Hamilton and Buffalo Railway in succession to Mr. H. H. Adams.

MR. A. S. ANDERSON has been awarded the Boiler and Inspection Co. scholarship for general proficiency in the Department of Mechanical Engineering of the University of Toronto Faculty of Applied Science.

DR. J. W. S. McCULLOUGH, chief health officer for the province of Ontario, will be the provincial representative at the International Congress on Hygiene and Dermography, which meets at Washington during the late summer.

MR. A. W. GRAY, formerly county roads superintendent in Frontenac, Ont., will be made assistant provincial engineer of highways, and MR. ARTHUR SEDGWICK will, according to report, be appointed second assistant engineer of the Provincial Highway Department.

OBITUARY.

MR. EDGAR CHAPMAN, a mining engineer of New Liskeard, was found dead in his berth on the North Bay Grand Trunk Railway train. Mr. Chapman was connected with the Casey-Cobalt mines, north of New Liskeard. Two months ago his wife predeceased him after an illness of nearly three years. He was on his way to Toronto to spend the week-end with his daughter.

MEETINGS.

The Regina Engineering Society held their inaugural dinner at the King's Hotel on the evening of May 2nd last. Sixty-five members and guests sat down. After the usual toasts were proposed, the toast of "Canadian Industries" was proposed by Mr. Thornton, who pointed to the dependence of the success of our industries on the engineering

profession. Canada's now world-wide industrial reputation must be upheld largely by her engineers.

Mr. Haggarty replied by drawing attention in particular to Saskatchewan's possibilities for industrial development.

An address on "The Future of the Engineering Profession in the West" by A. J. McPherson followed. The speaker spoke of the growing importance and variety of these industries to our national life. The engineering profession has a wide field in the development of Canada's coal, forest and water power resources, as well as in the solving of the many engineering problems of our new cities.

In all these matters the responsibility and opportunity of the profession are of the very greatest.

"Our Railway Systems" was proposed by Mr. Martin, who spoke of the place of engineers in the forefront of every problem of transportation, of water power, of water supply, and of all other problems affecting national welfare. Saskatchewan, he said, offered alluring opportunities for the engineer because of her great and as yet but barely developed resources, and the engineering problems they present. The railroads are one of the most important factors in this development and the engineer has a broad field of usefulness open to him in railway work.

COMING MEETINGS.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—May 22nd-25th. Annual Convention at Chicago, Ill. Secy., D. B. Sebastian, La Salle St. station, Chicago.

FOURTH NATIONAL CONFERENCE ON CITY PLANNING.—May 27th-29th. Meeting, Public Library, Boston, Mass. Sec'y, Flavel Shurtleff, 19 Congress Street, Boston, Mass.

AMERICAN WATER WORKS ASSOCIATION.—June 3rd-8th. Annual Convention at Louisville, Ky. Secy., J. M. Diven, 271 River St., Troy, N.Y.

CANADIAN ELECTRICAL ASSOCIATION.—June 19th-21st. Annual meeting at Ottawa, Ont. Sec'y, T. S. Young, 220 King St. West, Toronto, Ont.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.—June 26th-28th. Annual meeting at Boston, Mass. Sec'y, H. H. Norris, Cornell University, Ithica, N.Y.

ONTARIO MUNICIPAL ASSOCIATION —Annual convention will be held in the City Hall, Toronto, on June 18th and 19th, 1912. Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ont.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Second Annual Meeting to be held in Toronto, Sept. 16, 17 and 18.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE: Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving; Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, W. Alan, Kennedy; Headquarters: McGill University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; Address P.O. Box 1290.

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydonejack; Meets every first and third Friday of each month, October to April, in University of Manitoba, Winnipeg.

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION.—President, Chas. Hopewell, Mayor, Ottawa; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—President, George Thompson, Indian Head, Sask.; Secy-Treasurer, E. Hingley, Radisson, Sask.

THE ALBERTA L. I. D. ASSOCIATION.—President, Wm. Mason, Bon Accord, Alta. · Secy-Treasurer, James McNicol, Blackfalds, Alta.

THE UNION OF CANADIAN MUNICIPALTIES.—President, W. Sanford Evans, Mayor of Winnipeg; Hon. Secretary-Treasurer, W. D. Lighthall, K.C., Ex-Mayor of Westmount.

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Councillor Siddall, Port Elgin; Hon. Secretary-Treasurer J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. MacMillan, Warden, Antigonish, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Bee, Lemberg; Secy-Treasurer, W. F. Heal, Moose Jaw.

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor Planta, Nanaimo, B.C.; Hon. Secretary-Treasurer, Mr. H. Bose, Surrey Centre, B.C.

UNION OF ALBERTA MUNICIPALITIES.—President, Mayor Mitchell, Calgary.; Secretary-Treasurer, G. J. Kinnaird, Edmonton, Alta.

UNION OF MANITOBA MUNICIPALTIES.—President, Reeve Forke, Pipestone, Man.; Secy-Treasurer, Reeve Cardale, Oak River, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION. - President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont ; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, N. W. Ryerson Niagara Falls; Secretary, T. S. Young, Canadian Electrical News, Toronto.

CANADIAN FORESTRY ASSOCIATION —President, John Hendry, Vancouver. Secretary, James Lawler, Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewit, General Manager Consumers' Gas Company, Toronto; J. Keillor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President, J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary. H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto, President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp; Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council :—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5. Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2429 Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA —President, F. S. Baker, F.R.I.B.A., Toronto, Ont.; Hon. Secretary, Alcide Chausse, No. 5. Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, J. P. McRae; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Wm Pierce, Calgary; Secretary-Treasurer, John T. Hall, Brandon, Man.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. Rosevear, 115 Phœnix Block, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

PLANS AND SPECIFICATIONS ON FILE.

The following Plans (P.) and Specifications (S.) are on file for reference only unless otherwise noted at the office of The Canadian Engineer, 62 Church Street, Toronto:—

Bids close		Noted in issue of
5-15	Reinforced arch bridge, Guelph, Ont... (P. & S.)	5-2
5-25	—Sanitary sewer, Islington, Ont. ..... (P. & S.)	5-16
5-29	—Water works, sewerage and electric light systems, Melfort, Sask. ..... (P. & S.)	5-2
6-10	—Electrical equipment, Vernon, B.C. ..... (S.)	5-16

(Melfort plans and specifications are also on file at The Canadian Engineer Offices, 820 Union Bank Building, Winnipeg, and B33, Board of Trade Building, Montreal).

(Vernon specifications are on file at The Canadian Engineer Offices, Winnipeg and Montreal; Canadian Electrical News, Toronto; Contract Record, Toronto; Mather, Yuill & Company, Limited, Consulting Engineers, Vancouver, B.C.)

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page.
Australia, steel rails and fish plates	May 29.	May 2.	60
Aylmer, Ont., library	May 15.	May 9.	60
Calgary, Alta., timber structures	May 15.	Apr. 18.	76
Chatham, N.B., passenger station	May 16.	May 9.	62
Edmonds, B.C., reservoir	May 20.	May 9.	60
Fort William, Ont., garbage incinerator	May 15.	Apr. 18.	74
Fredericton, N.B., culvert	May 20.	May 2.	60
Guelph, Ont., bridge	May 15.	May 2.	72
Hamilton, Ont., castings, meters, etc.	May 30.	May 2.	72
Lebret, Sask., school house	May 31.	Apr. 25.	61
Lunenburg, N.S., sewerage system	June 1.	May 9.	60
Montreal, Que., city hall annex	May 20.	May 9.	60
Moose Jaw, Sask., paving	May 15.	Apr. 25.	72
Melfort, Sask., waterworks, sewerage, etc.	May 29.	May 2.	72
North Battleford, Sask., boiler, steam engine, etc.	May 15.	May 2.	60
Ottawa, Ont., coaling stations	May 31.	May 9.	72
Ottawa, Ont., station and other buildings	May 31.	May 9.	74
Ottawa, Ont., dredging	May 15.	May 2.	60
Ottawa, Ont., steel tug	Apr. 22.	Apr. 11.	60
Ottawa Ont., designs for monument	Oct. 1.	Apr. 18.	60
Ottawa, Ont., fishing protection vessel	June 17.	Apr. 18.	74
Port of Quebec, Que., proposals for drydock	July 2.	Apr. 18.	60
Point Grey, B.C., plans for university	July 31.	Feb. 7.	60
Quebec, Que., leasing of water-powers	June 26.	May 2.	72
Regina, Sask., electric supplies, Sec. 6 to 9	May 15.	Apr. 11.	72
Saskatoon, Sask., garbage incinerator	June 25.	May 2.	74
Saskatoon, Sask., superstructure 23rd Street subway	May 17.	Apr. 18.	76
Sault Ste. Marie, Ont., sewerage works	May 27.	May 9.	76
Sault Ste. Marie, Ont., cement walks	May 27.	May 9.	76
Sault Ste. Marie, Ont., dredging	May 20.	May 9.	62
Toronto, Ont., bridge	May 23.	May 9.	72
Toronto, Ont., main drainage works	June 4.	May 9.	74
Trout Cove, N.S., breakwater	May 23.	May 9.	60
Upper Maugerville, N.B., wharf	May 23.	May 9.	60
Varna, Ont., drainage work	May 15.	Apr. 25.	62
Vancouver, B.C., water pipe and gate valves	May 15.	Apr. 25.	62
Vancouver, B.C., bridging, grading, etc.	May 31.	May 9.	62
Winnipeg, Man., pipe sewer	May 15.	May 9.	62
Winnipeg, Man., sewer pipe	May 15.	May 9.	62
Winnipeg, Man., electric locomotive, etc.	May 15.	May 2.	60

TENDERS.

Broadview, Sask.—Tenders for the construction of a skating rink at Broadview, will be received by A. Sinclair, Town Clerk, up to May 27th, 1912. Plans, etc., at the office of the Town Clerk, Broadview, or office of architect, Hugh G. Holman, 11-12 Jordan Building, Winnipeg.

Edmonds, B.C.—Tenders for the construction of an extension to Reservoir No. 1, in D. L. 189, for the municipality of Burnaby, will be received until Monday 20th, 1912. Particulars may be obtained at the office of the Engineers, Cleveland and Cameron, 506 Winch Building, Vancouver. W. Griffiths, Comptroller, Edmonds.

Edmonton, Alta.—The City Commissioners are inviting tenders for grading and the construction of boulevards on six miles of residential streets, work to be put in hand at once.

Guelph, Ont.—Tenders will be received up to May 18th, 1912, for the erection of a factory building at Guelph for the Dominion Linen Mfg. Co., Ltd. Particulars at the office of Colwill, Tanner & Co., architects, Traders Bank Bldg.

Hamilton, Ont—Tenders for supplying the Corporation of the city of Hamilton with two units of synchronous motors for direct connection to turbine pumps with transformers, switching apparatus and accessories complete, also for two units of turbine pumps, each of a capacity of 6,500,000 imperial gallons per 24 hours, for direct connection to synchronous motors, will be received until June 3rd, 1912. Specifications at the office of the City Engineer. (See advt. in Canadian Engineer).

Islington, Ont.—Tenders will be received until May 25th, 1912, for the construction of a 6 and 10-inch sanitary sewer on Fifth and Morrison Streets, New Toronto, from the northerly limit of Lot 392, plan 1692, on Fifth Street to the centre of Morrison Street, and easterly on Morrison to main sewer on Fourth Street. Plans, etc., at the office of The Canadian Engineer, Toronto, and J. A. L. Macpherson, Clerk and Engineer, Islington, Ont. (See advt. in Canadian Engineer).

Kerrisdale, B.C.—The council for the corporation of Point Grey is prepared to receive tenders for fire fighting apparatus for the municipality to be in by 5 p.m., Monday, May 27th, 1912. H. Floyd, C.M.C., Kerrisdale.

London, Ont.—Tenders will be received at the office of the City Clerk until noon May 18th, 1912, for the construction of cement walks in the city of London. Specifications at the office of the City Engineer. (See advt. in Canadian Engineer).

Montreal, P.Q.—Tenders for the supply and delivery of the following general supplies and various materials required for the different departments of the municipal service during the year 1912-1913, will be received up to noon of May 21st, 1912, by L. N. Senecal, secretary, Commissioners' office, City Hall, Montreal:—1. General supplies, macadamizing stone, and screenings, inorganic dust, lead pipe, pig lead, ingot tin and bituminous and anthracite coal, lumber, brick, vitrified clay pipes and inverts, hardware, spikes, paints and oils, lubricating and burning oils, iron and brass castings, gullies, pitch, coal, tar, dualine, detonators, fuse, street names and house numbers and sundry other materials. 2. For the purchase of scrap iron, steel, brass, copper, zinc, rubber, leather, waste paper, etc., etc.

Moose Jaw, Sask.—Tenders for water work fittings will be received by the City Commissioners up to noon on May 30th, 1912. (See advt. in Canadian Engineer).

Moose Jaw, Sask.—Tenders for the erection of a concrete retaining wall and laying of a number of new sidewalks at the Collegiate grounds, will be received up to June 5th, 1912. Specifications to be seen at the Collegiate Institute. Clifford Kempton, secretary-treasurer.

Ottawa, Ont.—The Department of Public Works will receive tenders until June 4th, 1912, for the construction of a wharf or retaining wall at Owen Sound, Grey County, Ont. Plans, etc., at the Department; office of J. G. Sing, District Engineer, Confederation Life Building, Toronto; H. J. Lamb, District Engineer, Windsor, Ont., and on application to the Postmaster at Owen Sound, Ont.

Ottawa, Ont.—Tenders for the design and construction of the new steamship for Hydrographic Service for the Atlantic Coast, will be received up to noon of June 30th, 1912, at the office of G. J. Desbarats, Deputy-Minister of the Naval Service, Department of Naval Service, Ottawa. (See advt. in Canadian Engineer).

Ottawa, Ont.—The Department of Public Works, Ottawa, will receive tenders for the construction of a wharf at Fredericton, York County, N.B., up to June 4th, 1912. Plans, etc., at this Department; office of J. K. Scammell, Esq., District Engineer, St. John, N.B.; Geoffrey Stead, District Engineer, Chatham, N.B.; and on application to the Postmaster at Fredericton, N.B.

Ottawa, Ont.—Tenders for the reconstruction of an approach to the Government wharf at Sault Ste. Marie, Ont., will be received up to June 4th, 1912, plans, etc., of which may be seen at the office of the Department of Public Works; J. G. Sing, District Engineer, Confederation Life Building, Toronto; H. J. Lamb, District Engineer, Windsor, Ont.; on application to the Postmaster at Sault Ste. Marie, Ont. R. C. Desrochers, secretary, Department of Public Works, Ottawa.

Pembroke, Ont.—Tenders will be received by the Town Clerk, up to noon of May 18th, 1912, for the construction of a Carnegie Library, Pembroke, Ont., according to plans and specifications prepared by Francis C. Sullivan, Architect, Castle Building, Ottawa, which may be seen at the office of the Architect, or Town Clerk's office, Pembroke. A. J. Fortier, Town Clerk.

Pincher Creek, Alta.—Mr. G. D. Plunkett, secretary-treasurer of the town of Pincher Creek, will receive tenders for the erection of a municipal building until Monday, May 20th, 1912. Plans, etc., at the Builders' Exchange, Lethbridge; office of the town clerk, Macleod; secretary-treasurer, Pincher Creek; the architect, James A. Macdonald, Room 8, Dominion Block, Calgary, Alta.

Saskatoon, Sask.—Tenders for the erection and completion of an eight-room school building to be built for the town of Melfort, Sask., will be received up to noon of May 29th, 1912. Plans, etc., at the Winnipeg Builders' Exchange, and at the Saskatoon Builders' Exchange, also office of W. Wood, Melfort, Sask., and office of the architect, W. W. Lachance, top floor, Willoughby Block, Saskatoon.

South Nelson, N.B.—Tenders for the construction of a stone Court House with municipal offices, to be built in Newcastle, N.B., will be received until May 20th, 1912. Plans and specifications may be seen at the office of the County Secretary, P. Williston, Esq., Newcastle, or at the office of the architect. G. Percival Burchill, chairman of committee, South Nelson, N.B. Leslie R. Fairn, architect, Aylesford, N.S.

St. Lazare, Man.—Tenders for the construction of a bridge over the Qu'Appelle River at St. Lazare, according to plan from the Department of Public Works, Winnipeg, will be received up to May 24th, 1912. Henry Tillman, secretary-treasurer, St. Lazare, Man.

Toronto, Ont.—Tenders for the erection of a lock-up at South Porcupine, will be received up to Wednesday, May 22nd, 1912. Plans and specifications at the office of Cook & Mitchell, barristers, in South Porcupine, and at the Department of Public Works, Ontario. H. T. McNaughton, Secretary, Department of Public Works, Toronto.

Toronto, Ont.—Tenders for the supply of cast-iron penstocks for the high level interceptor, will be received up to noon, Tuesday June 4th, 1912. Plans and specifications at the office of the City Engineer. (See Advertisement in Canadian Engineer.)

Toronto, Ont.—Tenders for storm overflow sewer main, Garrison Creek, section No. 2, will be received until noon of June 4th, 1912. Plans and specifications at the office of of the City Engineer. (See Advertisement in Canadian Engineer.)

Toronto, Ont.—Tenders will be received until May 25th, 1912, for the construction of a concrete arch bridge over Copelands Creek, between Concession 13 and 14, Township of Tiny, County of Simcoe. Plans and specifications at the office of Frank Barber, Civil Engineer, 57 Adelaide Street East, Toronto. (See advt. in Canadian Engineer).

Vernon, B.C.—Tenders for electrical equipment will be received by D. G. Tate, City Clerk, up to 3 o'clock p.m., June 10th, 1912. (See advt. in Canadian Engineer).

Victoria, B.C.—Tenders for the erection of a new schoolhouse at Scott Road, Delta district, will be received by the Public Works Department up to noon of May 22nd, 1912.

Winnipeg, Man.—Tenders for an apartment building on River Avenue, will be received up to Saturday, May 18th, plans and specifications of which may be obtained at the office of William Bruce, architect, 222 McDermot Avenue.

CONTRACTS AWARDED.

Brantford, Ont.—The contract for the new nurses' home has been let to Messrs. Secord & Sons here. The building will cost $36,000.

Calgary, Alta.—Messrs. Grant-Smith Company and McDonnell, of Vancouver, have been awarded the contracts for a million-dollar work on the irrigation block. This includes a concrete aqueduct to cost half a million, other concrete structures to cost $300,000, and thirty steel bridges to cost $100,000. The aqueduct, which is the first of its design to be constructed, will be 10,500 feet long, with a maximum height of 55 feet and will irrigate 100,000 acres of the Canadian Pacific block.

Calgary, Alta.—The contract for the construction of the machine shop, foundry and office building, of steel, concrete and brick, for the Pioneer Tractor Company's plant, has been secured by T. F. Hook, of Calgary, and A. Groff, of Chicago.

Cobalt, Ont.—The town council has awarded the contract for laying sidewalks in the town at all town property to J. J. Anderson, whose bid was $25 a thousand. Several thousand feet of the walks will be laid, and the work is to be commenced at once.

Fredericton, N.B.—The contracts for supplies for water and sewerage work during the coming summer has been awarded as follows: D. J. Shea, soil pipe, at 25 cents per foot; J. S. Neill and Sons, terra cotta pipe, at 12 cents per foot; R. Chestnut and Sons were awarded the contract for supplying the galvanized iron and cement. J. L. Feeney, City Engineer.

Moncton, N.B.—The New England Artificial Stone Company of St. John was awarded a contract for thirty thousand dollars' worth of concrete sidewalks, crossings, etc., to be laid in Moncton this year. The tender ranged from 14½ cents for class A. to 16 cents for class D.

Montreal, P.Q.—Contracts approximating $100,000 for sewers and street improvements for the town of Outremont, have been awarded by the Outremont Town Council, as follows: Sewer awards to R. T. Smith and Company, Van Horne Avenue, from Rockland Avenue to Hartland Avenue, $3,544. Outremont Avenue, between Van Horne and Deschamp, $3,066. Sewer awards to Messrs. Gilbert & Payee: Wilder Avenue, $4,917. Wiseman Avenue, between Van Horne and

Deschamp, $2,905. Lajoie, from Querbes to Outremont, $5,850. Bloomfield Avenue, from Van Horne to Deschamp, $2,905. Champagnier Avenue, between St. Viateur and Bernard Avenue, $5,505.75. Marsolais Avenue, $2,137. Sidewalks contract was divided into two sections, and the quantities were A 20,000 and B 17,000 lineal feet. "A" section was awarded to Messrs. Contractors, Ltd., at 25 cents per square foot, and "B" section to R. T. Smith & Co., at 28 cents per square foot.

Moose Jaw, Sask.—Messrs. Wilson, Townsend & Saunders, of Moose Jaw, have received the contract for the construction of a reinforced concrete subway under the C.P.R. Company's tracks on Eleventh Avenue. Cost, $82,464.89.

Vancouver, B.C.—The British Columbia Permanent Loan Company has closed a contract with the Norton Griffiths Steel Construction Company for the erection of a magnificent ten-story modern office building in Victoria.

Vancouver, B.C.—The British Columbia Electric Railway Company has let the contract for the construction of the grading on its line on Nanaimo Street from Hastings Street to Broadway, to Messrs. Franklin and Shepherd. Messrs. Franklin & Shepherd have also received the contract for the grading preparatory to the double tracking on Fraser Avenue, South Vancouver.

Vancouver, B.C.—Messrs. M. P. Cotton & Company and the Canadian Mineral Rubber Company secured the largest share of the asphaltic mixture pavement contracts awarded by the board of works. Out of a total of 265,289 yards, covering sections of twenty-six streets, M. P. Cotton & Company obtained 100,000 square yards and the Canadian Mineral Rubber Company a like amount. T. R. Nickson & Company received 17,500 yards and the Columbia Bitulithic Company 15,000 yards. The former tendered on sheet asphalt and the latter on bitulithic. A balance of 32,789 yards was left over for future consideration. The amount represented in the laying of this amount of pavement will total almost $1,000,000.

Winnipeg, Man.—The contract for the bridge at St. Andrew's locks has been awarded by the Dominion Government to the Brown Construction Company, Limited, of Winnipeg. The contract calls for a bascule lift span operated by electricity which opens and shuts to allow boats to pass up and down the river. There will be upwards of 500 tons of steel required to complete this work as well as 25.000 cubic yards of concrete. The contract has to be completed in fifteen months. The contract price approximately is $150,000.

Winnipeg, Man.—The contract for the erection of twelve additional rooms to the Britannia School was awarded to J. Dolmer, contractor, Winnipeg, for $88,900. E. D. Tuttle, Architect, 701 McArthur Building, Winnipeg.

Winnipeg, Man.—Two deep well turbine pumps: Messrs. Stuart Machinery Co., Winnipeg, at $4,575 each.

RAILWAYS—STEAM AND ELECTRIC.

Brandon, Man.—The buildings and plant of the Maple Leaf Milling Company at this point were destroyed by fire on May 10th last. The loss is estimated at $40,000.

Montreal, P.Q.—A report states that the management of the Grand Trunk Railway have recently placed freight car orders as follows:—1,000 box cars with the Western Steel Car and Foundry Company, of Chicaga; 2,000 box cars with the Canadian Car and Foundry Company, of Montreal; 250 auto cars with the American Car and Foundry Company, of Detroit; 250 auto cars with the Western Steel Car and Foundry Company, of Chicago; 250 refrigerator cars with the American Car and Foundry Company, of Detroit; 250 refrigerator cars with the Canadian Car and Foundry Company, of Montreal; 1,000 new steel hopper bottom coal cars with the Pressed Steel Car Company of Pittsburg.

Montreal, P.Q.—A report states that the Canadian Pacific Railway Company has ordered 250 new engines and 12,500 box cars. It is altogether likely this is the largest amount of rolling stock ever placed on order at one time in this country.

Prince Albert, Sask.—Work was commenced on May 6th on the survey of the Canadian Northern Railway Hudson Bay road from this city.

Smiths Falls, Ont.—The Canadian Pacific Railway will commence construction work on a foot subway to accommodate traffic on that street. It will be 110 feet long, 10 feet wide, and seven and a half feet high, and will be built of white tile. It will be brilliantly lighted by day and by night, and will be maintained by the company except for the lighting, which will be done by the town.

St. Catharines, Ont.—Negotiations have been commenced to construct a belt line in connection with the lines of the Niagara, St. Catharines and Toronto Railway. It is reported that an extension of this railway to Niagara-on-the-Lake is contemplated.

York County, Ont.—The management of the Toronto & York Radial Railway will place sixteen new cars on their line during the coming season.

LIGHT, HEAT AND POWER.

Galt, Ont.—During the first eleven months' operation of the Hydro-Electric Department in Galt the financial statement shows the department to have made $7,510, a net profit for the town. In order to complete the ornamental and bracket lighting of the town, making extension of power and light and other services, the Hydro-Electric Commission finds that $45,000 more will be required to equip this work.

Medicine Hat, Alta.—The ratepayers will be asked to vote on June 3rd next to decide a by-law calling for the expenditure of $50,000 on electric light improvements, and $75,000 for extension of the gas system.

Moose Jaw, Sask.—The municipal superintendent of electrical matters has prepared drawings for a new ornamental lighting standard. It is materially different from those now in use, inasmuch as the first two lights are on arms elevated from the side of the post, while the second pair are immediately above the lower ones, but not extended as far from the post centre. The fifth light surmounts the standard.

Northern Ontario.—Five more towns in the northern part of the province will be served by the Hydro-Electric Power Commission—Barrie, Stayner, Collingwood, Coldwater and Elmvale. Preliminary estimates have been submitted by the commission to the town of Barrie for a supply of power under contract between the commission and the Simcoe Railway & Power Co., developing at the Big Chute Falls on the Severn River. An extension of the lines built by the commission supplying Midland and Penetang will be made to the five new municipalities in the Hydro-Electric belt. Final estimates will be submitted to these towns in the course of a week or two.

Regina, Sask.—The equipment at the power house will be materially increased within the course of the ensuing year. Provision has been made for the purchase or a street railway unit similar to the one already in use. Although extensions were made to the lighting plant during the early part of the present year, it will be necessary to purchase still another large lighting unit. It will be installed early in 1913.

Saskatoon, Sask.—As a result of the investigation of the conditions and possibilities of developing power on the South Saskatchewan, below the city of Saskatoon, H. M. E. Evans, head of the Saskatoon Power Company, has reported to the city council that 14,000 horsepower could be generated at a total construction cost of $2,200,000. The cost includes the electrical equipment for delivery of power to the city limits.

The estimate was made by a party of engineers from Stone & Webster, Boston, Mass. The original estimate of Canadian engineers was 4,000 horsepower at a cost of $866,000. On the basis of those figures an agreement was entered into by the city with the company to buy the entire output at $33 per horsepower delivered.

GARBAGE, SEWAGE AND WATER.

Province of Saskatchewan.—A report states that the Government of Saskatchewan, the Canadian Pacific, the Canadian Northern and the Grand Trunk Pacific railways have entered into a compact to divert the south Saskatchewan River to supply drinking water to Regina, Moose Jaw, Weyburn

and other towns and cities in Saskatchewan. The work will cost ultimately $20,000,000.

Mr. T. Aird Murray, C.E., of Toronto, is the consulting engineer and a member of the commission.

Vancouver, B.C.—A waterworks by-law will be placed before the ratepayers at an early date. This is for the purpose of raising funds to complete the laying of a water main into the district of Point Grey. The first expense for the city in connection with this by-law will be about $175,000.

BUILDINGS AND INDUSTRIAL WORKS.

Athabasca Landing, Alta.—A deputation from this town has been in Ottawa to secure pulpwood concessions and authority to erect a pulp mill at this point. It is claimed that there is a great deal of suitable materials and abundance of natural gas. Mr. James Wood, of Athabasca Landing, is interested in the project.

Battleford, Sask.—The Overland Manufacturing Company of Vancouver, will establish a plant in Battleford for the manufacture of doors, sash, and all kinds of woodwork.

Calgary, Alta.—Mr. Russell, formerly chief engineer of the Temiscaming and Northern Ontario Railway, and Mr. Wilson of Saskatoon, have approached the new Industries' Committee, with a view of establishing a sand, lime, and pressed brick plant on one of the city's industrial sites. They guarantee that if they could secure a suitable site they would put in a plant of $100,000 and employ about 40 men.

Cobourg, Ont.—The ratepayers will vote on a by-law calling for the exemption of The Canadian Ohio Motor Car Company from taxation, excepting school taxes, for ten years and to grant the company a sum not exceeding $1,000 for the purchase of a site. Mr. H. I. Matthews, Lakefort, has been elected president and managing director.

Eastern and Central Ontario.—The Commissioners of the National Transcontinental have prepared plans for the construction of six 200-ton mechanical coaling plants with sand houses and track approaches at the following points on the line: Moncton, N.B.; Napadogan, N.B.; Edmunston, N.B.; Grant, Ont.; Calvert, Ont., and Armstrong, Ont. A 1,000-ton coaling station with inclined trestle approach is also planned at Cochrane, Ont. Tenders for all these plants are now being called for.

Fort William, Ont.—Mr. A. E. Fenton will construct an elevator with storage capacity of 35,000 bushels. It is reported that this is the forerunner of fifteen others of a similar type to be erected in the near future.

Galt, Ont.—Preparations have been made for the construction of a drill hall in this town to cost about $15,000. It is to be 80 × 130.

Goderich, Ont.—The Canadian Pacific Railway will commence building operations on a new flour storage building to cost about $20,000. It is to be 200 × 40 and entirely of wood construction.

Lindsay, Ont.—A site has been selected for the new armory building, and it is probable that building operations will be commenced at an early date. Captain H. Hughes, Cd. Engineer, R.C.E., of Kingston, selected the site.

London, Ont.—The management of the Dominion Abattoir Company will erect a $75,000 building. Mr. E. Rechnitzer is at the head of this company.

Moose Jaw, Sask.—Plans for Moose Jaw's first skyscraper have been prepared, which is to be built by the real estate and automobile firm of Manley, Loney and Company. The building is to be erected at the corner on Athabasca and Main Streets. It is the intention to build the first two stories of the building this year, and the foundation will be built to carry a ten-story building. The building is to be reinforced concrete, and the Turner system is being considered. It will have an imposing front on Main Street, and the foundation will cover an area of 54 feet by 125 feet.

Moose Jaw, Sask.—The Board of Education have passed a by-law calling for $65,000 to be raised for school buildings.

Moose Jaw, Sask.—The ratepayers will be asked to vote on a proposed expenditure of $25,000 for the completion of the public library.

Montreal, P.Q.—The Federal Government plan to erect a new postoffice in the district of Westmount during the coming summer. The cost of this work will be $100,000.

Port Arthur, Ont.—A report states that the Regina Trading Company will erect a three-story steel and office building to cost about $70,000. Messrs. H. W. Laird and Peacock, of Regina, are interested.

Regina, Sask.—A new civic building law has been presented to the council for consideration. Protection from fire is especially aimed at, and for this purpose the bill proposes that 125 feet or ten stories be the extreme limit of height in future buildings to be erected.

Regina, Sask.—The management of the Westman Agencies, Limited, have under construction a new six story building, 85 × 110. Messrs. Reilly, Dawson and Reilly are the architects. The cost of this will be about $140,000.

Saskatoon, Sask.—It is reported that the C.P.R. has purchased a plot of land in this city adjoining the Bank of Montreal, and on the site it is proposed to erect one of the best office buildings in the West, to be used largely by the different departments of the company.

Western Canada.—Ten small elevators of the Saskatchewan Co-operative Elevator Company are being established between Regina and Griffin, along the line of the Regina-boundary branch of the Grand Trunk Pacific.

West Vancouver, B.C.—The council of this municipality have had plans prepared for the erection of a new town hall. Mr. J. C. McKenzie is the designer of the building.

BRIDGES, ROADS AND PAVEMENTS.

Calgary, Alta.—The municipal council are considering plans prepared for a bridge to serve Crescent Heights and Sunnyside. The plans of this bridge shows the southern approach to be between First and Second Avenues, and the amount of cutting which would be done at the top of the hill would depend entirely what grade was desired. A grade of about 6½ per cent. would not require a very deep cut. Archways at the north side would allow traffic underneath, and the height of the bridge on the north side of the river would be about 50 feet. The cost of a concrete bridge of this design would be, according to present figures, about $780,000.

Medicine Hat, Alta.—Much publicity is given a report in this district to the effect that the Canadian Northern Railway will enter the city from Police Point. Should this be true a large bridge will be required to span the river.

CURRENT NEWS.

Calgary, Alta.—The municipal council are taking steps to secure information on a project which has for its object the formation of a civic coal supply and it is not improbable that this city will shortly be operating its own coal property and selling fuel to residents at a price only slightly in excess of the cost of production. The members of the council are practically unanimous in favor of a muncipally owned coal mine, which, as municipal affairs go, is an innovation.

Fort William, Ont.—The municipal Fire, Water and Light Committee have received a request from the chief of the Fire Department that he be furnished with a new steam engine and an auto chemical hose wagon. The cost of these will be $13,000.

Ottawa, Ont.—The Railway Commission have requested the Railway Board to enforce an order to the effect that existing regulations regarding locomotive draft control be abolished, and a new set drafted by the commissioners. These new regulations provide that all engines must be fitted with netting mesh to prevent the escape of sparks, and that every railway company must provide inspectors at terminal points whose duty it shall be to examine from April 1 to November 1 each year all locomotives in use.

The proposed regulations given the chief fire inspector or any authorized officer of the board the power to inspect locomotves at all times, and to reject those found to be defective in regard to the fire arrangements.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from The Canadian Engineer for small fee.

16393—April 27—Directing C.N.R. to divert ballast pit track and clear shrubs and trees away at crossing known as Rosslyn Rd., Twin City Junction, Ont.

16394—April 25—Dismissing application of Trans. Bureau of Montreal Board of Trade re corn and cornmeal rates from Montreal to points in the Maritime Provinces.

16395—April 23—Refusing application of the Canadian Freight Assn. for revision of Order 6844, Apr. 6, 1909, re commodity rates on wire fencing and netting.

16396—April 23—Authorizing C.P.R. to construct its second track across Melville-Regina Branch of G.T.P. at Regina, Sask. Additional interlocking appliance to be installed.

16397-98—May 1—Authorizing C.P.R. to reconstruct bridge No. 7.3 and 17.0 on its Ingersoll and Sudbury S.D.

16399—April 27—Directing all express companies subject to Board to prepare tariffs or supplement to Express Classification showing a scale of charges for the return of the proceeds of C.O.D.'s upon other than "merchandise" rate basis, and file the same within three months from date of this Order.

16400—April 23—Naming express delivery and collection limits of city of Sydney, N.S.

16401—May 1—Authorizing village of North Red Deer to construct highway over tracks of C.P.R. at Cherry Avenue.

16402—April 30—Approving clearance of 18 feet for dump cars only into clay shed of Alberta Clay Products Co. by C.P.R. Siding at Medicine Hat, Alta.

16403—April 30—Extending until 31st August, 1912, time for completion of bridge across Shubencadie River at South Maitland, N.S., by Dominion Atlantic Railway.

16404—April 29—Authorizing Algoma Central & H.B. Ry. to construct bridge over Michipicoten River.

16405—April 20—Authorizing C.P.R. to construct siding for the Seaman, Kent Co., Ltd., town of Outremont, Quebec.

16406—April 29—Authorizing C.P.R. to reconstruct bridges 19.4 and 46.9 on Havelock and Megantic Subdivisions.

16407—April 29—Authorizing C.P.R. to construct an extra track across South Bay Road, Parish of Lancaster, Ct. St. John, N.B.

16408—April 30—Authorizing C.P.R. to operate its trains over Pacific Avenue, Fort William, and St. Railway account remodelling of interlocking plant completed.

16409—April 29—16410—April 25—Authorizing C.P.R. to construct spur for the Calgary & Western Lumber Co., at Bengal, Alta., and for the Canadian Sardine Co., at mileage 23.31 on St. Andrew's Branch, County of Charlotte, N.B.

16411—April 19—Providing for protection at crossing of Toronto Suburban Ry. and G.T.R. stock yards branch at Keele St. and St. Claire Avenue, Toronto.

16412-13—April 29—Authorizing G.T.R. to construct a track to connect with C.P.R. spur serving Standard Sanitary Mfg. Co., and to operate over said track in Toronto, and to construct spur for Steel and Radiation, Ltd., 6th Con., Twp. of Grantham, Ct. Lincoln, Ontario.

16414—April 29—Authorizing G.T.R. to reconstruct bridge No. 346 at mileage 198.03 on 6th District, Northern Division.

16415—April 30—Approving location of G.T.R. station at Rockwood, Ontario.

16416—April 29—Authorizing C.N.O. Ry. to construct across public road between Cons. A. and 1, Ottawa Front, Twp. of Nepean, Ont.

16417—April 29—Authorizing C.P.R. to construct spur line from its Swift Current Extension to serve Moose Jaw Clay Products Co., spur being 1.01 miles in length.

16418—April 29—Authorizing C.N.O. Ry. to construct over lead vein on the property of North American Smelting Co., Ltd., in Twp. of Loughborough, County of Frontenac, Ontario.

16419—April 29—16420—April 30—Authorizing C.N.O. Ry. to construct spur for W. J. Lawrence, village of Richmond Hill, Ont., and C.N.R. to construct spur for Newcastle Coal Co. at mileage 171.73, Alberta.

16421—April 30—Approving revised location of C.N.O. Ry. (Montreal-Port Arthur Line) in Twp. of Ross, Ct. Renfrew, mileage 62.09 to 66.19 from Ottawa.

16422—April 29—Approving location of C.N.O. Ry. through unsurveyed territory in Dist. of Thunder Bay, mileage 383 to 398 from Sudbury Junction.

16423—April 29—Approving location of C.N.R. through Twps. 26-28, Ranges 8-15, west 3rd M., Sask., mileage 0 to 49.59.

16424—April 30—Authorizing C.N.O. Ry. to cross forced road and township road in Twp. of Nepean, Ct. Carleton, Ont.

16425—May 2—Approving location of C.P.R. station at Weyburn, Saskatchewan.

16426—April 12—Approving location of Algoma Eastern Ry. Co.'s station at Espanola, in Twp. of Merritt, Ontario, Sudbury District.

16427—April 30—Approving Essex Terminal Railways Standard Tariff of Maximum Freight Tolls to apply between Walkerville and Windsor, Walkerville and Sandwich, and Windsor and Sandwich.

16428-29—May 3—Directing C.P.R. (Walkerton & Lucknow Ry.) to install electric bell at crossing of Hutton Hill Highway, Twp. of Bentinck, Ct. Grey, Ontario; and electric bell C.P.R. at Locust Hill, Ontario, within 90 days from date of these orders, 20 per cent. from Railway Grade Crossing Fund.

16430-31—May 2—Authorizing C.P.R. to construct and operate two spurs for T. S. Sims & Co., Ltd., at Fairville, N.B., and spur for George W. Upham, Parish of Southampton, Ct. York, N.B.

16432—May 2—Authorizing C.N.O. Ry. to cross Symes Road, Toronto.

16433—May 2—Authorizing C.N.O. Ry. to reconstruct bridges 24A and 24B crossing Kaministiquia River, at mileage 24.2 and 24.3, from Port Arthur.

16434—April 30—Authorizing C.N.R. to expropriate certain lands for road diversion and to file plans for overhead crossing; diversion or bridge to be completed before 1st September, 1912. Application, R. M. Kindersley, Sask.

Tenders Called For

THE CORPORATION OF THE TOWNSHIP OF ETOBICOKE.

TENDERS WANTED.

Sealed tenders, addressed to the undersigned, and endorsed "Tenders for Sewer," will be received by the Corporation of the Township of Etobicoke up to 3 o'clock p.m., the 25th day of May, 1912, for the following work, viz.:—

The construction of a 6 and 10-inch Sanitary Sewer on Fifth and Morrison Streets, New Toronto, from the northerly limit of Lot 392, plan 1592, on Fifth Street to the centre of Morrison Street, and easterly on Morrison to main sewer on Fourth Street. Plans and specifications may be seen at the office of the undersigned, or at the office of The Canadian Engineer, Toronto.

Tenders must be made on forms to be obtained from the undersigned, and must be accompanied by an accepted cheque for 5 per cent. of the amount of the tender, payable to the order of the Township Treasurer. The accepted cheque of the successful bidder shall remain in the hands of the Corporation until the work is satisfactorily completed.

The lowest or any tender not necessarily accepted.

J. A. L. MACPHERSON,
Clerk and Engineer, Islington, Ont.

Dated this 14th day of May, 1912.

BASSANO.

TENDERS FOR ELECTRIC GENERATING MACHINERY.

Sealed tenders, marked "Tender for Electric Generating Station Equipment," and addressed to S. E. Whiting, Esq., the Bassano Electric Power and Traction Company, Bassano, Alta., will be received by the undersigned at 6 p.m. of the third day of June, 1912, for the delivery and erection of the following machinery and apparatus:—

Section "A" Two Return Tubular Steam Boilers,
Section "B" One Steam Engine,
Section "C" One Electrical Generator and Equipment.

A marked cheque for 5 per cent. of the amount of the tender shall accompany each tender.

Tenders are invited for each section separately.

Specifications may be obtained from S. E. Whiting, Esq., Bassano, Alta., or from the Engineers, Messrs. Bowring & Logan, 322 Donald Street, Winnipeg, or may be seen at the office of Norman A. Hill, 43 Victoria Street, Toronto, or at the offices of The Canadian Engineer, 62 Church Street, Toronto, and 33 Board of Trade Building, Montreal.

BOWRING & LOGAN, Engineers, Winnipeg.

S. E. WHITING, President, Bassano.

(Tenders also on pages 72, 74 and 76).

RED DEER'S GROWTH.

April returns show the expansion in Red Deer, Alberta, continues. The building permits for the first four months of 1912 are $84,685, compared with $33,785 for 1911, which was a record for Red Deer up until that time. This is a gain of nearly two and a half times, or 250 per cent. Every department of business shows large increases. The passenger receipts are double those of April, 1911, and the freight, express, telegraph receipts have been very heavy. The local staff is rushed to handle their business, even with increased help.

In regard to customs, Red Deer was made a port of entry on April 1st, and the business done since then has shown the great need there was for such an office. At the rate of the business done since the office was opened, Red Deer will have more business during its first year than any port in Western Canada except Winnipeg. The receipts will be greater, too, than seven of the eleven western points up until two years ago, and will exceed that of several places of more than double Red Deer's population last year.