Canadian Engineer

(Including THE CANADIAN CEMENT ... REVIEW)

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Northern Engineering Works
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Tod, Geo. H.

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Standard Inspection Bureau, Limited.

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London Concrete Machinery Co.

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Glenfield & Kennedy.
Municipal Construction Co., Ltd.
Wood & Co., R. D.

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Bell Co., The Wallace.

Wire and Cable
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Hopkins & Co., F. H.
Peacock Bros.
Wire & Cable Co.

CONSULTING ENGINEERS

CONSULTING ENGINEERS

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THE CANADIAN ENGINEER

An Engineering Weekly.

LAYING A 48-INCH GAS MAIN UNDER THE HARLEM RIVER.*

By C. C. Simpson.

The 48-inch main was laid for the purpose of additional supply of gas for Bronx Borough.

The Borough of Bronx is practically a city of itself, with a population of 430,000. The capacity of the Central Union Works, which supplies the entire Borough, is 11,000,000 cubic feet per day, with very little, if any, room for extension. The maximum send-out from these works during the winter of 1909-1910 was over 10,000,000 cubic feet.

From the normal increase of population in this territory (over 10 per cent. a year), it was evident that steps had to be taken to provide an additional supply of gas. This gas—pending the completion of the Astoria-Port Morris tunnel—must necessarily come from Manhattan. Two methods were considered for bringing gas from Manhattan to the Bronx.

First—To build a tunnel under the Harlem River from 129th Street, Manhattan to Lincoln Avenue, Bronx. Through this tunnel a 48-inch line would be run from the end of the present 48-inch main near 129th street to Lincoln Avenue, and from that point to the Central Union Works. The cost of this tunnel, taking into consideration the purchase of sites for the two shafts, would have been not less than $500,000, and the difficulty of obtaining franchises and acquiring suitable property would have made the minimum time of construction two years.

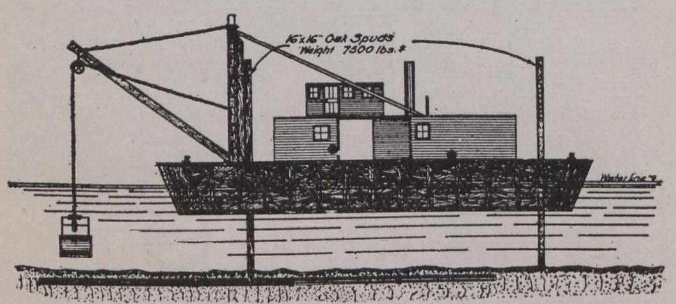


Fig. 1.—Diagram Showing way in which 20-Inch Submerged Gas Main was Broken by Dredge Spud.

The second scheme was to replace the present 20-inch main at this point with a 48-inch main, laying it at such depth below the bed of the river so as to insure against any possibility of damage from the buckets, anchors or the heavy, steel-shod spuds of dredges operating over the line of the main, and also to provide for any future deepening of the channel. (Fig. 1 shows the manner in which the former 20-inch main at this point was put out of service by a dredge spud.) The cost of this second scheme would be less than $150,000, and the work could easily be finished in from 6 to 9 months, thus allowing us to furnish gas in this way during the coming winter.

Taking into consideration, then, the items of time and cost, the second method of crossing the river was adopted. The general plan for carrying out this work (see Fig. 2) was as follows:

Steel caissons 10 feet in diameter were sunk just back of the bulkhead line on each side of the river. The bottoms of these caissons were then sealed with concrete, a drip pot was placed in each, and the standpipes built up inside. Cofferdams of steel sheet piling, in successive 125 sections, were then driven across the river, the pipe being laid on concrete piers as soon as the material was pumped out.

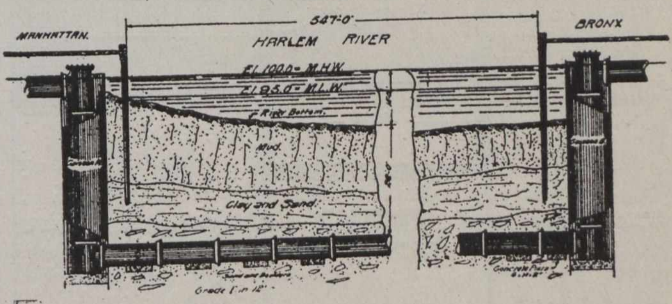


Fig. 2.—Profile of 48-Inch Harlem River Line Looking West.

The channel at this point extends from bulkhead line to bulkhead line (550 feet), and as there is a great deal of shipping, it would not be possible to close off more than half of the river at any one time.

The pipe used was ordinary water-weight (8,400 pounds per length) hub and spigot pipe, the depth of hub being 6 inches. An inside joint ¾ inch wide (see Fig. 3) was provided by not allowing the spigot to enter the full depth into the bell. As an additional precaution against breakage, and also to weight the pipe, a complete decking of concrete blocks was placed over the main (see Fig, 4).

The actual work started with the sinking of Caisson A on the Manhattan side of the river. This caisson was composed of sheets of ⅜-inch boiler plates. A guide frame of 12-inch by 12-inch timbers was erected, and through this the first four sections were lowered by means of the derrick scow, until the cutting edge had penetrated 5 or 6 feet into the mud. Four steel hooks, which had previously been placed under the cutting edge, were then fastened by means of wire cables to four 4-ton differential blocks, which were in turn secured to the guide frame. This scheme allowed us to hold the caisson at any time to allow the bolting on of additional sections, and also to check the progress should bad quicksand be encountered.

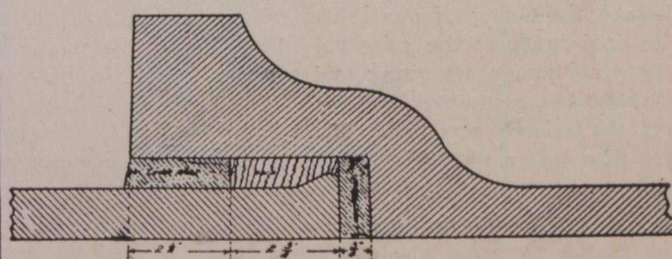


Fig. 3.—Section Hub and Spigot 48-Inch Harlem River Main, Showing Inside and Outside Joint.

*Read before the Commercial Gas Association.

The material inside the caisson was then pumped out by means of an 8-inch centrifugal pump, and a head of water greater than that outside constantly maintained by pumping in with a 12-inch pump. It was necessary to use a diver to tend this 8-inch suction, and also to loosen up the material by means of a water jet.

Additional sections were bolted on as the cutting edge was lowered, and on the inside flange of each section a loading platform, holding 10 or 15 tons of pig iron, was placed to help overcome the skin friction.

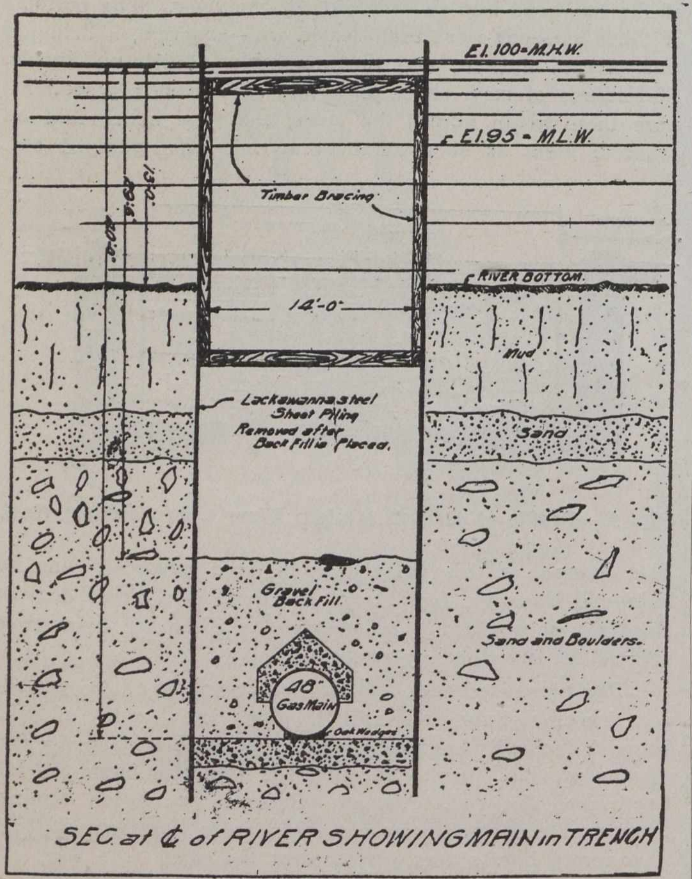


Fig. 4.

When the cutting edge was within 6 feet of the final grade, a slight crack was noticed in the street surface near an adjacent elevated railroad column, and levels showed a settlement of this column of about ¼ inch. This settlement was due to a layer of quicksand which we had penetrated, and to guard against any further movement we decided to drive a tight ring of steel sheet piling about 6 feet below the final grade of the caisson. Fig. 5 shows the relations of the column, sheet piling and caisson. After the driving of this piling no further settlement of the column took place, and the caisson was finally sunk to grade. The bottom was then sealed with a layer of concrete and the drip set in place.

While this work was going on Caisson "B" on the Bronx side of the river was started. This proved a much simpler matter than Caisson "A," as there were no elevated railroad columns to contend with. The material through which this caisson was sunk was a very sticky mixture of clay and sand. It was impossible to pump this, so a ¼ cubic yard Hayward, orange-peel bucket was secured and the material excavated by means of this, with very little assistance from divers. When this caisson had reached grade the bottom was concreted and work at this point temporarily discontinued until the main had been laid clear across the river. As stated before, the large volume of shipping at this point prevented us from closing more than one side of the river at a time.

In laying the pipe in the river the original idea was to dredge an open trench of the required depth, allowing the banks to take their natural slope. It was finally decided, however, on account of the great depth of the trench and the uncertainty as to what angle of repose the material would take under the action of the strong tide, to drive sectional cofferdams of steel sheet piling. While this method might have delayed the work a little it would certainly be much safer in the end, especially as we were unable to obtain any definite information as to the depth of the foundations under two adjacent piers of a heavy railroad drawbridge. An order was therefore placed for enough of this piling to sheet 150 feet of trench. Pending the arrival of this piling, we pumped the mud from 4 high-tension cables which lay directly on the line of our main. Divers fastened these together and there was fortunately enough slack to allow us to pull them about 15 feet east, so as to leave them entirely out of danger and clear of our trench. It was necessary to watch these cables very carefully during the entire process, as any break would have made us liable for heavy damages, besides endangering the lives of the workmen.

The river at this point is about 15 feet deep at high water. The permit granted for the main required it to be laid about 20 feet below the river bed. This would make the bottom of the trench at the center of the river (which was also the summit of the main), 42 feet below mean high

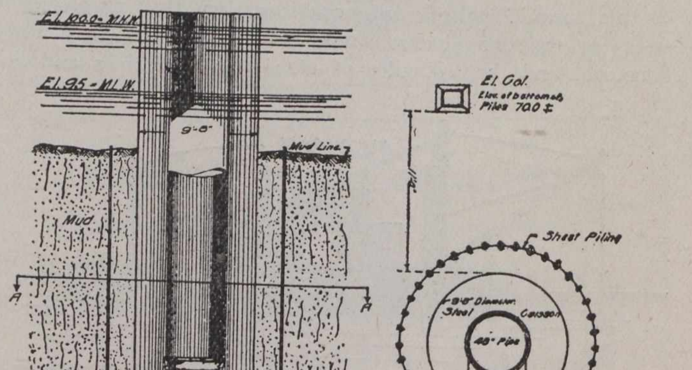


Fig. 5.

water. This allows for a concrete pier about 2 feet thick under the pipe. At the shore ends, allowing a grade of 1 inch in 12 feet. The bottom of the trench was 45 feet below mean high water.

The first consignment of piling (in 45-foot lengths) arrived shortly after the cables had been moved, and work was started on the first 130-foot section of cofferdam. The piling was driven an average of 4 feet below the pumping grade by means of a Vulcan steam hammer. The work was rather slow at the start, due to a layer of large boulders underlying the sand, but the section 130 feet long and 14 feet wide was finally driven to grade and pumping started. (Fig. 6 shows the sheet piling on this section driven and pumping in progress.) This pumping was done by the 8-inch and 12-inch centrifugal pumps worked from the derrick scow, with a diver tending each suction and stirring up the material with a 5-inch water jet. We were able to take out from 100 to 150 yards per day until the layer of boulders was reached. Pumping here became rather difficult and much of the material had to be removed by the divers.

There was originally a rather strong tide at this point and it became considerably stronger after we had dammed off part of the river. This necessitated some heavy cross-bracing to keep the sheeting in shape when the trench had been excavated. Fig. 4 shows a cross-section of this trench with the pipe in place, and also the amount of bracing necessary.

When about 20 feet of the inshore end of this cofferdam had been pumped to grade the plate over the lower opening

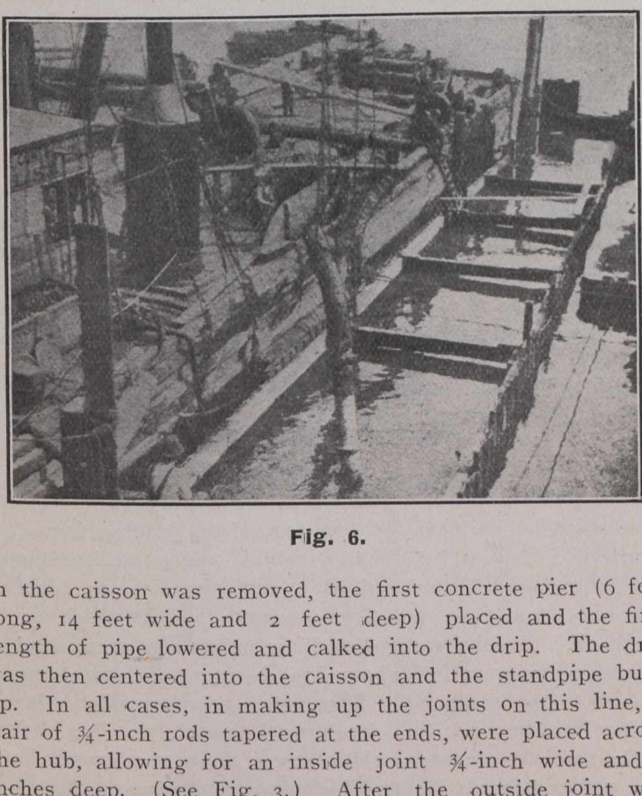


Fig. 6.

in the caisson was removed, the first concrete pier (6 feet long, 14 feet wide and 2 feet deep) placed and the first length of pipe lowered and calked into the drip. The drip was then centered into the caisson and the standpipe built up. In all cases, in making up the joints on this line, a pair of ¾-inch rods tapered at the ends, were placed across the hub, allowing for an inside joint ¾-inch wide and 2 inches deep. (See Fig. 3.) After the outside joint was calked these rods were withdrawn by means of turn buckles, and when a section of pipe was completed and pumped out, men were sent inside to calk these joints. All the calking both above and below the water was done with lead wool and pneumatic tools, considerable time and expense being saved by the use of the latter.

As successive lengths of the trench were pumped out the concrete piers were placed and the pipe lowered and set to grade. The pipe was placed two lengths at a time, the two lengths being lined up and calked on the derrick scow, then firmly strapped to a 15-inch I-beam and lowered into place. This made it necessary to have only every second joint calked under water by the divers. (Fig. 7 shows the method of placing the pipe into the trench.)

In laying pipe under water it is usually a rather difficult problem to preserve line and grade, but on this work it was simplicity itself. Divers first placed heavy wedges under the pipes on the piers. Then by means of a long rod held on top of the pipe and read from instrument on shore, the divers were signalled to wedge up until the pipe was at the

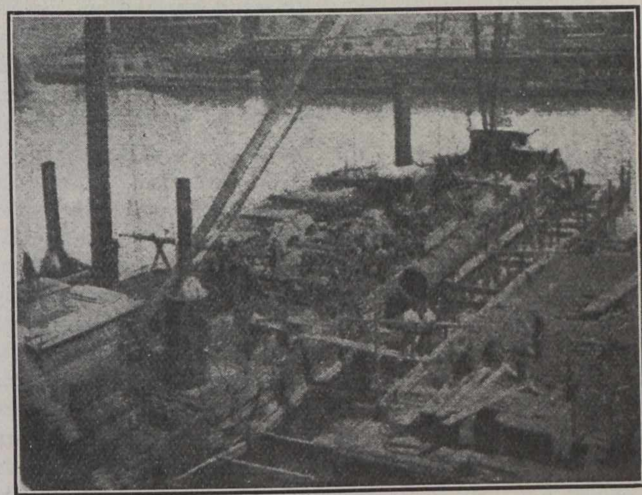


Fig. 7.

proper grade and the line then checked from the instrument.

After the pipe had all been laid and calked in this section the end was closed by means of a plug and a rubber gasket, and the water pumped out. An inspection by the engineers in charge was then made and the main found to be absolutely tight and true to line. Advantage of this opportunity was taken to calk the inside joints and at the same time the concrete protection blocks were lowered into place. As an additional precaution against breakage the trench was back-filled to a depth of 4 feet above the concrete blocks with gravel. The sheeting was then pulled and driving started on the second section of cofferdam.

This second section was driven for a distance of 143 feet, carrying us to the center of the river. Both the driving and pumping on this section were much easier than on the first, the layer of boulders seeming to thin out toward the center of the river. The trench was driven, braced and excavated in precisely the same manner as in the first section, and after the pipe had been laid and calked the water was pumped out and a second inspection made. The line proved absolutely tight and correct as to line and grade, so that

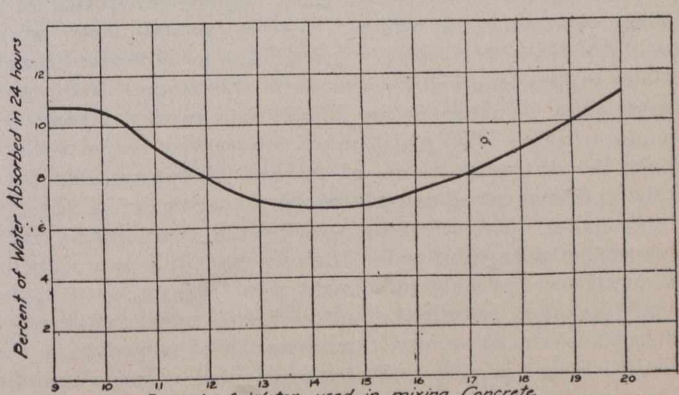


FIG.-3. CURVE SHOWING AMOUNT OF ABSORBTION

the protection blocks were ordered placed and the sheeting pulled.

We decided to make the third section of cofferdam continuous across the north half of the river, leaving the trench open at both ends and re-driving the sheeting at the north end of the trench, as the pipe was laid and back-filled at the south end.

SIGNALLING.*

Francis G. Bloyd.

The adaptation of electricity as a control on the mechanical working of signals had contributed much towards the march of progress, with the result that although in some quarters British railways were held to be the most expensively signalled lines in existence, yet they occupied the satisfactory position of being the safest lines of transport in the world. It was suggested that the recently introduced plan of multiple route signalling in place of the former system of having a separate signal to govern each movement within a section was open to objections which were not altogether balanced by the saving in lever maintenance which the plan might effect. In the multiple plan, only one signal might be provided to govern movements in two, three, or even four distinct directions, the signal thus being permissive only, and not directive, as to the route to be followed. Although the movement might be carried out under the control of a shunter the working could hardly be regarded as so satisfactory as the former system, in which a visible signal defined the exact route at the start, and further indications confirmed the correctness of the movement at each point of divergence. Another point referred to the provision of "outer home" signals at junctions or other spots where it might be thought expedient to give a driver a more complete intimation of the state of the route than was afforded by a single distant and stop signal, such as at an intermediate box on a long falling gradient, or at a station placed at the foot of such a gradient where curvature of the railway prevented a good view ahead from being obtained. In such cases the provision of an "outer stop" signal in a position rather over a full train's length from the stop signal proper, which then became an "inner stop," gave timely warning to a driver, and removed all risk of the junction or the stop signal proper being over-run, while in some instances the advantage gained was still further enhanced where fast running occurred if a "through distant" were also provided under the "inner stop" to indicate the state of the route through the junction or station.

One or two words might be devoted to the question of the better distinction by night of distant signals, and the abolition of the anomaly, existing under present conditions, of enacting that while a red light should be treated as a danger indication, at which a driver should stop, yet it might be passed at speed when affixed to a distant signal. Many suggestions had been made in this respect, and active steps were being taken to differentiate distant signals by using a fishtail lamp which practically reproduced in a white light the distinctive shape of the semaphore arm, but even this improvement did not remove the anomaly of the red light being disregarded as an absolute stop signal. The plan adopted on the London Underground Railways of using a special orange light for distant signal lamps, when in the "on" position, appeared to furnish the more satisfactory solution of the question. It was worthy of note that, in the United States, a yellow light was adopted 12 years ago for the "caution" indication. At the present date a green light was used for the "clear" indication and a yellow light for "caution" on approximately one-half of the mileage of the railways of the United States and Canada. Similar remarks might be made regarding the retention of red lights in dwarf signals, but it was satisfactory to observe in this instance that a white light was now being used largely for such signals when in their normal position. Although mechanical signalling had been brought to a high state of perfection, and, for all ordinary purposes, probably formed the cheapest type of control, both as regards first cost and future maintenance, yet, like all manual-worked appliances, it had had to give way under exceptional circumstances to power-worked plants, of which several varying descriptions had been brought into practical use during recent years.

*Presidential address before the Society of Engineers, Eng.

Electro-Pneumatic System.

In the Westinghouse electro-pneumatic system the signals, points, bars, and locks were operated by motors worked by compressed air at a pressure of from 60 lb. to 70 lb. per sq. in., the valves of the motors being opened and closed by electric circuits controlled from the signal box. A special feature of the system was that, in the case of levers working points, the full movement of the lever was not at once obtained, a lock on the lever arresting the full stroke. The initial movement only set up the electric circuit which admitted the compressed air to the motor. When this had been done another circuit conveyed the return indication of the movement to the box, released the lock on the lever, and permitted it to be pulled fully over, the complete operation taking only two seconds to accomplish. A similar procedure was followed when restoring a signal lever to a normal position in the frame, the movement not being completed until the return indication proved that the arm had properly assumed the danger position. These precautions eliminated all risk of points or signals failing without detection, as in case of any movement being either partially or altogether impeded, the lever controlling the movement and all other levers dependent on it were immediately locked up, and continued locked until the impediment was removed. A good instance of the practical working of this system was installed at the Glasgow Central Station of the Caledonian Railway Company, where one signal box, containing 374 levers, controlled the whole of the station.

The "All-Electric" Method.

In the Siemens "all-electric" system the operation of points and signals was effected by electrically worked motors controlled by switches forming part of the locking frame and connected thereto by suitable cables. The mechanism for working points consisted of a reversing motor, driving, through worm gear and a friction clutch, a shaft which carried a crank. In the case of trailing points the crank had an angular movement of about 150 degrees, and was coupled direct to the tongues. The worm gear securely held the points in either position, but the friction clutch allowed them to be run through without damage to the connections; should the points become jammed by stones, etc., during the movement, the motor was allowed to revolve, but without sending the return current to withdraw the check lock. For facing points, provided with locking bar and bolt, the crank had a movement of 320 degrees, and was coupled by a special rotary escape crank arrangement with both the bar and the points. As the crank revolved the bar was first lifted, which in turn withdrew the bolts. The latter, however, was not clear of the stretcher rod until the bar had passed the middle position. Movement was then given to the points by the escape crank. The bar had meanwhile begun its return stroke, and the bolt entered the hole in the stretcher rod when the points were home. The motor circuit was automatically opened on the completion of each movement, the current being shunted through the detector contacts back to the cabin to operate the check lock. The current required for working an ordinary pair of points of the heaviest rail section, together with facing point lock and bar, averaged 4 amperes at 130 volts, and the time taken for the complete movement was two to three seconds. The semaphore signals were worked by a motor attached to the back of the post. The motor revolved a coupling magnet through a worm which geared into teeth formed on the magnet casting. The current received from the cabin passed through the coupling magnet in shunt with which was the motor having in its circuit a quick-break switch. The magnet, being energized, formed with its armature a magnetic clutch, thereby coupling the motor, through the worm gearing and pinion, to the signal arm. The motor, revolving, lowered the semaphore to a predetermined angle, at which point its circuit was opened by a switch. Its motion was arrested, but the magnet was still energized, and the arm was held in the "off" position until the main circuit was opened. The signal then returned to danger by gravity, a contact giving a return indication to the cabin. A special safety device prevented the arm from being lowered either accidentally or wilfully. The current for working a signal averaged 2 amperes during the movement, which took 1½ second. The motor was then automatically cut out, and the signal held off by the coupling magnet with a current of ¼ ampere until the lever was replaced in the frame. This system was being installed at the new Great Western Railway station at Snow-hill, Birmingham, where 300 levers would eventually be working, of which 124 had been in use for the past year.

Electro-Mechanical System.

With the Sykes electro-mechanical system the points were mechanically worked by levers grouped in a frame of the ordinary pattern, the signals being electrically operated by small slides placed immediately over the frame in the signal box. The system had been installed at St. Enoch Station, Glasgow, where 715 electrical slides were in use; at Victoria Station, London (L.B. and S.C. Railway), where 377 slides had been fitted; and at Folkestone and from St. John's to Orpington, where 277 slides were fixed. The semaphore signals were actuated by motors, and the shunting signals by electric coils.

Automatic Signalling.

The automatic system of signalling which had played so important a part in the success attending the electrification of the old steam-worked Metropolitan District Railway was also perfected and installed by the Westinghouse Company. It enabled a service of 40 trains an hour to be maintained with commendable regularity. Under this system the automatically worked portions of the lines were divided into sections varying from 900 feet to 4,000 feet in length by a special arrangement of track circuits, one of the running rails being divided into block sections by means of insulated fish plates, while the other rail was electrically continuous. A potential of from two to four volts was maintained between these two rails. At each end of a block section a polarized relay was connected by one terminal to the block rail and by the other terminal to the continuously bonded rail. The local signal circuit was controlled by both relays, and unless both were suitably energized by a current in the normal direction, the signal could not drop to clear. The entrance of a vehicle into the block section short-circuited one or both of the relays, and the signal was placed at danger, and remained there as long as the section was occupied. The chief feature of this system, which was the patent of Mr. H. G. Brown, was that currents extraneous to the signal system could not affect the apparatus so as to cause a false indication of safety. When a train was in the section, one or other of the relays was always reversely energized or shunted, thus opening the local signal circuit at one or two points. Each signal was governed by the section next in advance, and this section began 400 feet beyond the signal, and extended to a similar distance beyond the next signal. This length was known as the "overlap," and a signal could not be lowered until the whole of the preceding train had gone out of the section in advance, and had also passed the next signal by the length of the "overlap." This arrangement guarded against a collision resulting through a signal being passed at danger, and a further safeguard was given by the automatic train-stops, which applied the continuous brakes if a train passed a danger signal.

Audible Signals.

The driver's cab signal was the outcome of an attempt on the part of several experienced railway officers to produce a signal of a trustworthy character which would inform the driver of a locomotive of the position of the stop-signals ahead of him, when atmospheric conditions rendered it difficult, and sometimes impossible, for the semaphore arm to be seen. Since the inception of the idea, however, the scope of the invention had widened, and it was now found not only possible, but desirable, to make the driver's cab signal a substitute for the distant signal. The apparatus could also be fixed in tunnels where an ordinary signal could not be placed, and could be used as a warning signal for temporary or permanent speed slacks. This system had been introduced on the Great Western Railway.

Electric Traction.

The electrification work already carried out on the English and Continental railways showed that it was an undoubted fact that the higher rate of acceleration which was possible with electric as compared with steam working greatly increased the average speed for station to station traffic, and, if motor-driven trains were employed, the movements at a terminal station were practically reduced to actual arrival and departure, thus adding considerably to the carrying capacity of any section of a line so equipped. The question of the application of electric traction resolved itself rather into a matter of expediency, capital cost, and upkeep. If the operating expenses of steam-worked railways were examined, two facts of primary importance presented themselves—first, that the cost of locomotive power formed a very appreciable proportion (approximately 30 per cent.) of the total transportation cost, and if the details of this cost were analysed the second fact was established that the unit cost of conducting a suburban service, with frequent stops and delays, at terminal stations, was much higher than the unit cost for long-distance services.

The partial adoption of any alternative mode of traction on an existing railway needed almost closer consideration for its justification than would the question of the entire conversion of a system, as, with two independent sources of power, the risk arose that one or possibly both sources might not be worked to a degree that approached full economy. In the case of a purely suburban line, which was independent of main-line trains, and on which traffic was capable of being created by the provision of an improved service, an electric service might be advantageous, but in other districts where competitive carrying agencies existed or were about to be established, the outlook might not be so favorable, as it must be borne in mind that acceleration and a more frequent service entailed additional working expenses, to which had to be added the interest charges on the capital expenditure in giving the service, so that, to ensure financial success, not only must the whole of the existing traffic be retained, but an accretion of receipts was also required to meet the extra expenditure.

On broad grounds, therefore, the factor that perhaps marked the real balance of the question was the fixing of a point or points on a railway above which (reckoning from the terminal station) the fostering of local traffic was not likely to prove remunerative under steam working, and below which the provision of increased and improved facilities promised successful results, the prospects in the latter case being naturally enhanced if the upper end of the line was not monopolized by barely paying short-distance trains. Having established this dividing point, the engineer, in conjunction with the other responsible officers, had next to consider to what extent or for what period the existing lines and stations would accommodate the altered conditions; and, in the event of congestion being feared, if the required relief was likely to be afforded better by adopting electric traction on the existing lines to an extent that would not act detrimentally on the longer distance steam-worked traffic, or by widening the railways so as to provide increased means for dealing thoroughly with an electrically worked local service, which might reasonably be expected to hold its own with all outside competitive agencies, and at the same time allow of the longer distance traffic being properly developed under steam working. The consideration of these matters required particular thought, and would entail much investigation into several side issues which were closely bound up with the terminal workings of a railway. Of these issues the future influx of traffic from newly opened districts was not the least important, and it behoved all who had to deal, or were likely to deal, with the question to acquire a thorough knowledge of the altered conditions that were now connected with the travelling public.

REMEDIES FOR LANDSLIDES AND SLIPS ON THE KANAWHA AND MICHIGAN RAILWAY.*

The southern portion of the Kanawha and Michigan Railway for ninety-three miles (from Point Pleasant to Gauley Bridge, W. Va.), is located on the east side of the Great Kanawha River. For about one-third of this distance the road is close to the banks of the river, on a hillside location, where there is practically no valley, the mountains rising directly from the stream. Owing to the character of the soil, there is considerable trouble, due to landslides and slips, the term slips being used where the fill or embankment under the tracks, settles or slips toward the river.

Excessive rains occur during the winter, and small landslides are numerous, but do little damage; in most cases the water rushing from the mountains brings with it one or two uprooted trees and a few yards of earth. There is much more trouble with the larger landslides; that is, where the whole hillside gradually slips down toward the river, pushing the track ahead of it, and giving bad line and surface. At some places the track is not only pushed out of line, but raised.

Landslides occur in almost every case where the hill or mountain side has been cleared of all forest. The top soil, or earth, above the rock, which varies in depth from 8 to 20 feet, is mucky clay, which holds water in every low place, apparently being impervious. This clay soil soon becomes saturated, soft, and mucky, and, not having any roots or vegetation to hold it in place, and being on a slope, starts a downward movement, slipping on the rock, covering the ditches and ballast of the track, and pushing it out of line. These so-called landslides do not come down at once, but move slowly, thereby causing no immediate danger. In several places reverse curves have to be given to the alignment, in order to keep the track in surface.

At Point Pleasant, where there was a small landslide, the earth, as it came in, was removed by a steam shovel at the toe of the slope. The soil at this point was slipping on an inclined stratum of rock, the top of which was smooth and had the appearance of soapstone.

In cases where it was impracticable to remove the slide, the top-soil drainage system on the hillside above was at first tried, but did not work successfully, as the ditches, due to the slippery soil, soon filled up. It appeared that the small amount of surface water collecting in the low places caused by the roughened surface was sufficient to cause the slipping.

At Leon, where considerable expense was incurred in maintaining the track around a slide, the hillside was removed, and the track, for 2,000 feet, was relocated on the rock bottom, obtained by cutting back to a side-hill location. By this method the entire landslide was removed and the track put on rock bed, thereby doing away with the trouble, at a cost of $20,000.

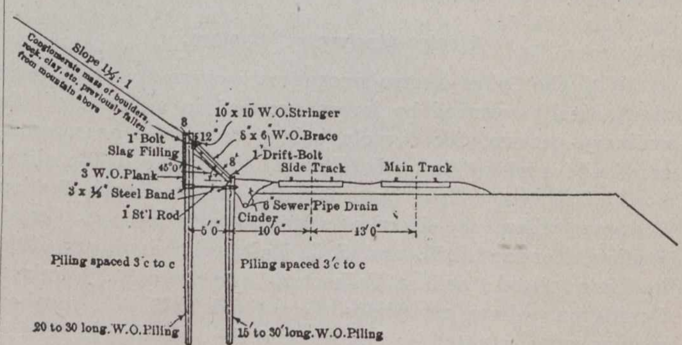


Fig. 1—Pile Brace Against Landslide.

At Cannelton, where the largest slow-moving landslide occurred, the main track had been pushed out of line. Reverse curves were made, in order to get back to the alignment on either side, but, on account of the continual lining out of the track, the curves became too sharp for operation, and the side track between the hillside and the main track became completely covered. As this slide was of such extent and depth, it was out of the question to remove it in order to get back far enough for a rock sub-grade, as at Leon. The change of line not being feasible, it was proposed to remove part of the landslide, permitting the relocation of the tracks on their original alignment, and, after completing this, to protect them from further slides.

A steam shovel was cut in at one end, and removed enough of the landslide to allow the two tracks to be changed to their original location. After the shovel had worked about three days a slide occurred one night, half burying the shovel. Steps were then taken to hold back the hillside before further slides could develop. This was done successfully by driving two parallel rows of piling, 5 feet apart, about 3 feet from centre to centre, as shown in Fig. 1. The upper rows, against the hill, were backed with 3-inch plank, the front rows being driven against this brace in order to aid in supporting the upper row. A 10 x 10-inch stringer was placed against the upper row, and from this 8 x 8-inch braces were carried diagonally at an angle of 45°, to the lower row of piles, and these were sawed off at the ground

* A paper by R. P. Black, presented September 7th, 1910, to the American Society of Civil Engineers, and published in the "Proceedings," Vol. XXXVI., p. 877.

level. Steel bands, with 1-inch rods to hold the two sets of piling together, were put on about 8 inches below the top of the brace pile. The depth of penetration of the piling varied from 15 to 30 feet. The piling was selected large white oak, and oak timber was used for the stringer and braces. Moving the shovel ahead about 30 feet, then cutting it back, and driving the piling as shown, constituted a day's operation. The work was completed successfully without further serious landslides. In four weeks about 12,000 cubic yards of earth were removed, the track was thrown back to its original alignment, and the landslide was stopped. This work cost $16,000.

The upper limit of the slide is about 135 feet above the track. The slide consists of about 200,000 cubic yards of moving earth. This work was done in the spring of 1907, and has been successful. At several places, due to excessive pressure, the braces have been embedded in the stringers. The earth from the top of the piling was given a slope of 1½ to 1; at everal other points smaller slides have been stopped with one row of piling. The piles were driven 3 feet, centre to centre, and cut off 3 feet above the top of the rail, the ground above being given a slope of 1½ to 1. At one or two places, where one row was not sufficient, the trouble was stopped with brace piling. At points where the single row of piling showed signs of leaning, due to the pressure against that part of the piling above ground, this overturning, apparently due to too much length above ground, was stopped by cutting off the piling 3 feet above the ground and giving the earth above it a slope of 1½ to 1.

this slipping action stopped. In Fig. 2 is shown a cross-section of the Brighton slip, which gave the greatest trouble. The section is taken at right angles to the track, the information for which was obtained by levels and test-rods driven to rock. A stratum of rock, below the earth, slopes toward the river, ranging from 1:0.2 to 1:1. This rock is covered by successive layers of red clay, varying from 3 to 6 feet in thickness. Immediately above the rock, and in thin seams, from 4 to 8 inches thick, between the layers of clay, is found a quicksand mixed with fine clay. When the quicksand and fine clay become thoroughly saturated with water, the mixture affords a smooth surface over which the top soil or successive layers of clay slide toward the river. After high water these seams of quicksand can be traced readily by the water seepage. The quicksand is very slimy, and contains no grit. The water must remain over the ground long enough to force its way back into this quicksand and saturate well before the slipping action can take place.

In 1908, in order to keep the track safe, the gangs on four sections were increased from three—the normal force—to ten men each, and these increased forces were maintained for four months. The tracks had to be resurfaced and lined continually. At three different times, it was necessary to put on filling material and ballast in order to keep the track up to grade. This entailed a cost of $4,400 more than the normal expenses for the year. The track over the slips was not only costly to maintain, but dangerous, due to wrecks resulting from derailments on account of rapid settlement of the roadbed.

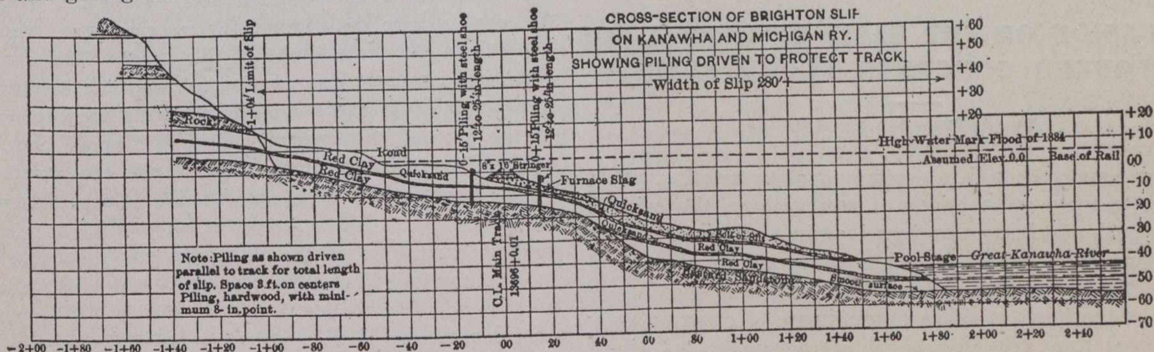


Fig. 2—Cross Section of Brighton Slip Showing Piling Driven to Protect Track.

In contending with landslides of this character in West Virginia, all that seems to be necessary is to obtain a good toe hold, which stops the movement of the earth above. The so-called slow-moving landslides on the Kanawha and Michigan Railway have been stopped successfully by one of these methods.

The term "slips," as the conventional name indicates, is applied to places where the soil slides into the river. These slips occur when the roadbed is constructed on a fill, ranging in depth from 5 to 10 feet, across narrow flats, between the hill and the river. Due to the constant movement of the earth, no trees grow on the land between the river and the railroad. The ground slips gradually into the river, where, from time to time, its toe is cut away by the current.

The peculiarity of these slips is the fact that they may continue for one or more seasons without giving any trouble. Slips are due to high water and not to surface water. A quick rise and fall of the river will not cause the soil to move, but continued high water, or several successive floods, will start the slipping action.

In the spring of 1908, the length of track affected by the slips was 7,600 feet, necessitating, at several different points the maintenance of speeds ranging from 6 to 20 miles per hour for five months, until the dry season, when

At Poca, where a trestle was maintained over a slip for about 800 feet, due to the heavy cost of changing the alignment, the trestle-work was filled with heavy quarried rip-rap, and the fill was widened so that the stone reached the river's edge. The weight of this stone fill caused settlement, but, after adding stone from time to time for five years, the roadbed became solid. It is thought that the stone fill settled to the rock stratum below the slip, thereby stopping the movement.

For slips at other points, where small fills were maintained, several remedies were suggested, one being to construct, at the river's edge, a wall which would act as a toe to hold back the moving soil. Owing to the necessary height of the wall, however, this was deemed too costly. At Brighton and Leon slips, where the alignment could not be changed, the remedy shown by Fig. 2 was proposed, the scheme being to drive two rows of piling, one on each side of the track, with a track-driver, the piling to be equipped with steel shoes for penetrating the rock strata. It was supposed that, with the toe-hold in the rock, and the pinning together of the successive moving slay strata, this slipping action in the vicinity of the track would be stopped.

In the spring of 1909, test-piling was driven for a distance of 50 feet in the centre of the Brighton slip. Transit observations taken from a base line showed that the piling did not move any appreciable distance. The track held up well within the limit of the piling, where, as on either side, it had been necessary to resurface continually.

The test being successful, two rows of piling were driven during December, 1909, on either side of the track at the Brighton slip, and between its limits for a distance of 740 feet. The piles were equipped with steel shoes, and were driven 3 feet apart, centre to centre, on the down-hill side. Continuous 8 x 16-inch timber bracing was bolted to the piling. The work was done with a self-propelling track-driver. A temporary spur track was constructed at one end of the slip, thus dispensing with the services of a work train. The cost of this work was as follows:—

Hardwood piling, 8,075 feet at 13 cents..........	$1,049 75
Steel shoes, 12,690 pounds at 3 cents............	380 70
Labor	856 35
Fuel, etc.	120 00
Total	$2,406 80

Up to the present time this remedy has been successful.

At another point, where the rock strata are not at great depth, it is proposed to go down the hillside about 20 feet from the track, put down holes about every 20 feet, and blast the smooth surface of the rock. Thus, by roughening the surface and destroying the stratification, the sliding of the clay may be stopped.

A DISCUSSION OF THE BASIS OF DESIGN FOR REINFORCED CONCRETE FLOOR SLABS.*

By Arthur R. Lord.†

In this paper the writer desires to state briefly, without attempting to make connections or applications, the evidence presented by the building test described in a previous paper** and also such confirming evidence from other tests made recently at the University of Illinois, as is applicable to a consideration of the basis of design for reinforced concrete slabs. In the limited time available it will be necessary to simply state any conclusions. Points on which a division of opinion may be expected will be discussed more fully.

The division of the slab into beams or beam strips gives a method of analysis which appeals to many as the logical manner of approach in undertaking the analysis of the reinforced concrete floor slabs. It does not seem, however, that the true stresses may be so arrived at, but we may safely conclude that the stresses so found will represent the maximum value.

It may be recognized that the stresses indicated by the beam method of analysis are reduced by slab action and by arch action to a very considerable degree, but it is not possible to state co-efficients for this reduction or to give it quantitive expression at present. The amount of this reduction probably depends on the depth of the slab and on the details of the head and slab reinforcement, and may be expected to vary considerably under different conditions.

Certain lines of approach do not seem to be tenable as a basis of analysis. Whatever the value of Grashof's analysis of homogeneous plates fixed on a system of equidistant points may be (and this value is not clearly established) the use of the ratios from Grashof does not seem to be warranted without advancing supplementary evidence. Other writers have pointed out the important bearing which Poisson's ratio has on the value of the stress found by Grashof's equations. The writer would mention also that the expression found by Grashof is indeterminate for other than square panels, and that the maximum stress is located at the center of the cross band (as applied to the floor slab) and not at the support as Mr. MacMillan evidently supposes. This can hardly be said to represent the conditions in the reinforced concrete floor slab.

Treatments based on Dr. Eddy's analysis of the circular flat plate do not seem to apply, and for the same reasons. Dr. Eddy's analysis assumes certain relations in both shear and moment curves which, while tenable for cases that he treats, do not seem to be applicable to a plate supported over a considerable area at its center. Dr. Eddy does not attempt to apply his analysis to any similar cases.

A study of stress conditions would indicate that certain limitations should be recognized in designing the flat slab. Beam analysis applied to the slab and the results of tests both indicate that the moment is greater over the support than at the center, and that the critical section is at or near the capital. If this be true and we wish to adhere to the established practice of maintaining the same slab design for all floors, it is essential that the capital be also maintained at or above some minimum size, for which minimum size the moments have been figured. Common practice makes the capital size depend on the column size, when it should depend on the dimensions of the panel. The stresses in the steel and concrete due to moment and the shearing and diagonal-tension stresses are all increased rapidly by a decrease in the size of the capital. Over the small capitals in the upper floors of buildings of this type the stresses must be much higher than they are for the lower floors with their large capitals. For a study of shear and moment stress in several buildings it is recommended that the capital be maintained at a diameter of at least two-tenths the dimension of the side of the panel, if the capital is square, or at an equivalent area if the capital be of different shape. Shearing and diagonal-tension stresses will be safe for this size of capital provided a proper percentage of steel is used in the slab design proper.

It is quite commonly held that only the rods which pass over the capital may be taken into account in figuring the resistance to negative moments. Under this conception the strips containing the outer rods of a band serve only to carry load to other strips which they intersect and which do pass over the capital. In this conception it would seem that there is a confusion between transfer of weight and of stress. The weight or load follows the most direct path to the column, being transmitted in the form of shear in the concrete itself, and does not need to be transferred from strip to strip at their intersection. The wide beam, while stressed very high at the support locally in shear, may be stressed over its entire width in moment. A series of tests made during the past year at the University of Illinois illustrates this lateral distribution of stress in wide beams. These beams were of various dimensions and proportions, and we may be permitted in advance of the full publication to present one particular set in which the proportions are very near to the conditions found in ordinary building design. The beams were 36 ins. wide, 4 ft. 10 ins. long, and 3 ins. deep to the steel. Thus the ratio of depth to width is 1/12 or somewhat in access of the usual ration of depth to steel to width of band in the flat slab. The beams were loaded across their full width at their ends, and were supported at

*Presented at the Seventh Annual Convention of the National Association of Cement Users.

†Research Fellow, Engineering Experiment Station, University of Illinois.

**See the January issue of this journal, p. 31.

the third points, in some cases for their full width, in others for one-half their width. The beams were made and tested in duplicate at approximately 60 days. The table gives the loads carried.

		Total Load Carried.		
Beam No.	Supported	Beam No. 1	Beam No. 2	Average
711.1-.2	Full width.......	15,550	15,800	15,770
713.1-.2	Half width......	15,000	17,000	16,000
715.1-.2	Fifth width......	14,900	12,250	13,500
717.1-.2	Fifth width......	14,550	16,000	15,300

The 717 beams were provided with 0.4 per cent. cross reinforcement. All the beams had ten ⅜-in. round rods 3 ins. from the face, and beams 717.1-.2 had ¼-in. round rods 4 ins. on centers crosswise of the beam. We may note that for one-half the support there was no appreciable falling off in the load carried. The defection curves showed also that the steel at the edges took the same stress as did the rods in the beam supported for its full width. The yield point of the steel used was 37,000-38,000 lbs. per sq. in., and computations show that all the steel present in both cases was stressed about 10 per cent. beyond the yield point when the yielding of the steel caused the concrete to fail in compression. This is exactly the phenomena of the ordinary beam test where there is no lateral distribution involved. When the beam was supported for only one-fifth its widths there was but a small falling off in the load carried. For all cases where the recommendations of this paper with regard to column size is followed, the beams or bands will be supported for one-half of their widths, in which case the entire steel would seem to be effective.

The evidence of the wide beam tests is further confirmed by tests of footings. It may be pointed out that the portion of the slab inside the line of inflection is in effect an inverted footing loaded wih a perpherial load at the line of inflection (reactions of the supported beams between the lines of inflection) and a uniform load over the base. The footings tested were of uniform depth throughout, being somewhat thicker in proportion than the cantilever slab about the column. From a consideration of all the results Professor Talbot has arrived at the conclusion that the width of the resisting section, as governing the stress in the steel was composed of the width of the pier, plus the depth to the steel on each side of this, plus one-half of the remaining width of the footing. Applying this to several designs revealed the fact that this width includes all the steel in both the cross and diagonal bands in all ordinary sections. In other words, not the steel passing over the capital only, but the entire steel in both bands may be counted on to take its full resisting moment. Actually observed stresses found in the building test, bear out this statement. The stress was found to be nearly constant across the entire band, the slight falling off in the case of the outer diagonal rod being accounted for in part at least by its lower position in the slab. To offset this the outer rods of the cross bands were observed to be taking a slightly higher stress than those in the center of the bands.

The footing tests previously mentioned afford evidence also as to the position of the section at which negative moments should be figured for any band. The reinforcements in the footing were laid sometimes in four bands without any noticeable effect on the strength of the stresses found in the specimen. The tests have been interpreted for a bulletin on footings now in manuscript form and the conclusion was reached that stresses figured for a section at the face of the pier would represent fairly the structural action involved. Additional evidence was afforded from the observation of cracks about the columns in the building tested. These cracks formed at a distance of about 2 ins. on the average outside of the edge of the capital below, and would seem to indicate that moments may safely be figured about a section at the edge of the capital as giving a maximum condition.

If we consider the bands as continuous wide beams we should expect to find that the moment at the support was twice that at the center of the span for uniform loading. The test indicated that this center moment was somewhat less in proportion, but it is possible under a single panel loaded that the stress at the center may reach as high a value as one-half that at the support under full load and this fraction may be considered a maximum for design purposes. Much current practice is in direct contradiction to this conclusion. This objection to any adaption of Grashof's analysis has been noted in a previous paragraph. Mr. C. A. P. Turner's formula, based as it apparently is on tests of single panels and without the determination of actual stresses, must be applied with caution. When a formula is to be derived from tests it is essential that the tests be so planned as to give as high stresses as may reasonably be expected under full load conditions. Certainly tests, which from their nature predetermine low stresses at the critical section at the support, do not constitute an acceptable base for a design formula. Mr. Turner's contention that by the use of a uniform grade of open hearth steel it is possible to tell when the stress in the steel reaches the yield point, and that in this manner a basis of design may be arrived at, does not inspire one familiar with test phenomena with much confidence. It does not answer the objection to single panel loads at all. Again it is not clear that any noticeable change will occur in the slab when the steel at the support reaches the yield point. At that time the steel over the support starts to yield, simultaneously the deflection and hence stress at the center increases, and thus relief is afforded the steel of the support. The final failure may even occur at the center, and yet it is evident that this re-adjustment should not be necessary in good design, even if there is sufficient over-reinforcement at the center to safely carry the added stress (which is not always the case). After the re-adjustment has taken place there are present in the steel and concrete large permanent stresses and marked set, and against the repetition of the load the structure is even less secure than at first.

The test indicated that the line of inflection lay between a square having a column at its center and its inscribed circle. If the slab be considered as simply supported, the least dimension of the line of inflection (in the cross band direction) would be approximately 0.44 L where L is the dimension of the panel. Owing to the fact that the slab is fixed for a considerable area at the column capital, the effective clear span is much reduced, and the least dimension of the line of inflection correspondingly increased. If we take the effective clear span as the distance between the critical sections already determined for negative moment, which seems a reasonable basis, and if we follow the recommendation as to size of the capital stated previously in this paper, the least dimension of the line of inflection becomes $.2\ L + 2\ (.22 \times .8\ L) = 0.55\ L$; (the .8 L being the effective clear span). In the building tested at Minneapolis the capital size was 0.24 L and the observed least dimension of the line of inflection (in other words the dimension along the cross band) was about 0.56 L. On the basis given above it would figure at $0.24\ L + 2\ (.22 \times .76\ L) = 0.57\ L$, which checks closely with the observed fact. It would seem that for the conditions found in practice, and if columns are not permitted to have unduly small capitals, the variation of this dimension of the line of inflection would be small, and the value of 0.55 L here given may be quite generally applicable. The dimension of the line of inflection along the diagonal band was observed in the test to be about .64 L.

A question exists as to the value of compressive stress in the concrete at the edge of the capital, and as to whether or not compression reinforcement is needed. It is difficult to compute the stress at this point owing to the fact that the concrete is stressed not in one, but in several directions. In the test, however, the resultant stress was measured directly, ranging from 650 to 750 lbs. per sq. in. which is undoubtedly safe for concrete stressed in several directions and over a very short distance. In the design of this building a very low percentage of reinforcement was used at the center of the span, and it would seem as though the percentage was imperative to proper design unless compressive reinforcement is to be used. We may well ask what the stress in the concrete would have been had ½ per cent. of 6/10 per cent. reinforcement been used at the center as is frequently, I might say commonly, done. For such practice compressive reinforcement seems to be required.

The writer would like to add a word on the question of shearing stresses in flat slabs. To the designer of beam constructions these stresses have seemed high, and a proper consideration of shear, as well as of moment, makes it advisable to provide a larger capital than is ordinarily used on the upper floors of our present buildings. The recommended minimum size of capital of 0.2 L was selected with the shear computations of several buildings directly in mind. We should remember, however, that a sharp distinction should be made between so called "punching" shear and shear which indicates the tendency to diagonal tension. Punching shear may properly be figured along the periphery of the capital giving a punching shear unit stress of

$$V = \frac{W\ (L^2 - c^2}{12 \times 4cd} = \frac{0.1\ wL}{d}$$

the last simple equation applying only when the capital is 0.2 L on a side as recommended (or a circle of equivalent area). In this formula,

L = side of square panel in ft.
c = side of equivalent square capital in ft.
d = depth of slab in ins.

For such shearing stress the value recommended by the Joint Committee of 120 lbs. per sq. in. is certainly permissible.

In computing shear as indicating the tendency to diagonal tension, we should give to the flat slab the same treatment which we accord to beam design. In a restrained beam we find that the failure in diagonal tension does not occur at the support but at some distance out from it. In like manner Prof. Talbot has found in the tests of footing that the failure in diagonal tension took place some distance out from the pier and he concludes that an indication of the tendency to diagonal tension the intensity of shearing stress should be computed on a section at a distance out from the pier (or edge of capital) equal to the depth of the slab to the steel. Using the same notation as before.

$$V^1 \text{ (diagonal tension tendency)} = w\frac{L^2-(c+.167d)^2}{12 \times 4\ (c+.167d)\ jd}$$

In any particular case it is simpler to figure this stress directly than to use the formula. For this value the various limits specified by the Joint Committee should govern.

ELECTRICAL RAILWAY REPAIR SHOP PRACTICE.*

By W. J. Kelsh, Master Mechanic Wisconsin Electric Railway Company and Eastern Wisconsin Railway & Light Company.

The Eastern Wisconsin system, composed of the Eastern Wisconsin Railway & Light Company, of Fond du Lac, and the Wisconsin Electric Railway Company, of Oshkosh, operates 67 miles of electric railway along the east shore of Lake Winnebago, including city lines in Neenah, Fond du Lac and Oshkosh and interurban lines from Fond du Lac to Oshkosh, Oshkosh to Neenah and Oshkosh to Omro. Our equipment consists of 10 double-truck interurban cars, 5 double-truck city cars, 23 single-truck closed city cars, 2 sweepers, 1 snow plow, 1 work car, 1 double-truck 15-bench Narragansett, 6 single-truck 10-bench open cars and 17 open trailers.

Six cars are required in our daily interurban service, three double-truck cars in our daily Fond du Lac service and from three to five additional cars in the morning and evening to handle our shop traffic between Fond du Lac and North Fond du Lac. Eleven single-truck cars are in daily operation in our Oshkosh city service and from three to five additional cars are required to handle our shop service morning and evening. In Neenah one single-truck car is required. Our summer traffic requires much additional equipment, the amount depending upon the weather and attractions.

At Fond du Lac, our southern terminus, we have a large inspection barn and shop for light repairs. At Oshkosh, about the centre of our system, our main shop is located. An inspection barn is maintained at our substation 10 miles north of Oshkosh, where the Neenah city car is taken care of. At Fond du Lac we keep an extra interurban car, allowing us to change every round trip or every 67 miles. As soon as a car is over the pit two inspectors go over every part of the car, making such repairs as are necessary or as can be made in one hour. If anything is discovered which cannot be taken care of in this barn the shop at Oshkosh is notified by telephone and the car is taken off the road when it reaches there on its outward trip. This car, while being inspected, is also being cleaned and fumigated. This gives us a clean and fresh car every round trip. The Fond du Lac city cars are taken care of at this barn.

All city cars, both at Fond du Lac and at Oshkosh, are inspected by night men as to armature clearance, loose bolts, carbon brushes, brakes and lubrication, and are also swept and dusted. All cars are left in the car barn or shop one day each week for a general inspection and a thorough cleaning. We believe that thorough inspection will prevent failures on the road and also is much cheaper from a maintenance standpoint.

Our shop is equipped with a 200-ton Niles wheel press, a 38-in. Niles wheel-boring mill and a 48-in. Niles wheel lathe, all operated by individual motors geared to the machines. In addition to the foregoing a 24-in. engine lathe, a planer, drill press and other minor machinery are operated by a line-shaft belt connected to a single motor. We also have two 10-ton chain blocks suspended from an overhead truss, enabling us to raise one end of a car at a time. With this shop equipment we are able to do all of our own work, both in equipment and power-plant maintenance.

*Abstract of paper presented at meeting of Wisconsin Electrical Association, Milwaukee, Jan. 19, 1911.

For our fenders we use ¾-in. pipe for the frame, and strips of ⅛-in. x 1-in. iron, fitted and riveted around pipe, for a filler. These fenders are designed to be tripped by the motorman and cost us $8.06 per pair installed. We make our armature shafts out of broken car axles for one-half the price we would have to pay for new ones.

Our railway storeroom is at Oshkosh, from where supplies are distributed to the different car barns and other departments. We keep an individual mileage record of all cars, also a card system on all wearing parts, showing actual mileage obtained on car wheels, brake shoes, trolley wheels, carbon brushes, bearing metals and oil. This enables us to judge what material is best adapted to our conditions.

We have adopted as standard on our interurban cars a 34-in. steel wheel with 3-in tread and ⅞-in. flange, after trying cast-iron and steel-tired wheels. While the steel-tired wheels compared well with the steel wheel in mileage we found a difference in cost.

Our present steel wheels have given us 80,000 miles before the first turning and 60,000 miles since turning. The softest part of steel wheels, it is claimed, is after the first turning, that being the part farthest from the rolls when the wheel is being made. I have reason to believe from the present condition of these wheels that with another turning we shall get 60,000 miles more before scrapping them.

We use 425-lb. cast-iron wheels on all city cars, and get about 50,000 car miles from them. I believe that all double-truck cars equipped with air brakes and weighing 20 tons or over should be fitted with steel wheels from the standpoint of economy. We use a soft-composition-filled brake shoe on all cars, costing us $0.3392 per 1,000 car miles.

We are using a 6-in. trolley wheel without a bushing on our interurban cars. It has a ¾-in. axle and is lubricated by a special graphite grease which is forced through a 5/16-in. hole in the end of the axle. This hole extends through the centre of the axle to a deep groove in the middle of the axle and the grease flows through this groove into the oil cellar of the wheel. We rarely have to change a wheel because it is worn in its bearing. This shows that we are getting good contact as well as good lubrication. We get an average of 5,000 car miles from this type of trolley wheel. On our city cars we are using a 5-in. trolley wheel with oil-lubricated graphite bushing and get 10,000 car miles from it. Part of the motors on our cars are oil-lubricated and the rest are lubricated with cup grease. In 1909 the oil and grease used on all cars cost us $0.2015 per 1,000 car miles, and I am satisfied that in 1910 we have done as well, if not better, but the figures have not yet been compiled.

During the past two years we have painted nine interurban and 14 city cars from the bare wood at an average cost of $137.38 for interurban cars and $83.55 for city cars. This cost includes burning off old paint, three coats of primer, two coats of color, lettering, striping, two coats of outside varnish and one coat of inside varnish. The floors and roof are painted with lead and the rattan seats are enamelled.

All cars go through the paint shop at least once a year for varnish and at this time, if the color is marred so much as to require any spotting out, we cut in between stripes and letters with the original shade of color, and with two coats of varnish outside, one coat of varnish inside, roof and floors painted with lead and rattan seats enamelled. For a 38-ft. interurban car his work costs us $81.57 and for an 18-ft. city car the cost is $43.47. We do not attempt to spot out defects in paint after the car has been in service, as the color is more or less faded. While we might be able to match faded color at the time it would not stay matched long and would soon show a difference in color, but when the entire panel is cut in between stripes and letters we have no trouble in keeping our cars looking fairly well. We believe we shall not have to paint cars throughout oftener than once in six or seven years.

During the past two years we have rebuilt vestibules on 12 single-truck closed cars. These cars originally did not have vestibules, but later the platforms were enclosed with temporary frames which had glass fronts extended over the dash to allow room for the brake handle and were fastened to hood at top. The left side of the platform was also closed. From this style we changed to a permanent solid vestibule, like those on modern cars. They cost $116 per car.

Our shop organization is such that we can take care of the general repairs of our Fond du Lac electric light and gas departments. We maintain a testing department with our light department, which also can take care of light repairs required by customers from time to time.

THE FLOW OF WATER OVER DAMS.*

By Gardner S. Williams,† M. Am. Soc. C.E.

Two formulas are in common use in this country for computing the flow of water over sharp-edged weirs without end contractions. The older one, known as the Francis formula, was devised by Mr. James B. Francis in 1854. As usually written, this formula is

$$Q = 3.33\, L \left(h + \frac{v^2}{2g} \right)^{\frac{3}{2}}$$

where Q = the discharge in cu. ft. per sec.
L = the length of weir in ft.
h = the observed head on weir in ft.
v = the mean velocity of water at the point where the head was measured.
g = the acceleration due to gravity.

From a series of experiments performed in France between 1887 and 1898, Bazin deduced the following expression:—

$$Q = \left(0.405 + \frac{0.00984}{h} \right) \left(1 + \frac{0.55\, h^2}{(h+p)^2} \right) L\, h \sqrt{2gh}$$

where p = the height of weir above the channel in ft. and the other letters have same significance as before.

In the two sets of experiments from which these formulas were deduced, slightly different methods of measuring the head were used. In applying the formulas, in very accurate work, care must be taken that the head is measured in a manner corresponding to the formula which is to be used. If this precaution be observed and the weirs are carefully constructed, with sharp edges and level crests, the results from the two formulas will accord with each other and with volumetric measurements within 1 or 2 per cent.

While the sharp-edged weir is thus such an admirable instrument for stream gauging, the expense of constructing such a weir is very considerable. As power or storage dams are found on nearly all streams in the settled part of the country, it is evident that a modification of these formulas, which would allow them to be applied to a dam of the ordinary type would be of great value to everyone engaged

* From "The Michigan Technic," June, 1910.

† Professsor of Civil, Hyraulic and Sanitary Engineering, University of Michigan, Ann Harbor, Mich.

in hydraulic work. Until recently, little was known of the manner in which the cross-section of a weir affected the discharge over it. Hydraulic engineers were accustomed to assume that the flow over any dam was the same as that over a sharp-edged weir of the same length under the same head, a procedure which is now known to introduce errors of from 1 to 20 per cent. Although Francis had pointed out about 1860 that the discharge of a weir was decreased by replacing a sharp edge with a broad, flat top, no satisfactory investigations were made of the matter until about fifteen years ago. Since then, two important series of experiments on this subject have been performed.

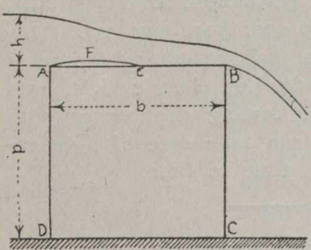


Fig. 1. Rectangular Dam.

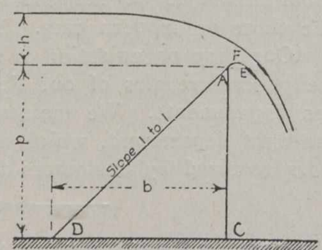


Fig. 2. Triangular Dam, Sloping Face Up-Stream.

In 1898, M. Henri Bazin published in "Annales des Ponts et Chaussées" several sets of such experiments. He used the formula $Q = mLh$, and determined the value of m for a large number of different dams under heads varying from 0.3 to 1.3 feet. Portions of Bazin's reports have been presented to different scientific societies in this country, but the work, as a whole, has not been translated.

At the Hydraulic Laboratory of Cornell University there was performed by the writer a series of weir experiments, begun in 1898 for the United States Board of Engineers on Deep Waterways, and afterward continued independently and with the aid of the United States Geological Survey for a number of years. The discharge over various dams was compared with that over a sharp-edged weir of the same length and of the same height, and thus factors or multipliers were obtained by means of which the discharges of either the Francis or Bazin formula can be reduced to those of ordinary dams. A sufficient quantity of water was available in the experimental canal to permit the observations being carried to heads of 4 feet over weirs 16 feet in length.

The tables accompanying this article contain the factors found for fourteen dams of common forms under heads varying from 0.5 to 4.0 feet. To find the discharge over a dam, first compute, by either the Francis or Bazin formula, the discharge over a sharp-edged weir of the same length and height, and under the same head. Then multiply this discharge by the factor given in the table for the given type of dam and the given head. This gives the discharge over the dam under the given conditions with an accuracy nearly as great as that of the discharge computed for the sharp-edged weir.

Rectangular Dams.—The simplest form for the cross-section of a dam is a rectangle, as in Fig. 1. When water flows over, there is a vertical contraction beginning at A, the same as in a sharp-edged weir, but the water meets the crest again at E. The sudden change of direction at E and the friction on the surface E B both cause a loss of head, and tend, therefore, to diminish the discharge; hence, the discharge under these conditions is always less than that of a sharp-edged weir, and the factor is less than unity. As h increases, the amount of vertical contraction and the distance A E increase, and the distance E B, in which loss of head due to friction takes place, diminishes; the discharge relatively to a sharp-edged weir consequently increases; therefore, the factors increase as h increases until the sheet jumps clear of the crest and the condition is that of a sharp-edged weir. With the 0.48-foot crest, the points E and B coincide when h is a little less than 1.5 foot, and at heads of 1.5 foot or greater the sheet of water leaps clear of the dam. That is, for heads above 1.5 foot the 0.48-foot dam discharges exactly like a sharp-edged weir, and the discharge should be computed as such. In the 0.93-foot dam the same thing occurs at $h = 2.5$ feet. With the 1.65-foot crest, the factor continually increases, and, while it appears that the dam would act as a sharp-edged weir if the head were made great enough, that point was not reached in the experiments.

As the head increases, the velocity across the crest increases, and, in the region E B, the friction per foot increases. In the wider dams, a point is thus reached where the increase in friction due to the greater velocity exceeds the decrease in friction due to the diminishing of the distance E B. Hence, from this point the factor begins to decrease once more. In the dams more than 3 feet wide this point occurs when the head is about 1.5 foot.

In all the dams of this type the factors decrease as the breadth of the crest increases, since the length E B, over which friction acts, is increased. The height p, of the dam above the bottom of the channel, has no effect on the discharge relatively to the sharp edge, provided it is great enough to insure complete vertical contraction.

Triangular Dams.—As the vertical contraction existing in the case of the sharp-edged weir is due to the fact that part of the water approaches the crest from beneath(that is, moves nearly vertically upward along the up-stream face of the dam), it follows that if the up-stream face of the dam is inclined, this contraction will be diminished and the discharge correspondingly increased. Table II. gives the factors for two such dams of the type shown in Fig. 2. Since these dams give a greater discharge than a sharp-

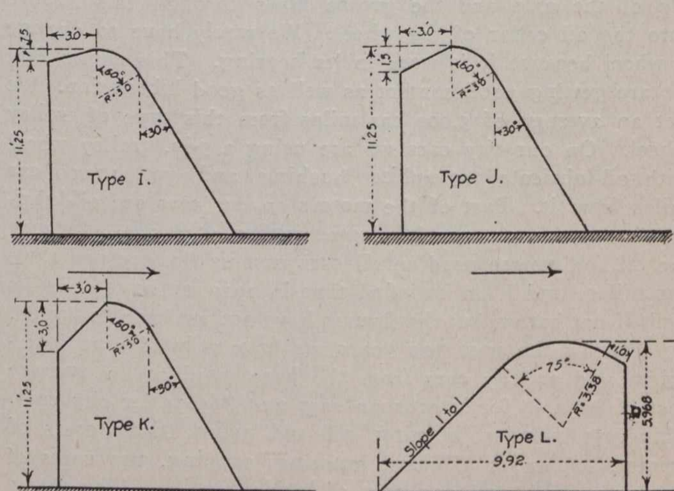


FIG. 3. FOUR ROUND-TOPPED DAM FORMS.

edged weir, the factor is always greater than unity. It increases slightly with the head at first, and then, after the head has become as great as 1.5 or 2.0 feet it gradually diminishes. This subsequent decrease is due partly to the fact that, as the head increases, the form is of less importance in determining the discharge. This may be better understood by considering the effect of an infinite head, in which case the discharge will evidently be entirely independent of the shape of the dam. At low heads, the height p has little influence on the factor, but as the head increases the slope of the smaller dam is not long enough to give its full effect in diminishing the vertical contraction. Therefore, under high heads, the factor is less for the low triangular dam than for the high one.

Round-topped Dams.—Turning again to Fig. 2, it is easily seen that, if the dam were built out to just touch the curve A F E, the discharge would be but slightly affected, while the head would be diminished by the difference in elevation of the points A and F. By thus rounding the crest the factor will be increased. Acting on this principle, a dam of the shape shown as Type L in Fig. 3 was built and the factors given in Col. 4 of Table III. determined. At heads below that for which the curve was designed the values of the factors are low, due to the friction on the underside of the sheet, but for the larger heads they are higher than the values for the corresponding triangular dam.

The three types, I, J, and K (Fig. 3) were used to show the effect of the up-stream slope on the discharge. They all have the same crest, very similar to that of Type L, but the up-stream slope varies from one on four to one on one. The factors for these are also given in Table III. They vary with the head in much the same manner as the factors for Type L. Under high heads, the discharge over Type I is a little less than over Type L, but J and K are always more efficient than L, and of these two K gives the greater discharge.

These tables cover, in a general way, the most common cross-sections of power and storage dams, and by their aid these dams are made available for measuring the flow of streams.

There is also another valuable use to which these data may be applied. At many water-power plants the quantity of water used is fixed by the flow of the stream at low water, while the head is limited by the fact that in time of flood all the water must be discharged over the dam without submerging the lands above. By the use of these tables it is frequently possible to select a form of dam capable of discharging all the flood water under less head than is required by the dam previously in use. The new dam may be higher than the old by the difference in the heads required by the two different forms in time of flood. This increase of head will give an increased output of power under ordinary conditions of flow. In this way a very moderate expenditure may be sufficient to permanently increase the capacity of the plant.

Discharge Coefficients for Overflow Dams. Determined by Prof. G. S. Williams.

(To find the discharge over a dam: Compute the discharge over a sharp-edged weir of ssame length and height, and under the same head; and multiply this discharge by the factor given in the table for the dam and head in question.)

Table I. Rectangular Dams, Fig. 1. Head in feet.	Breadth of crest in feet. 0.48	0.93	1.65	3.17	5.89	8.98	12.24	16.30	Table II. Fig. 2. p in feet= 6.65	11.25	Table III. Fig. 3. Type I.	Type J.	Type K.	Type L.	Head in feet.
0.5	0.902	0.830	0.819	0.797	0.785	0.783	0.783	0.783	1.060	1.060	0.968	0.971	0.971	0.971	0.5
1.0	0.972	0.904	0.879	0.812	0.800	0.798	0.795	0.792	1.079	1.079	1.008	1.040	1.040	0.983	1.0
1.5	1.000	0.957	0.910	0.821	0.807	0.803	0.802	0.797	1.091	1.092	1.032	1.083	1.092	1.022	1.5
2.0	1.000	0.989	0.925	0.821	0.805	0.800	0.798	0.795	1.086	1.097	1.041	1.105	1.126	1.040	2.0
2.5	1.000	1.000	0.932	0.816	0.800	0.795	0.792	0.789	1.076	1.096	1.043	1.118	1.146	1.057	2.5
3.0	1.000	1.000	0.938	0.813	0.796	0.791	0.787	0.784	1.067	1.095	1.044	1.128	1.163	1.072	3.0
3.5	1.000	1.000	0.942	0.810	0.793	0.787	0.783	0.780	1.060	1.094	1.045	1.136	1.177	1.085	3.5
4.0	1.000	1.000	0.947	0.808	0.790	0.783	0.780	0.777	1.054	1.093	1.046	1.144	1.190	1.097	4.0

A MEMONIC SYSTEM FOR DISTRIBUTING LABOR COSTS ON CONSTRUCTION WORK.

A very convenient method has been devised by the Aberthaw Construction, Co., of Boston, for indicating the various classes of work in making their daily labor distributions on the job. These entries are made on a daily time sheet on which the employer's name appears in the left-hand column and on which there are thirteen spaces opposite each name in which can be entered the number of hours each laborer is employed on each class of work. At the top of each column the letters indicating the class of work are entered. This system of symbols is as follows:—

Main Divisions.

Initial letter covering kinds of work.

P, Plant; D, Digging, excavating and back-filling of all kinds; M, Concrete Labor (mixing and placing); F. Form Work; R, Steel Reinforcement for Concrete; K, Finish of surface (granolithic, rubbing, picking, etc.); C, Carpentry other than form work (form work must be reported under F); S, Steel work-structural and ornamental-cast iron, etc.; B, Brick or stone masonry; Z, Miscellaneous; X, Extra work (prefix to any of above).

Sub-Divisions.

Kinds of Labor. (Second Letter).

(To all main divisions except D. & K.)

a, making up centers, bending and fabricating steel, mixing concrete; e, erecting centers, placing steel, placing concrete, laying brick, fixing sash or frame, etc.; i, removing centers, cutting away concrete, etc.; o, repairing and patching; u, receiving stock, unloading and storing same, loading and shipping plant for return to yard, etc.

(Second Letter with D.)

a, excavate; e, backfill; i, pumping; o, grading; u, drilling and blasting.

(Second Letter with K.)

a, picking; e, bush hammering; i, rubbing with carborundum; o, repairing, filling voids, cleaning down, etc.; u, granolithic finish.

Sub-Divisions.

Location of work, material, etc. (Last Letter.)

(To all main divisions except for P, S and C.)

b, mass foundation; d, footings; c, column; ch, column heads (mushroom); f, floor (self-supporting); fs, floor slabs; fb, floor beams; g, isolated girders; h, cellar or basement; j, k; l, lumber; m, monitor or pent house; n; p, paving or sidewalk; gp, glass sidewalk; q; r, rubbish; s, stairs; sl, stair landings; t, cast ornamental work; v; w, walls; rw, retaining walls; x, cement; y, sand; z, stone or gravel.

(Last Letters with C.)

c, ceiling; d, doors; df, door frames; dt, door trim; w, window; ws, window sash; wf, window frame; wt, window trim; m, monitor; ms, monitor sash, etc.; f, floors; fb, floor beams or timber; fs, floor screens; fp, sub-floor planking; ft, top floor maple, etc.; r, roof; rb, roof beams; rp, roof plank; t, trusses; g, gates; k, fence or railing; h, hardware; z, miscellaneous.

(Last Letters with P.)

c, crusher; d, drill; f, boiler; g, engine (loco portable type); h, hoisting engine; j, derrick; k, cableway; l, elevators; m, mixer; n, temporary buildings; p, air compressor; q, pump; s, saw bench and wood working shop; t, track; w, water supply; z, miscellaneous.

(Last Letters with S.)

Structural—

b, beams; c, columns; d, trusses; f, floor; g, rivets; h, holding down bolts; j; k; l; m.

Architectural—

n, stairs; p, posts; q, fire escapes; r, grating; s, sash; t, doors; v; w; z, miscellaneous.

To illustrate the use of this system let us assume that you wish to indicate carpenter work in making up centers for the roof. This would be entered at the top of one column of the time sheet as follows: A capital C (C) to indicate carpenter, a small a (a) following indicates making up centers, r would stand for roof, thus the entry at the top of the column would be Car.

It will be noted that this system is extremely easy to memorize and greatly simplifies the work of making labor distributions in the central office.

A. C. ENGINE TYPE GENERATORS.

A line of low speed, 60 cycle, engine type alternators embodying a number of new features of design has been recently placed on the market by the Westinghouse Electric & Manufacturing Company. The line covers capacities from 50 to 1100 Kva., 2-phase or 3-phase, and standard voltages of 240, 480, 600, 1,200 and 2,400 volts. A striking characteristic of the entire line, as shown by the machine already in operation, is the ability of the generators to successfully carry commercial loads of low power factor.

As the general construction and arrangement of parts of the revolving field generator is familiar to all, this description will be confined to the new features of this design, known as the type "E".

The stator frames are of such design as to give great rigidity and plenty of freedom for the end connections of the armature winding. At the same time the construction is economical of material and affords excellent ventilation. The frame consists of a one-piece casting, except in sizes of such diameter that a split frame is a necessity for shipping reasons. In such cases the halves are bolted firmly together, making practically a solid frame. The frames of the smaller sizes are provided with slide rails on which the frame can be shifted to expose the rotor.

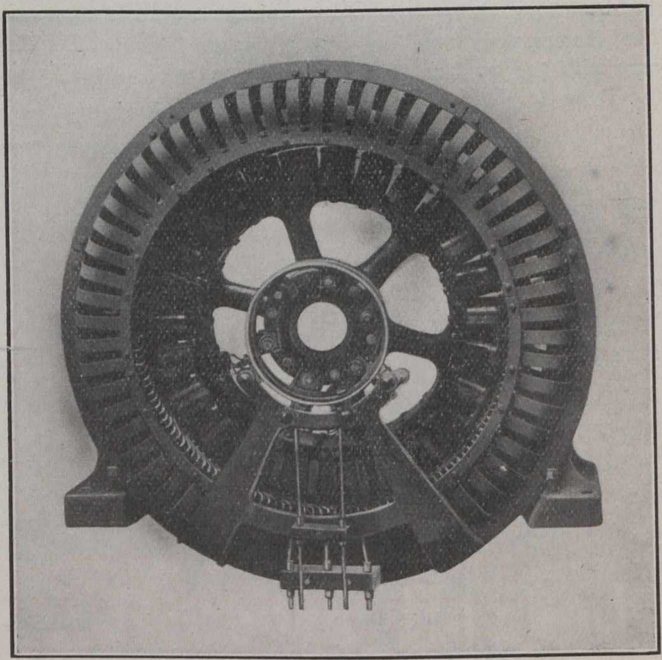
The armature core is built up of laminations of japanned steel of good magnetic characteristics. The laminations are dove-tailed in recesses in the frame. They are assembled under pressure and securely held by finger plates and end-plates. Generous ventilating ducts are provided in the core to maintain uniform low temperature. The teeth are firmly supported at each end of the core by finger plates.

Repairs to the armature winding are very easily made because of the design of the winding. The armature slots are open and the coils are held in place by wedges. The coils are entirely interchangeable and are completely formed and insulated before assembling in the core.

The end bells provided for the protection of the armature winding and attached to the end of the frame are of segments built up into circular form and so bolted together that they are light and open, yet rigid and indestructible.

The brush holder brackets, except in the larger sizes, are bolted to the armature frame, which makes each generator complete in itself. On the larger sizes, however, the brush holders are mounted on a pedestal which is to be bolted to the engine bed plate. At least two brushes are provided for each collector ring, which makes it possible to adjust any brush without opening the field circuit.

The rotor consists of a casting with laminated pole-pieces bolted on. The proportions of the casting are worked out with special reference to cooling strains, and the material used provides a homogeneous magnetic circuit. Edgewise wound strap is used for the field coils of all type "E"



generators. This makes an ideal construction for field coils as every turn of winding is exposed to the air and heat is readily radiated and dissipated. The insulation between turns is of fire-proof quality.

The entire design of the type "E" generators is arranged for thorough circulation of the air.

The field poles of type "E" generators are so designed that a cage damper winding may be used when desired. Such a winding consists of a series of copper bars embedded in the pole faces, with the ends short-circuited like the squirrel cage winding of an induction motor. The winding serves as an effective damper to any fluctuation and thus tends to prevent "hunting." The cage damper winding is not essential to satisfactory operation, however, when modern steam engines are used as the prime mover. Where internal combustion engines are used the cage damper winding is advisable.

The collectors are of the spider type, consisting of two machined cast iron rings mounted on a cast iron bushing or hub, from which they are carefully insulated. The hub is bolted to the rotor spider casting, so that the alignment is entirely independent of shaft adjustments.

Ample factor of safety is allowed throughout the mechanical design, and the electrical design is such that overloads and low power factors do not interfere with satisfactory service.

The Canadian Engineer

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Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS.

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

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CONTENTS OF THIS ISSUE.

CANADA'S MATERIAL PRODUCTION FOR 1910.

The preliminary report of John McLeish, B.A.A., on the Material Production of Canada for 1910 indicates that Canada's material production last year exceeded $105,000,000.00. Although complete statistics are not yet available, yet the information is sufficient to indicate that the production last year was 14 per cent. greater than the preceding year.

This report must be particularly gratifying, not only to those who are directly interested in the material products of Canada, but to the public at large, who are indirectly interested in all development.

The subdivision by provinces places Ontario in the lead with over 40 per cent. of the production to her credit. Next comes British Columbia with over 23 per cent.; Nova Scotia, 13 per cent.; Quebec, 7.8 per cent.; Alberta, 7.5 per cent., and the Yukon a little over 4½ per cent.

The noticeable increases are in Nova Scotia, where the coal and gypsum productions were large, and in Quebec, where the increases were largely in cement and asbestos. Ontario's increase was in the metals—copper, nickel and silver. A noticeable increase in clay products took place in Alberta and Manitoba, indicating the development of the brick plants, tile and sewer pipe manufacture.

The total value of structural materials and clay products reached almost $20,000,000.00, cement heading the list with about $6,500,000.00; brick comes next with almost $6,000,000.00 and limestone with about $2,500,000.00.

Complete statistics have been received from the manufacturers of cement, covering their production and shipments during the year 1910. These returns show that the total quantity of cement made during the year, including both Portland and slag cement, was 4,396,282 barrels as compared with 4,146,708 barrels in 1909, an increase of 249,574 barrels, or 6 per cent.

The total quantity of Canadian Portland cement sold during the year was 4,753,975 barrels as compared with 4,067,709 barrels in 1909, an increase of 686,266 barrels, or 16.87 per cent. The total consumption of Portland cement in 1910, including Canadian and imported cement, and neglecting an export of Canadian cement valued at $12,914, was 5,103,285 barrels, as compared with 4,209,903 barrels in 1909, or an increase of 893,382 barrels, or 21.22 per cent.

Detailed statistics of production during the past two years are shown as follows:—

	1909. Barrels.	1910. Barrels.
Portland cement sold..........	4,067,709	4,753,975
Portland cement manufactured..	4,146,708	4,396,282
Stock on hand January 1st.....	1,098,239	1,180,231
Stock on hand December 31st..	1,177,238	822,538
Value of cement sold..........	$5,345,802	$6,414,315
Wages paid	1,266,128	1,323,264
Men employed	2,498	2,085

The average price per barrel at the works in 1910 was $1.34, as compared with an average price of $1.31 reported for 1909, and $1.39 in 1908.

The imports of Portland cement into Canada during the twelve months ending December 31st, 1910, were 1,222,586 cwt., valued at $468,046. This is equivalent to 349,310 barrels of 350 pounds at an average price per barrel of $1.34. The imports in 1909 were 142,194 barrels, valued at $166,669, or an average price per barrel of $1.17.

The imports from Great Britain during 1910 were 123,880 barrels, valued at $130,951; from the United States, 168,972 barrels, valued at $253,463; from Belgium, 19,027 barrels, valued at $20,618; and from other countries, 37,431 barrels, valued at $63,014.

Following is an estimate of the Canadian consumption of Portland cement for the past six years:—

	Barrels. Canadian.	Barrels. Imported.	Barrels. Total.
1905	1,346,548	918,701	2,285,249
1906	2,119,764	665,845	2,785,609
1907	2,436,093	672,630	3,108,723
1908	2,665,289	469,049	3,134,338
1909	4,067,709	142,194	4,209,903
1910	4,753,975	349,310	5,103,285

The increase in the production of pig iron was 5.5 per cent., making a total production of eight hundred 797 short tons, valued at eleven and a quarter million. These figures do not include the output from electric furnaces, which are situated at Welland, Sault Ste. Marie, Ont., and Buckingham, Quebec, which make ferro-products.

The classification of productions for 1910 is as follows: Bessemer, 219,492 tons; basic, 425,400 tons; foundry, including miscellaneous, 138,741 tons. The amount of imported ore used was almost a million and a half tons, while the amount of coke imported almost equalled the amount of home production, which was 499,717 tons.

ADVERTISEMENTS.

There is a great deal of talk nowadays about the obligations of the engineer to his client, the merchant to his customer, and the manufacturer to his selling agent, and we think that some consideration should be shown to the reader of advertisements by the advertising copy writer.

Frequently advertisements are prepared with a view to attract without full regard to the obligations of honestly stating the value, usefulness or reliability of the machine or contrivance referred to.

This tendency to overstate the qualifications of the thing advertised fortunately finds small place among the advertisers in technical publications, but occasionally this does occur, and not only does that journal suffer which allows the advertisement to appear, but the other advertisers sometimes suffer because of the statement in the advertising pages of one irresponsible.

As the advertiser has an obligation in the matter of copying, so has the reader when he makes enquiries. Sometimes all he requires is catalogues for information and has no intention of purchasing. He would save himself much annoyance and the firm to whom he inquires considerable trouble if he would state candidly that is all he requires. The catalogue would be just as gladly sent. Some people are so negligent of business courtesy as to neglect answering the first inquiry that follows the sending of the catalogue. The firm that have been kind enough to forward a catalogue and to follow it up later with an inquiry as to its safe arrival should at the very least be accorded a reply thanking them for their favor and intimating just the requirements of the receiver.

Advertising is expensive, and catalogue publishing is expensive, and the information given, both in the advertisements and in the catalogues is valuable, and if the recipient of catalogues would be more courteous towards the sender.

A MECHANICAL WATER TESTING MACHINE.

Messrs. Digby & Biggs have brought into vogue a novel method and appliance for testing water, the apparatus being known as the Dionic Water Tester. The function of the apparatus is not to analyse water, but to measure the amount of extraneous matter dissolved in water or other liquids.

There is no pretence made that the machine will discriminate between one kind of substance and another. Before making use of the apparatus it is necessary that the ordinary chemical analysis be made in order to determine the classification of any foreign ingredients. After this determination the machine affords a ready, simple and practical method of measuring the quantity of such ingredients. It should be of practical use in determining the extent of hardness for boiler use where the character of the hardening qualities are already known.

The principle of the Dionic water tester is both novel and interesting, and is based upon a fact demonstrated by Kohlrausch: that the conductivity of pure water containing any electrolytic substance in solution is due almost entirely to the dissolved substance, and only to a negligible extent to the water itself. The purpose of the machine is, therefore, to simply measure the conductivity of any particular water; such measurement gives the amount of impurity present. Actual measure tests can be made by any unskilled person, and traces of impurity measured which would, owing to their minuteness, escape ordinary chemical measurement analysis.

The makers claim that its practical utility comprises measurement of impurities in connection with "Hardness of water"; "Degree required in water-softening apparatus"; "General testing of a water supply, after constituent ingredients of water are known by ordinary analysis"; "Leakage into a surface condenser"; "Boiler Priming"; "Pollution of rivers (measure of)"; "At sewage works (measurement of any change in quantity of constituents in effluent)"; "Purity of distilled water," etc.

To take an example: In the case of river pollution, if two tests of the water are made, one above the outfall and the other below, the presence of sewage effluent will be immediately detected by the increased conductivity of the water below the outfall. The method has the advantage that an inspector can easily carry the apparatus with him and make his tests on the spot, thus avoiding the errors due to the rapid change which takes place in sewage polluted water if bottled for any length of time.

Again, whenever it is important to keep a continuous check and record of the character of a water supply, the tester enables all laboratory analyses subsequent to the initial one to be dispensed with until such time as the conductivity indicates an alteration to the character of the water by an increase in the substances present.

Messrs. Vandeleur & Nichols (Toronto) are the Canadian agents for this novel and practical instrument, which is bound to become part of the paraphernalia of every chemical laboratory, as well as find ordinary use by those who are incapable of making chemical analysis.

CHLORINE TREATMENT OF TORONTO'S WATER SUPPLY.

The disinfection of Toronto's water supply by the use of hypochlorite, derived from calcium hypochlorite, has proved most effectual, especially during the recent contingency, when the city has had to fall back upon the sewage-polluted Bay water for its domestic supply.

Apart from the question of the value of hypochlorite as a permanent adjunct in connection with any water purification plant where organic and pathogenic impurities are apt to exist, it is established beyond all shadow of doubt that, at least as a temporary method during critical periods, the effects of the disinfectant are remarkably successful, and warrant its use.

Toronto mixes with its water, which undergoes at present no other form of purification treatment, only half a part of free chlorine to 1,000,000 parts of water. The proportion of half a teaspoonful to one million teaspoonfuls appears to the practical mind as so absolutely infinitesimal that the marvel is that any effect whatever is produced.

That an effect, and a great effect, is produced is absolutely apparent. This effect is happily apparent in the abnormal low typhoid rate which has characterized the zymotic statistics of Toronto ever since chlorination was introduced in May of last year. Especially is this so in the three cases of typhoid which occurred in February of this year as compared with the epidemic which marked the corresponding month of last year.

Dr. G. G. Naysmith (City Bacteriologist) published on February 24th the following remarkable results in the elimination of bacteria by the use of the chlorine:—

"Before treatment the water showed B. Coli present in two samples taken at 9 a.m. and 11 a.m., while 16,000 and 8,700 colonies of bacteria per c.c. were found in the respective samples. After treatment samples taken at 11 a.m. and 12 a.m. showed Coli absent and only 41 and 78 colonies of bacteria per c.c. These figures give respectively for each sample a 99.7 and a 99.1 per cent. reduction in bacteria.

Again on the following day samples of untreated water were taken at 9 a.m., 10 a.m. and 11 a.m., Coli being present in all, with bacteria counts of 2,420, 1,770 and 2,101. After treatment samples showed no Coli present, with bacteria counts of 63, 79 and 43, respectively. Here we have an average reduction of 97 per cent.

That Toronto should be obtaining results which were previously only looked for by methods of filtration is truly remarkable, and speaks volumes for the marvellous efficiency of chlorine as a disinfectant of water.

While chlorine has certainly relieved the typhoid risk in Toronto, owing to the temporary necessity of relying upon acknowledged sewage polluted water, there have not been wanting complaints of dissatisfaction with what is being termed "a chemically doped water." Chloride of lime does not sound nice in connection with drinking water, and certainly one must regret the necessity for its use. After all, however, is not the objection more of sentiment than otherwise? Chloride of lime is simply ordinary lime which has been made to absorb about 33 per cent. of chlorine gas. In adding half a part of chlorine to one million parts of water, it is necessary to use one and a half pounds of chloride of lime to every 1,000,000 pounds of water. Thus only one part in 1,000,000 of ordinary lime is added to the water, whereas the water contains naturally about 19 parts in 1,000,000 of ordinary lime to start with. Again, when one appreciates the proportion of half a teaspoonful of chlorine to 1,000,000 of water, and further appreciates the fact that this chlorine undergoes almost an immediate reaction by combination with the hydrogen of the water and the liberation of nascent oxygen, is it possible to conclude otherwise but that sentiment only must form the chief objection to its use? Of course, it is possible to overdose a water with chlorine, and so find traces of free chlorine in the water, but such a contingency can only be due to careless administration and defective apparatus.

The question has been asked in Toronto as to the effect of chlorinated water on plant life, and we understand that at least one nurseryman has made complaint of sickness in plant growth since the installation of the method. If the small proportion of chlorine added is maintained, we are at an entire loss to understand how any ill effects to plant life can be attributed to it. There is no doubt, if water was used for plant growth containing a proportion of hypochlorite equal to producing sterilization of the soil, but that growth would be retarded by the elimination of the nitrifying bacteria which produce the nitrates or basic nutriment for plant life. Granted, however, that the chemical reaction has taken place long before the water reaches the garden, it is impossible to imagine any further sterilizing effects in the water. The initial destruction of bacteria in the raw water may, however, have some weakening effect upon its stimulating properties in bringing about nitrification in soils. It is well known that rain water has a more stimulating effect on plant life than ordinary pure water, owing to the nitrates contained. We consider that the subject of the effect of chlorinated water is one worth while investigating at the agricultural experimental stations, as if it is found that the addition of chlorine to water weakens its stimulating effect, it is a simple operation to dechlorinate or neutralize any such ill effects.

THE AMERICAN INSTITUTE OF CONSULTING ENGINEERS.

At a meeting of the council, held February 24th, 1911, it was decided to oppose all the bills now pending in the Legislature at Albany to license civil engineers, and the president, Mr. Boller, and the Committee on Legislation of the Institute were instructed to attend the hearings on these bills at Albany, and to use all legitimate means to prevent their passage; also to co-operate with other engineering bodies having a like object in view.

CONGRESS OF TECHNOLOGY.

A Congress of Technology will be held in Boston on April 10th and 11th in celebration of the fiftieth anniversary of the granting of the charter of the Massachusetts Institute of Technology. In line with this idea the fifty or more papers which will be presented at the Congress will be written by graduates of the Institute, and will thus serve to record the part the alumni of the institution have taken in the development of scientific industry.

As the titles of these papers are sent in by the writers, it is becoming evident that the managers of the Congress will succeed in their effort to make the proceedings of the Congress show from another point of view the general industrial advance that has taken place during the past fifty years under the guidance of trained engineers. The papers will cover a wide range of subjects, from architecture to sewage purification, and the names and professional standing of the writers show that they will together discuss authoritatively every important problem of modern industrial technique and management.

It is already clear that this record is not limited to any narrow activity within merely technical lines, but that it covers the broader problems of the relations of science to industry, the place of the engineer in creating a more efficient type of industrial management, and the general shaping of material conditions to serve alike the changing conditions of business and the improving conditions of labor.

EDITORIAL NOTE.

The thirteenth annual meeting of the Canadian Mining Institute is now in session in the city of Quebec, Que. This association, of which Mr. Frank D. Adams is president, and H. Mortimer-Lamb is secretary, is the largest and most representative of the societies which appeal to the mining men.

INSTITUTE OF CIVIL ENGINEERS.

Sir;—On page 291 of your issue of 9th February appears a most interesting contribution by Mr. William Storrie, on the subject of the "Canadian Society of Civil Engineers," in which he makes reference to the practice of the Institution of Civil Engineers, London, England.

When Mr. Storrie, in speaking of papers read before associations of students, states that "on no consideration whatever will the parent body publish those papers in the transactions," he is under a great misapprehension. The writer, when a student, read a paper before the Manchester Association of Students, which paper was published by the Institution in their Minutes of Proceedings, and also issued by them in pamphlet form.

This is by no means a unique case, and is an example which might be followed by the Canadian Society of Civil Engineers with beneficial results to its members.

Although not having the honor to belong to the Canadian Society of Civil Engineers, I am very much interested in their advancement.

Yours faithfully,

Robert Bruce, Assoc. M. Inst. C.E., A.M.I.E.E

Vancouver, B.C., February 22nd, 1911.

ANNUAL CONVENTION OF THE AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.

The twelfth annual convention of the American Railway Engineering and Maintenance of Way Association will be held in the Florentine room of the Congress Hotel, Chicago, on March 21, 22 and 23, 1911. There will be two sessions daily, the morning session beginning at 9 o'clock, and the afternoon session at 2 o'clock. In addition to this there will be an evening session on March 21, and the annual dinner at 7 p. m., March 22. The program, as announced by the secretary, is as follows:

First Day, March 21.

President's Address.
Reports of Secretary and Treasurer.
Reports of Standing and Special Committees.
Rules and Organization .... Bulletin 129
Signals and Interlocking .... Bulletin 130
Electricity .... Bulletin 127, 130
Special. Brine Drippings from Refrigerator Cars .... Bulletin 129
Yards and Terminals .... Bulletin 129
Wooden Bridges and Trestles .... Bulletin 130
Iron and Steel Structures .... Bulletin 130
Economics of Railway Location .... Bulletin 130

Evening Session.

Special. Illustrated Lecture on Steel Rails, by M. H. Wickhorst, Engineer of Tests for the Rail Committee; being a digest of the investigations made by the Rail Committee.
Informal Smoker.

Second Day, March 22.

Ballast .... Bulletin 129
Ties .... Bulletin 131
Track .... Bulletin 131
Rail .... Bulletin 123, 132
Masonry .... Bulletin 130
Water Service .... Bulletin 130
Signs, Fences and Crossings .... Bulletin 130
Annual Dinner at 7 p. m.

Third Day, March 23.

Records and Accounts .... Bulletin 131
Wood Preservation .... Bulletin 131
Special. Grading Rules for Maintenance of Way Lumber .... Bulletin 131
Buildings .... Bulletin 131
Roadway .... Bulletin 133
Special. Uniform General Contract Forms.. .... Bulletin 133
Conservation of Natural Resources ..... Bulletin 133
New Business.
Election of Officers.
Adjournment.

The officers of the association are as follows:

President, L. C. Fritch, chief engineer, Chicago, Great Western R. R., Chicago.

First Vice-President, W. C. Cushing, chief engineer maintenance of way, Pennsylvania Lines, Southwest System, Pittsburg, Pa.

Second Vice-President, Charles S. Churchill, chief engineer, Norfolk & Western R. R., Roanoke, Va.

Secretary, E. H. Fritch, 962-3 Monadnock Block, Chicago.

Simultaneously with the convention, there will be held at the Coliseum, Chicago, the annual meeting and exhibition of the Railway Appliances Association.

DOMINION ASSOCIATION OF LAND SURVEYORS.

The annual meeting of the Dominion Land Surveyors' Association took place at Carnegie library, Ottawa, on Tuesday and Wednesday, March 7 and 8. A comprehensive program covering the two days, was as follows:

Tuesday, March 7.

Morning, at 10—Opening address by the president, Thos. Fawcett, D.T.S., O.L.S.; correspondence; business.

Afternoon, at 3—Address by Wm. Ogilvie, D.L.S., entitled Reminiscences of Camp Life on Surveys in the North-West during the last 30 Years; discussion, etc.

Evening, at 8—Annual dinner.

Wednesday, March 8.

Morning, at 10—Address on the management of a survey party in the field, by F. H. Kitto, D.L.S.; discussion; 11.30 a.m., discussion of any business of importance before the meeting.

Afternoon at 3—Address on the Calendar, by Dr. W. F. King, C.M.G., D.T.S., hon. president.

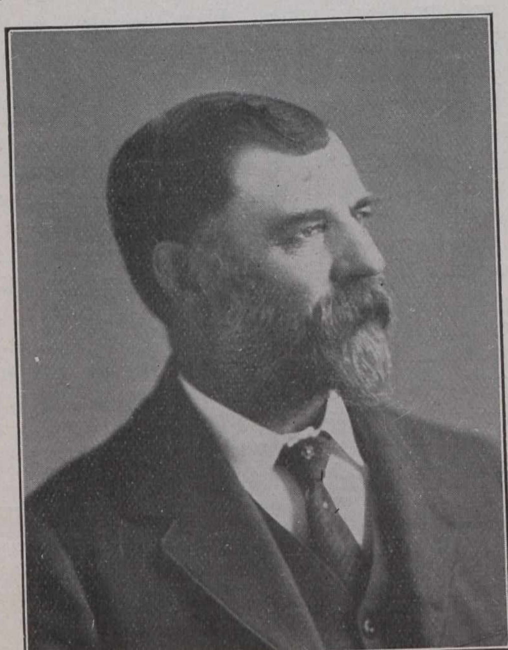
Evening, at 8—Address on The Measurement of the Kootenay Base Line with Invar Wires, by P. A. Carson, D.L.S.

Further particulars may be obtained from Sec.-Treas. A. W. Ashton, department interior.

THE ONTARIO GOOD ROADS ASSOCIATION.

The ninth annual convention of the Ontario Good Roads Association convened March 1st, at 10 o'clock in the York council chamber, Toronto, and in the absence of W. H. Pugsley, the president, T. W. Kennedy of Cooksville officiated. There was a fairly good attendance, probably 150 delegates having registered.

A resolution introduced by Mr. Bowman of Waterloo, requesting the Ontario Government to increase their grant from one-third to one-half on standard macadam roads, was discussed, but laid over for further reference.



W. H. Pugsley,
President Ontario Good Roads Association.

Mr. Russell of Coleman Township introduced the novel idea that the government ought to consider the assessments and revenues of the different northern townships in their appropriations, and accord to each grants according to their financial ability. The wealthier municipalities should not receive so much money in grants as the poorer.

E. M. Maxwell, of Cleveland, Ohio, formerly of Essex, explained the system of good roads construction in Ohio. The state appropriated $440,000, divided among 88 counties, each receiving $5,000. An additional tax of $5,000 was raised by direct taxation, making a round sum of $10,000. He then described in detail the course outlined.

Complained of Motorists.

Reeve Kennedy, of Toronto Township, gave an excellent paper, treating more particularly of the maintenance rather than construction. Perfect drainage was essential. Referring to the presence of automobiles on the country roads, Mr. Kennedy stated that he lived on Dundas Street, and that as many as 300 autos passed and repassed there within a day. The dust was most offensive to residents along the highway, and Mr. Kennedy suggested that a tax be imposed, or that the auto owners be required to pay for the cost of oiling or watering the streets. The ordinary farmer's rig raised little or no dust. No action was taken along this line.

C. R. Young, C.E., of Barber & Young, gave an interesting address on "Highway Bridges From an Investment Point of View." While technical in its nature, Mr. Young clothed his statements in plain everyday language. Dealing with the quality of material, of which bridges in general ought to be built, Mr. Young gave concrete preference over steel, except in cases of great length. Frequent painting also tended greatly to preserve the life of the bridge.

Mr. L. J. Street, in his discussion on "Shop Fabrication and Erection of Highway Bridges," had an excellent model of a 60-ft. highway bridge constructed on a scale of a half inch to a foot.

This model was worked by Wm. Cushing, a graduate of Cornell University, and at present engaged by the Hamilton Bridge Company.

THE NIAGARA RIVER BOULEVARD.

John H. Jackson, C.E.

The name Queen Victoria Park for the most part, I suppose, calls to mind when it is mentioned the Falls at Niagara and the public domain skirting the gorge and upper rapids, some two hundred acres in extent, set apart for a breathing spot to be enjoyed by the thousands of visitors who annually come from far and near to view the mighty cataract. It is with considerable surprise that the vast majority of tourists, both from our own land and across the border, learn that the name stands for a system of parks and interconnecting lengths stretching along the Niagara frontier from Lake Erie on the south to Lake Ontario on the north, comprising within its borders over eight hundred acres of land, whose extremities are some thirty-five miles apart. Commencing at the old village of Fort Erie, where Lake Erie discharges its waters into the Niagara River, a considerable acreage surrounding the ruins of the old fort, historic for its part in the War of 1812, is preserved with all the early earthworks, an interesting spot for the historian and rich in memento for the relic hunter. Situate midway between the lakes is the park proper, where the administration offices are located, and the most highly developed portion of the system. Here also is the Lundy's Lane battlefield, occupying the highest elevation in or around the city of Niagara Falls, and the last resting-place of many heroes on both sides of the bloodiest battle of the conflicts of 1812. Farther down the river there is Whirlpool Point and Niagara Glen, where the rough and rugged rocks, chaotic in their setting, are looked upon with more wonder than the areas developed by the highest skill of modern landscape art. Here primitive nature reigns supreme, and receives her rightful share of adulation. On the brow of the escarpment overlooking the Niagara fruit lands and the lower river is the Queenston Heights Park, memorable for the battle in which General Sir Isaac Brock lost his life. The towering shaft, some one hundred and seventy-five feet in height, erected here to his memory, may be seen for many miles around. At the mouth of the Niagara River adjoining the town of Niagara-on-the-Lake, there is Butler's Burying Ground, where Colonel John Butler and others of the Butler family lie buried. All of these plots and parks are under the care of the Commissioners, and, with the sixty-six-foot reserve along the entire frontier, form a continuous chain of territory to be expanded and developed for the people.

In the years 1890 and 1891 the Governments at Ottawa and Toronto granted to the Park Commissioners in trust the old chain reserve in the townships of Bertie, Willoughby, Stamford and Niagara, these four municipalities crossing the entire frontier from lake to lake. This reserve comprised a width of sixty-six feet, measured from high-water mark, and was used, where the contour of the surface permitted, as a highway and means of communication between the settlements and villages bordering on the river. It was the main travelled roadway from the earliest times. On the upper river, particularly, and at points below the Falls, the erosive action of the swift waters materially diminished the width of sixty feet until it had entirely disappeared. At intervals, when the Commissioners came into possession, and at many other places this was prevented only by the planting of willows and placing of stone where the owners wished to protect their own lands from being encroached upon. The Park Board realized from the beginning the importance of protecting the shore line and making the reserve an integral part of the park system, but, from the lack of financial support and owing to the large demands for the most necessary works in the park proper, where the tourists came in large numbers, nothing was attempted for some years. In 1898 it was thought that some definite step might be taken, and a report was made giving the physical condition of the property with recommendations for not only preserving the land from erosion, but by a system of groins extending into the river at an angle with the current to make it possible for accretions to form from the sediment being carried down stream. The expense of this appears to have been too large to enter upon, and land was purchased from the lots fronting upon the reserve at several places where the roadway had been narrowed to an impassable width. This was in the year 1899, and in the following year an agreement was entered into with the Fort Erie Ferry Railway Company whereby that corporation procured a franchise for an electric railway between Chippawa and Fort Erie along the river on condition that the bank should be properly protected and sufficient property purchased to form a road after the width required for right-of-way was taken off. This project was approved by the Government, and the plans were prepared for construction, when one of the chief promoters interested in the scheme died, and the franchise lapsed without any construction being attempted. In the years 1902 and 1903 small sums were expended in acquiring additional lands where the highway had partially disappeared, but by the year 1904 the action of the stream had become so marked as to require immediate action, and a permanent scheme of rip-rap work was entered into. This work was prosecuted during the years 1905, 1906, and 1907, while general plans were being discussed looking to the construction of a boulevard or esplanade to extend from the Queen Victoria Park to a point opposite Buffalo. By the spring of 1908 the plan had taken definite shape, and an initial expenditure of one hundred thousand dollars ($100,000) had been authorized by the Government to pay for shore protection and the building of a roadway, with the incidental requirements. Surveys were begun and plans made showing the layout of the lands, with the problems to be solved in the completion of the project. After careful consideration and a thorough examination, it was decided to acquire a minimum width of one hundred feet from the top of the bank to extend from the northerly limit of the village of Bridgeburg through Black Creek and the village of Chippawa into the park at the Dufferin Islands. All abrupt projections were to be added, and at intervals, when the nature of the ground permitted, sufficient extra width was to be included to allow of special features being planned in the planting. The width being measured from the top of the bank leaves the space to the water's edge for park development, where it is fit for the purpose, and provides enough room for building the rip-rap protection. This decision to proceed with preliminary plans marked the real beginning of the boulevard scheme as a work that had to be completed. The surveys showed that nearly one hundred parcels of land had to be purchased from owners fronting on the proposed new road, and, strange as it may seem, the majority chose to stand in the way of progress notwithstanding the very liberal offers of compensation that were made for property that ultimately stood to benefit many times the value of the acreage that was taken for park purposes.

The general arrangement comprises lawns, trees, shrubbery and a first--class macadam roadway. From the top of the bank fifteen feet is taken up with planting that will not obstruct the continuous view of the river, and adjoining this thirty feet is set apart for roadway purposes, while the remaining fifty-five feet will be utilized in lawns and shrubbery and a pathway.

The extent of the work under consideration gives a continuous road from Niagara Falls to the entrance into the villages of Bridgeburg and Fort Erie, some nineteen miles, and the remaining length in the two villages will likely be provided for by joint action on the part of the Commissioners and the two councils. When the whole of this work is completed a trip may be taken up the Niagara River along the Canadian shore, and the return may be made on the New York side on the new State boulevard now under construction.

The road occupying the thirty feet of width on the river side consists of eighteen feet of macadam construction, with six feet on either side for the shoulder and gutter, and it is laid out with tangents and circular curves in a similar manner to railway lines, with curves of large radii to avoid as far as may be abrupt changes of alignment. Complete profiles and sections are obtained, and the grades are carefully struck to provide for proper drainage and to balance up cuts and fills. With over five miles in one section almost a level area, it is at once evident that the drainage problem requires much consideration. The typical section adopted shows a road with nine inches of crown in the eighteen feet of stoned surface, and the shoulder of clay slopes in its width of three feet ten inches to the bottom of the gutter, which has a bottom width of two feet. The remaining two feet on either side forms the outer slope of the two gutters. From the centre of the road to the gutter, therefore, there is a curved slope of nineteen inches, rather more than would be given were the natural grades not so flat. The depth of stone on the centre line is ten inches, gradually reducing to seven inches at the edges, nine feet away on each side. The subgrade, therefore, has a crown of six inches, and the lowest point of the subgrade next to the shoulder will drain to the gutter with three inches of fall. Every effort is made in building to make the macadam not only to shed water, but to make it impervious to water, and it is believed that the section described will materially assist in this direction. In some stretches of very uncertain material though side-drains of field tile leading to the catch-basins may be laid.

The first work by the contractor after the right-of-way has been cleared of fences, trees and buildings, is to commence the drainage system for carrying the waters from the gutters to the river. This consists of outlet drains from the water's edge across the road itself, and extending to the landward limit of the esplanade lands. These cross-drains, or outlets, are spaced from five hundred to eight hundred feet apart, as the natural slope of the adjoining land and the gutter requirements call for, and the water enters the outlet by three catch-basins, one in either gutter and one at the end opposite the river side. The size of pipe used varies with the location, but ordinarily is twelve inches in diameter, and of concrete laid to a minimum grade of 0.5 per cent. The discharge end is protected by a hand-laid dry masonry headwall and apron. This structure is bedded under the last two pipes twelve inches deep for three feet, and the apron extends to and below the normal water level in the river. It is carried two feet above the top of the pipe and two feet on either side. This heavy block of dry wall is designed to prevent under-cutting and washing of the river slope in time of heavy freshet. The catch-basin itself is not built until the gutters are excavated and the shoulder shaped when it is placed with its top at the grade of the gutter at the point of its location. It consists of a fifteen-inch concrete tile, and the junction with the twelve-inch discharge is made with a block of concrete two feet two inches long and bedded four inches below the bottom. No sump is left in the catch basin for the length of pipe is short, and it is preferred that any sediment should be discharged into the river. The opening of the catch basin is protected by a circular cast-iron top designed to fit the pipe with a collar one and three-eighth inches in depth.

When the drainage outlets are well in advance, excavation for the subgrade is proceeded with according to the levels staked upon the ground by the field men in charge, along with the inspector of a working section of the road. This work varies greatly, requiring much labor in the heavy clay and progressing rapidly in the sandy loam. The trimming to the required section is done by an ordinary road grader, and from one to two inches is left to be consolidated by the heavy road roller (twelve to fifteen tons), which is now placed to work. With the eighteen feet to the proper elevation and section and the side gutters roughly excavated to the top of the macadam surface the foundation stone is started. This is a layer of heavy, unquarried, irregular stone, five inches in depth at the centre, and four inches at the shoulder. It is hand-laid with projecting points, and edges knocked off with the hammer to fill the crevices. With the harder class of stone in the vicinity this course must be filled with screenings before rolling commences, but when the base course is of medium soft stone, the roller is placed to work without filling and enough of the projections are worn off to fill the interstices. This layer is thoroughly compacted and rolled to its required camber and then follows a layer of three to two-inch stone, three inches deep at the centre, and two inches deep at the shoulder. This middle course is filled but lightly with screenings and watered and rolled when the top course of one inch stone is added and rolled into the honey-combed of three to two-inch stone. This top layer is two inches deep at the centre of the road, and one inch at the shoulders. Rolling now continues till the whole is completely compacted, and the roadway shows an acceptible surface for traffic. The work now remaining is the shaping of the shoulder and gutter with the placing of the catch basins. The clay shoulder must be rolled to its required section to show a continuous crown between side ditches.

The stone of the Niagara district, for the most part limestone, varies considerably, and a close inspection has to be maintained to ensure a hard tough quality of metal particularly for the top courses. Some of the material offered crushes under the roller until there is practically nothing but screenings for wearing surface. But by careful selection and strict enforcement of the requirements a very fair quality of stone is being procured. In addition to the road drainage all of the water courses and large ditches are taken care of by either single or double box culverts of reinforced concrete and bridges of artistic design. The streams of any considerable size emptying into the Niagara River between Chippawa and Bridgeburg, and requiring to be spanned by bridges, are six in number. These structures will all be of the arch type, built of concrete, reinforced with steel and veneered with limestone or sand stone, except on one span where concrete is used in massive form. The bridges vary from thirty feet to seventy-five feet in span, and each one is individual in its architectural features.

From the beginning of construction work the problem of maintenance has been kept prominently in the foreground, and the sections of roadway already completed have been under constant inspection to learn the effect of the traffic, and note the efficiency of the drainage. In addition to the studying of conditions a series of experiments is being conducted by the engineering department with dust laying preparations and surface binders to determine the cost and effect of the products that are being offered to keep the top course from ravelling. It too often happens that the main construction is given much intense consideration, and its details are worked out with so much thought that the matter of operating the system receives but scant attention, and yet the success of the road like any other work depends upon whether it will perform its function as it is designed to do and resist obstacles in its pathway. Only recently it was publicly stated that on one of the large road systems the construction laid at the first of the season was failing before the contractors laid off for the winter. Several binders have given evidence of their value in the roadways in the park, and the cost has not been excessive, but the same product gives different results under different conditions, and a proper selection must be made for the roadway to be treated.

THE ONTARIO LAND SURVEYORS' ANNUAL MEETING.

The annual meeting of the Ontario Land Surveyors' Association was held at the Engineers' Club, Assembly Room, Toronto, February 28, March 1st and 2nd. A number of very interesting papers were read, together with a large amount of business having to do with the affairs of the Association. Mr. C. H. Fullerton suggested that the existing mining law should be readjusted, so that the survey of a claim by a qualified surveyor should be accepted as title to that claim. He would abolish the present custom, which forces the prospector to put a certain amount of work into his claim before he can hold it. This, he claimed, would not only benefit the miner, but also the surveyor, while the Government would have an accurate delineation of the land, and many of the disputes which now arise would be obviated.

Prevention of Dust.

"Surface treatment of roads as a preventive of dust and a preservative" was the title of Provincial Engineer W. A. MacLean's address, though he dealt with the methods by which the roads of Ontario could be bettered. "The general situation at the present time," he said, "has shown the value of petroleum oil as a dust palliative, and the use of tar is a promising field in Canada, as it affords an opportunity of being less dependent upon patented materials and the larger asphalt and oil trusts."

The quality of stone used in the road has a marked influence upon durability, no matter what binder may be employed. Western Ontario has only limestone, while some parts of eastern Ontario are better favored with the more durable rocks. Field stone when used should be selected and inferior stone removed, while for roads of heavy traffic much would be accomplished by securing for the wearing surface a coat of good granite.

City Extension.

Mr. T. B. Speight urged that a recognized system of city extension should be adopted, and cited the methods in vogue in New York, where streets are laid out years in advance of the needs of the population.

Mr. C. H. Mitchell, who was resident engineer of the Ontario Power Company at Niagara Falls gave a paper on "Hydro-Electric Developments."

Lantern slides were used by Mr. Mitchell to illustrate high, intermediate and low water falls in Italy, France, Switzerland, Austria, Mexico, and Canada, and the machinery used with the different heads of water at those falls.

In the evening the annual dinner was held, Mr. J. F. Whitson being in the chair. The guests included Mr. Frank Arnoldi, K.C., Dr. Wm. Ellis representing the University, Dean Galbraith, Mr. R. E. Stupart of the Observatory, Mr. E. A. James, and Mr. H. Irwin of Montreal.

The officers for 1911 are as follows: Mr. J. F. Whitson, Toronto, president; Mr. T. B. Spreight, Toronto, vice-president, and Captain Killaly Gamble, secretary-treasurer. The following nominations were made for the Council: G. B. Kirkpatrick and A. R. Davis, Toronto; J. M. Watson, Orillia; W. J. Blair, New Liskeard; J. S. Dobie, Thessalon; J. H. Moore, Smith's Falls. Elections will take place next month by letter ballot. Two are returned to office. The auditors are: J. H. Burd, Sudbury; N. A. Burwash, White Horse, Yukon.

CARBON IN IRON AND ITS INFLUENCE ON THE GRADING OF PIG.*

By W. J. Foster (Darlaston).

An accurate knowledge of the effect of carbon relatively to the action of other elements present is undoubtedly of great importance in determining the physical properties of cast iron, and the observations here described were made with the object of arriving at a simpler and more effective way of explaining the general properties of cast iron, of arriving at a more definite system of standardizing by fracture and other physical properties, and of avoiding the constant introduction of unnecessary analytical operations, particularly with regard to foundry irons.

The chief factors which lead to the separation of carbon and have, therefore, a tendency to govern the appearance of the fracture and the general properties are: First, the casting temperature of the iron, or the temperature when leaving the furnace; second, the time allowed after casting from its maximum temperature of carbon saturation to the point of total solidification necessary to ensure the total separation of free carbon; and third, the quantity of each of the elements in chemical combination or in solution in the iron.

These statements deal only with the separation of carbon from the iron after leaving the furnace, and the total carbon content of the iron is found to vary considerably, under regular working conditions the range being from 3.163 to 3.272 per cent. Under abnormal conditions the range was even more considerable, being from 3.164 to 3.965 per cent. In this latter case the iron with least carbon contained 120 per cent. more sulphur and 33 per cent. less silicon.

With regard to the variation of solubility in the blast furnace, the author has found that:—First, the variation increases with the irregular temperature produced in the neighborhood of the tuyeres, together with the rate of driving; second, the separation or diffusion of the various constituents held in solution has some relation to the difference in their specific gravities; and third, it is found that under normal conditions the lowest total carbon accumulates at the lowest level in the hearth, owing to loss of heat by absorption in the foundations and general working conditions. This fact appears to show that the ultimate absorption of carbon in cast-iron is absolutely independent of the chemical reactions involved in bringing about carbon precipitation and impregnation.

The result of the chemical and physical changes which take place in the top reducing zone of the blast furnace, assisted by slight variations in the temperature and pressure, is that a proportion of the precipitated carbon is mechanically mixed with the iron until the temperature is raised sufficiently high to allow of diffusion and, ultimately, the first stage of solution.

A sample of iron was taken from a furnace just before a 9½ hours stoppage for cleaning flues, etc., and a second sample was taken just before the blast was again put on. Analysis proved that there had been a reduction in the total carbon of the metal, as follows:—

	Per cent.
Total carbon before stopping	3.362
Total carbon after stopping	3.187
Difference due to reduction of temperature	0.175

To ascertain the amount of graphitic carbon that would separate from normal cast-iron through a given range of temperature outside the furnace, a sample of grey, close-scattered No. 4 iron, such as does not ordinarily allow the graphitic carbon to separate at the point of solidification, was treated, from its melting point to the temperature of an electric arc, in a pure carbon crucible, completely covered except for the electrode opening. A pig-iron such as this sample can be made to leave the furnace at a sufficiently high temperature for a considerable quantity of fumes (consisting chiefly of carbon) to be evolved from the surface of the metal, whilst the oxidation of the metal itself is practically prevented.

The composition of the metal before and after heating in the crucible was:—

	Before. Per cent.	After. Per cent.
Total carbon	3.110	3.648
Graphite	2.582	1.800
Combined carbon	0.528	1.848

The carbon actually absorbed, 0.528 per cent., would at least equal the quantity thrown out of solution on cooling the same saturated iron through the same range of temperature.

To ascertain the saturation point in ordinary commercial steel, punchings were taken from a steel section and melted in a carbon crucible in a similar manner to the electrical experiment referred to.

The quickly chilled product was a crystallized mass containing a considerable amount of graphite as thin flakes, and large pockets in a solid solution of carbon, and had the following composition:—total carbon, 4.665; graphite, 2.136; combined carbon, 2.529; silicon, 0.098; sulphur, 0.073; phosphorus, 0.063; manganese, 0.454 per cent.

As the carbon saturation temperature in the experiments could not be ascertained, a further series of experiments was made, in which iron taken from the blast furnace was gradually cooled to near the freezing point, a typical result being:—The iron from the furnace was poured into a red-hot crucible, a little charcoal was added to prevent any oxidation or change in the chemical composition, and a very small quantity of grey slag from the same cast was also added to make a thin layer on the surface of the metal. The pot was hermetically sealed and the whole placed in the electric furnace.

The measured temperature of the iron when poured into the pot was 1,560 degrees C., and at the end of the trial, and

*Abstract of paper read before the West of Scotland Iron and Steel Institute.

approximating the freezing point, was 1,195 degrees C. The analysis was:—

	Before. Per cent.	After. Per cent.
Total carbon	3.932	3.326

from which it will be seen that a reduction of 455 degrees C. in temperature caused a reduction in carbon of 0.606 per cent., equivalent to a reduction of 0.0013 per cent. carbon per degree Centigrade. Particularly noticeable was the change in fracture, the iron direct from the furnace being grey No. 2, but, after the experiment, a scattered No. 4, the difference in grade being due entirely to the elimination of carbon.

Treating soft high-silicon No. 1 grey iron, containing 4.063 per cent. silicon, in a similar manner, the total carbon was found to vary from 3.671 per cent. to 3.370 per cent., with a reduction in temperature of 310 degrees C., giving the carbon elimination as 0.00097 per cent. per degree C.

For a further experiment a special hematite pig was taken and allowed to cool slowly on the sand bed under cover of a layer of slag and hot sand and, as might be expected, it was found that the graphite was well developed, there being only 0.35 per cent. of carbon held in solution, or partly so. The analysis of the pig was:—Total carbon, 4.09 per cent.; graphite, 3.74 per cent.; combined carbon, 0.35 per cent.; silicon, 1.82 per cent.; sulphur, 0.008 per cent.; phosphorus, 0.016 per cent.; arsenic, 0.024 per cent.; manganese, 0.009 per cent.; and copper, 0.014 per cent.; and it may be assumed that the whole of the elements exist in a solution in accordance with the usually accepted formula, giving a chemical combination of the pig as:—

	Per cent.
Fe_3C	5.25
Mn_3C	0.133
Fe_2Si	9.10
Fe_3P	0.103
Fe_3As	0.777
Fe-Cu alloy	0.038
Graphite	3.74
Ferrite (free iron)	80.859

This apparently explains the absence of any free non-metallic elements, the presence of which would be necessary to bring about chemical decomposition.

Therefore the solution-chemical-carbon theory represented by the equation $2Fe_2C+Si \rightleftarrows 2Fe_2Si+C_2+Fe_2$ could not be sustained, since decomposition in this respect could not be brought about. In fact it often happens that the higher the silicon the less carbon leaves the iron on cooling. Thus with 2.272 per cent. silicon, 0.0013 per cent. carbon per degree was thrown out of solution, while with 4.063 per cent. silicon, only 0.00097 per cent. carbon per degree was eliminated, and these results lead the author to challenge the accuracy of the Fe_3C chemical-carbon theory, this theory supporting the view that iron or steel is a solution of chemically combined carbon, or cementite, and known as eutectoid steel.

Thermo-chemists are generally agreed that a true chemical compound once formed is not subject to alterations in the elements and compounds involved, unless such alterations comply with the laws of constant multiple, or reciprocal proportions, from which it follows that such alterations must necessarily be proportionate to the atomicity or valency of the compounds concerned, and probably the strongest argument in the chemical-carbon theory in favor of the existence of a true carbon-iron compound, Fe_3C., is the supposed heat evolution on the union of these two elements which occurs at the recalescence point.

But, against this theory, it must be understood that the specific heat of carbon varies with the temperature, as at 978 degrees C. it is 0.467, while at 10.8 degrees C. it is only 0.1604, and, owing to lack of data, its atomic volume is not accurately known. One fact to be noted is that, near the recalescence point, there is a sudden change in the physical properties of carbon, chiefly due to a rapid change in its specific heat, and to this may be explained the prolonged cooling in the curve at that point.

Again, carbon is gradually eliminated from saturated iron in proportion to the decrease of temperature until the iron is nearly at the freezing point, when an excess of carbon is liberated from the liquid, and heat is evolved for the carbon so liberated in the same ratio as that in which it was originally absorbed during solution, plus the latent heat brought into existence when the mass solidifies, and this is confirmed by the fact that grey irons require a greater length of time for solidification than leaner varieties.

Observations made by the author appear also to confirm the evaporation of iron under certain conditions. In an electric furnace, under certain conditions, the iron appears to evaporate and again condense, forming globules of iron, and graphite, even when pure iron oxides are originally treated.

On reviewing the facts already demonstrated, and remembering that iron is never found in nature with a combining capacity corresponding to a valency of Fe_3C, representing an oxide or sulphide equivalent to Fe_3O_2 or Fe_3S_2, it appears impossible to conceive the formation of a true binary compound under these conditions.

Although the carbon is the predominant element in producing the crystallized appearance of iron fractures, other elements also play a very important part in the development of important characteristics, but, unfortunately, no general standard has yet been arrived at to enable iron to be graded accurately by fracture and general mechanical structure, as whilst some makers regard certain properties as distinctive of a particular grade, others represent such iron by different numbers.

Assuming that the iron is made in a blast furnace under normal conditions, any particular fracture, with other visible characteristics, indicates an equilibrium of the elements in at least the majority of cases, and the true chemical and physical character of the iron is so indicated. Therefore a knowledge of the quantity of one of the elements, say sulphur or silicon, in any specific brand of iron, should ensure a representation of the iron sufficiently true to guarantee its use in the most difficult castings. Hence the importance of continuing, though in improved forms, the system of standardizing by fracture.

Greater accuracy in defining the various fractures of pig is desirable, and for this purpose it is necessary to introduce additional numbers, for which purpose the author suggests 15 distinct grades, he commonly using terms in conjunction with numbers, as follows:—No. 1; No. 2 open, No. 2 close; No. 3 open, No. 3 medium, No. 3 close; No. 4 scattered, No. 4 centered; No. 5; No. 6 open, No. 6 close. In addition there are:—Mottled soft, mottled hard, spotted white, and pure white.

The question as to whether the six fractures shall be subdivided, or a new series of numbers, from one to fifteen, be used, can probably only be settled by a conference between blast-furnace men and foundrymen, but the successful issue of this important problem will require a considerable amount of practical investigation which, when accomplished, will lead to a simpler and more accurate means of grading pig-iron.

REINFORCED CONCRETE BARGES.

By James Taylor, M.E.*

In view of the almost universal adoption of the use of reinforced concrete for structures on land which up till quite recently were constructed wholly of wood or steel, it seems strange that its application to marine purposes has met with so little consideration. Certainly the use of wood and steel has been so closely associated with shipbuilding that merely to consider any other material seems out of the question. But, in the light of past experience with reinforced concrete for land purposes, and its success where used in preference to any other material, it would seem to be only a matter of a very short time before it will be used entirely for marine floating structures within certain limits, as far as size is concerned.

Of course, at the present time, it would be idle to forecast that it will ever replace steel for large steamers—the limit can only be arrived at by experiment and gradual development—but for certain types of vessels, such as tow barges, open or deck scows, pontoons of all descriptions and for all purposes, floating drydocks, etc., it is far superior to either wood or steel. It has none of the disadvantages which these materials have. For instance, once the reinforced concrete boat is built, it requires no periodical overhaul such as is usual for a wood or steel vessel; neither scraping, painting, nor calking being necessary. This is due to the fact that, before launching, the structure is brought to a very smooth surface outside by a process of rubbing, which, it has been found, makes the hull watertight, and also reduces the skin resistance to a minimum. The absence of rivets, plate landings, seams, etc., does away with calking altogether, and consequently obviates the chances of leakage from these sources; a very important point in a barge carrying a cargo which must be kept as dry as possible.

In general, it may be said that for the purposes indicated above, reinforced concrete is a perfect substitute for wood or steel, is much cheaper than steel to construct and maintain, and, when the low cost of maintenance is taken into consideration, is much cheaper than wood.

It can be used in the most out-of-the-way places, doing away with the necessity of having vessels constructed in some far away shipyard, and transported in sections to their destination and re-erected there; it also removes the difficulty which is always present with owners of wooden vessels employed in waters infested with the toredo worm.

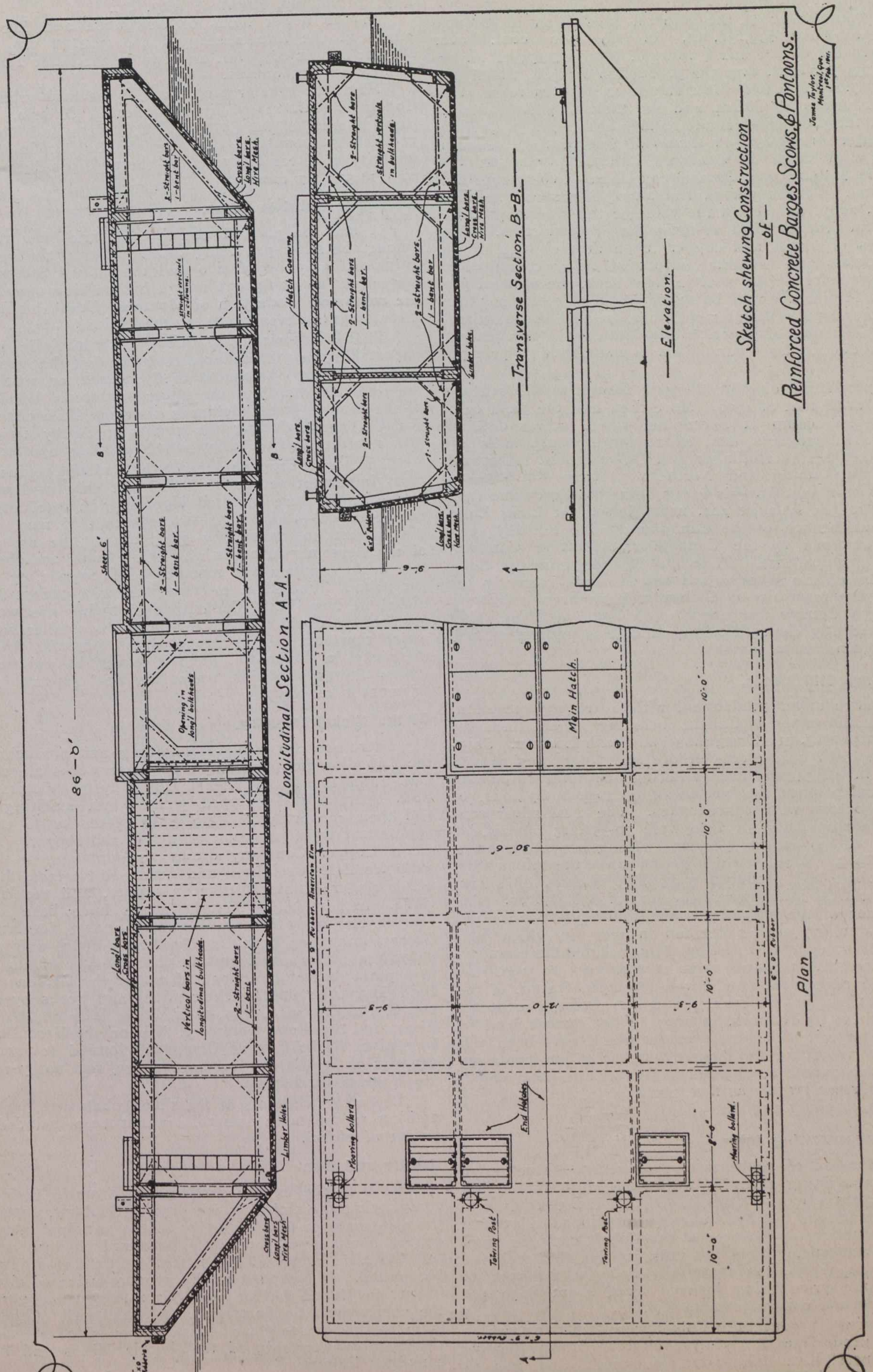
The principal objection to its use the writer has met with, is the fear that this construction will not withstand such severe shocks as the present type of vessel, such as bumping against rocks, piers, and other boats, but this objection is entirely removed by a knowledge of the results obtained from vessels actually in active service. It is not generally known that barges, scows, pontoons, and car ferries, up to 150 feet long, are in use, and have been for a number of years, in Italy, France, and other European countries, and also in the United States. Last year, three heavy barges for dredging purposes were constructed at Panama for use on the canal there, and quite recently a large scow 80 feet long by 24 feet beam was built in Canada for maintenance purposes on one of the canals in Ontario. In every case as satisfactory results have been obtained as if the vessel had been of steel, and it is quite safe to say that a reinforced concrete boat will stand as much hard usage, and under certain conditions, more than a wood or steel vessel.

*Consulting Engineer, Montreal, Canada.

The accompanying sketch, prepared by the writer, will give some idea of the strength and method of construction of these barges. No special type of vessel has been selected, but the illustration shows a barge which could be, with modifications adapted for cargo purposes, deck scow, or dredging pontoon. No sizes are given, as it will be readily understood that calculations and sizes vary with the different conditions to be provided for. The object of the writer is merely to show a simple method of reinforced concrete barge construction.

Various methods are in use; some boats for certain classes of heavy work have a concrete keel laid first and the whole structure built up from that, but in the sketch an ordinary flat bottomed barge is under consideration. The bottom and sides of the boat consist of sheets of wire mesh, reinforcing bars, and cement mortar. The beams, bulkheads, columns, and decks are of concrete, suitably reinforced, and the construction is as follows:—A wooden cribbing is erected on the spot where the boat is to be built, of sufficient head room for working under while plastering the framework and of sufficient area to take the bottom of the boat. On this cribbing, which is put together in sections, the sheets of wire mesh are laid first of all, bent up the height of the sides of the boat, and all securely fastened together where they butt. Next, the transverse bars are laid, spaced and spliced as required by the design, and tied to the sheets of wire mesh. These also are bent to the shape of the boat. When these are in place the longitudinal bars are put in position in the bottom and sides and tied to the transverse bars. Annealed wire is used for tying the bars and wire mesh. The longitudinals are bent at the ends to conform to the shape of the boat. Temporary deck beams are placed at intervals to tie the sides together, and when this has been done, the whole framework is ready for plastering. To do this, sections of the cribbing are removed as required, exposing the framework of the bottom, and the first coat of plaster is then applied to the bottom and sides from the outside, until the required thickness is attained. When this first outside coat sets, the cribbing is put back, and after three days the plastering of the inside is commenced. When the bottom and sides have thus been formed, and after the whole has set, the forms for the floor beams, with the reinforcement for same, are placed in position and concreted. Following up this, the next step is the erection of the forms, and the placing of the reinforcement for the columns, deck girders, bulkheads, and deck. When this has been done and the concrete poured and set, the hull of the boat is practically finished. Mooring and towing posts of concrete may be built into the shell during construction while rubbers, ring bolts, fairleads, etc., may be placed where required and fixed to the hull by bolting. After the skin of the boat, under the water line, has been brought to a very smooth surface by rubbing, she is ready for launching and active service. Stirrups are used wherever necessary, according to the best practice, and different styles of girder and column reinforcement may be used, as long as the stresses and strains met with in marine work are provided for.

From the foregoing it will be seen that the construction of concrete boats is a comparatively simple matter. The commercial possibilities in the adoption of this construction for boatbuilding are evident. Neither expensive plant nor skilled labor is required, and the boats can be built in a much shorter time than the present type. It is probable that the next few years will see a great development in concrete boatbuilding in Canada, and there is no doubt that reinforced concrete will finally supersede wood and steel for the purposes indicated in this article.


Sketch shewing Construction
— of —
Reinforced Concrete Barges, Scows, & Pontoons.
Longitudinal Section. A-A.
Transverse Section. B-B.
Elevation.
Plan
86'-0"
Main Hatch.
End Hatches
Towing Post
Mooring bollard
Hatch Coaming
Opening in long'l bulkheads
Vertical bars in longitudinal bulkheads
Limber Holes
10'-0"
9'-6"

ONTARIO'S MINERAL PRODUCTION.

The total value of the mineral production in Ontario last year was $39,232,814, or 19 per cent. over 1909, when the output had a value of $32,981,375; or an advance of 53 per cent. over the production of 1908, which was $25,637,617. The chief contributors to this increase were the silver mines of Cobalt and the nickel-copper mines of Sudbury, the production of the former being $2,972,272, and of the latter $1,462,251, in excess of that of 1909. Assuming the total value of Canada's mineral production last year to be $100,000,000, Ontario can claim to contribute half of the total. The Provincial Bureau of Mines in compiling statistics, adopt as a basis the value of the several products in the form produced and at the point of production. Were the values of nickel and copper taken at the price of the refined metals and the total output of silver computed at the average price for the year in New York, the mineral production of Ontario would be worth about $50,000,000. Mr. Gibson, the Deputy Minister of Mines, is to be congratulated on the publication of a preliminary bulletin giving particulars of production last year. This is commendable promptitude.

The production of gold, $60,918, though small, is nearly double in value that of 1909. More than half the yield came from the new camp at Porcupine, where active developments are in progress, and where large stamp mills are being erected at the Hollinger and Dome mines. A branch of the Temiskaming and Northern Ontario Railway—the Ontario Government line—is being built into Porcupine from the main line at Mileage 224, near Kelso. At Long Lake, on the Sault branch of the Canadian Pacific Railway, gold is being obtained by the Canadian Exploration Company from an arsenical ore. The old Mikado mine at Shoal Lake, Lake of the Woods, and the Havilah, formerly the Ophir, in the township of Galbraith, have been re-opened. In Hastings County the Cordova or Belmont Mine, long idle, has recently changed hands, and it is understood will soon go again into commission.

Cobalt Camp Still Leads.

The entire silver production, with a trifling exception, comes from the mines of Cobalt, including in that term not only Cobalt proper, but Gowganda and South Lorrain. Shipments comprised 27,394 tons of ore and 6,845 tons of concentrates, in all 34,316 tons, bringing the total shipments from the camp since the beginning up to 112,965 tons, of which 10,930 tons were concentrates. The total silver contents of the shipments for 1910 were 30,558,825 ounces, or an average of 890 ounces per ton, taking ore and concentrates together. For the whole period since the mines were opened Cobalt has produced 93,977,833 ounces of silver, which brought the mine-owners the sum of $48,327,280. The average tenor of the shipments fell from 1,309 ounces per ton in 1904 to 677 ounces per ton in 1907, in which year low-grade ores began to be shipped in considerable quantity, before concentration plants were introduced. In 1908 the effects of concentration, now a well-developed feature of the camp, began to be noticeable, and the average contents per ton rose to 758 ounces, in 1909 to 844 ounces, and in 1910 to 890 ounces. The improvement would have been still greater were it not for the large quantities of low-grade ore or rock, which have been shipped to Denver and other smelting points for use largely as flux, much of it containing less than 60 ounces silver per ton.

Fourteen Concentrating Mills.

The extension of concentration processes—there being now 14 concentrating mills at work—the shipment of bar silver from several properties, and the introduction and universal adoption of hydraulically developed electrical power, were noticeable features of the Cobalt camp in 1910. The power transmitted from the falls on the Montreal and Matabitchewan rivers has materially reduced the cost of operations, the price being lowered from about $150 per horse power when using steam to $50.

The principal producers at Cobalt were Nipissing, which led with a production of 5,584,742 ounces, Crown Reserve 3,158,156 ounces, Kerr Lake 2,877,299 ounces, Coniagas 2,621,681 ounces, McKinley-Darragh-Savage 2,607,071 ounces, Temiskaming 1,887,127 ounces and Buffalo 1,514,895 ounces; others with large outputs were La Rose, O'Brien, Hudson Bay, Trethewey, Right of Way, etc.

In the newer fields of Gowganda and Elk Lake, six mines in the former shipped 480 tons of ore, containing 481,523 ounces of silver, and two in the latter 233 tons, containing 221,233 ounces.

Much the greater proportion of the high-grade ore from Cobalt is now treated by refineries in Ontario. These are three in number, at Copper Cliff, Deloro and Thorold. All produce merchantable bars for the London market. The quantity of silver recovered at these plants during the year was 14,574,837 ounces.

Ontario is Third in Silver.

It may be pointed out that Ontario now ranks third among the silver-producing communities of the world, being surpassed only by Mexico and the United States. In 1910 her output was only one and a half million ounces short of the combined production of Montana, Utah and Nevada, the three largest silver states of the Union.

That silver-mining at Cobalt as a whole is a profitable undertaking may be deduced from the fact that the dividends declared in 1910 amounted to $7,275,240, or nearly one-half the total returns from the silver produced. Up to the end of the year the total dividends distributed amounted to $21,802,180, not including the profits made by two or three mines, either individually owned or close operations.

The nickel-copper mines of the Sudbury region, now the most important source of nickel not only in America, but in the world, were operated vigorously in 1910, and the output of nickel—18,636 tons—exceeds that of 1909, previously the largest on record, by 5,495 tons. The matte product of the Bessemer furnaces was 35,033 tons, and the value of the nickel contents was returned at $4,005,961, or 10.7 cents per pound. Valued at 40 cents, the price quoted for refined nickel in New York, the output of nickel was worth $14,908,800, but credit it taken herein at the smaller figure only, which represents, or is supposed to represent, the value of the nickel in the matte, when it leaves the smelters for the United States or Wales, where the final separation and refinement take place.

Of the Nickel Industry.

There are two companies mining and producing nickel, the Canadian Copper Company, whose works are at Copper Cliff, and the Mond Nickel Company at Victoria Mines. Both operate well-equipped plants, first smelting the ore and then converting it into a Bessemer matte containing approximately 80 per cent. of nickel and copper. The Canadian Copper Company draws its supplies ci
pally from the Creighton and Crean Hill mines, the former being richer in nickel than in copper, and the latter vice versa. Hitherto the Victoria Mines have been the chief sources of supply for the Mond Company, but latterly the Garson mine has been largely drawn upon, and the company has under consideration the removal of its furnaces to a point east of Sudbury and nearer the Garson ore body. Both companies operate their mines and works by electrical power, the Copper Company utilizing falls on the Spanish River, and the Mond Company, falls on the Vermilion. The Dominion Nickel-Copper Company, formed to work large deposits of ore on the northern range, has not yet reached the stage of production.

The nickel contents of the silver-cobalt ores, which yield nothing to the mine owners, are not here included in the output of nickel.

Copper and Iron.

Most of the copper produced in Ontario is found accompanying the nickel in the ores of Sudbury, consequently the yield rises or falls with that of the principal metal. The copper contents of the matte produced in 1910 amounted to 9,630 tons, valued at $1,374,103, or at the rate of 7.1 cents per pound. If reckoned at the average value of electrolytic copper in New York for 1910, viz.: 12.73 cents per pound, the value would be $2,451,798. A small part of the copper is to be credited to Bruce Mines, from which a quantity of silicious ore was shipped to Victoria Mines and used for converter linings.

Four iron mines were in operation in 1910, producing 231,453 tons of ore, which is a falling-off as compared with

1909, when the output was 263,777 tons. Of the ore 119,207 tons was magnetite from Moose Mountain, Atik-okan and Bessemer; 112,246 tons was hematite from Helen mine. The ore was returned as worth $513,538, or $2.21 per ton. The Lake Superior Corporation has been developing an iron prospect called the Magpie mine in Michipicoten district, and have ascertained by borings that it contains a large body. The ore is sideritic, but preliminary roasting will reduce the sulphur contents and raise the percentage of metallic iron. At Moose Mountain it is proposed to install a magnetic concentrator to treat the run-of-mine.

There were eight blast furnaces at work producing pig iron last year, the total yield being 447,351 tons. The total quantity of ore charged into the furnaces was 822,174 tons. of which 143,284 tons was of domestic and 678,890 tons of foreign origin. The value of the pig product was $6,975,418. Steel produced amounted to 331,321 tons, valued at $7,855,407.

Petroleum and Natural Gas.

Of late years the production of petroleum has been declining. In 1910 the yield amounted to only 11,004,357 Imperial gallons, which is about one-third the production of 20 years ago. The diminution is most marked in the newer field of Tilbury, but is also going on in the older districts of Petrolea and Oil Springs. The average production per well is now very small, averaging only a few gallons daily. A new oil pool was located during the year in Onondaga township, but the production has not yet been important.

On the other hand, the flow of natural gas is increasing year by year, in 1910 amounting in value to $1,490,334, at a low rate per thousand cubic feet, as compared with $1,188,179 in 1909. The gas fields are confined to the Lake Erie counties, but the gas finds a ready market not only in the localities in which it is produced, but also in the cities, towns and villages of southwestern Ontario. Several wells have been drilled in the shallow water along the shore of the lake, and a new field is being exploited in the township of Bayham, Elgin County.

The list of Ontario minerals is long and varied, and a number of other substances in the table of production constitute the basis of industries of considerable importance Among these are salt, corundum, iron pyrites, feldspar, quartz, graphite, talc, gypsum, arsenic, etc.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

12950—February 11—Approving revised location of C.P.R. Kipp to Aldersyde Branch previously approved by Orders 6870 and 9278, from mileage 28, on the south boundary of Sec. 5, Township 14, Range 23, west 4th, to mileage 67.06 on south boundary of Sec. 32, Township 18, Range 26, west 4th, Alberta.

12951—February 11—Authorizing C.P.R. to construct industrial spur to premises of Diamond Coal Co. along and across Jarvis St., and across Lot 22 on west thereof, city of Toronto.

12952—February 8—Authorizing Vancouver, Victoria & Eastern Railway to take certain lands in city of city of Vancouver, B.C., being whole of bed and foreshore of False Creek, east of Westminster Avenue with exception of portion reserved by city.

12953—February 10—Prescribing forms to be used by express companies as follows:—"Schedule A"—Merchandise Receipt. "Schedule B"—Money Receipt. "Schedule C"—Collection Receipt. "Schedule D"—Limited Liability Live Stock Contract. "Schedule E"—Livestock Attendants' Contract, and ordering that Express Classification for Canada C.R.C., No. 2, appended to judgment delivered December 24th, 1910, be approved and take effect on March 1st, 1911.

12954—January 23-24—Approving C.N.Q. Railway's Standard Tariff of Maximum Sleeping and Parlor Car Tolls, C.R.C., No. S-3.

12955—February 10—Approving Marconi Wireless Tariff of Rates, C.R.C., No. 4, and C.R.C., No. 5.

12956—January 16—Authorizing G.T.R. to construct spur line to premises of Massey-Harris Co., Brantford, Ont.

12957—February 7—Authorizing T. H. & B. Ry. to take certain lands in the Township of Barton, County of Wentworth, Ont., for purpose of increasing yard facilities at Hamilton, Ont.

12958—February 13—Authorizing Marx & Rawolle, of Canada, Ltd., to lay water main under G.T.R. near St. Amnroise St., Montreal, P.Q.

12959-60—February 13—Authorizing Hydro-Electric Commission to cross with its wires track of G.T.R. at Main St., Norwich, Ont., and at Concession Street, town of Tillsonburg.

12961—February 13—Authorizing Water Commissions of London, Ont., to cross with wires track of G.T.R. at Talbot St., London, Ont.

12962—February 13—Directing G.T.R. trains to not exceed speed of four miles an hour and that stand pipe and exhaust pipe be removed at Lyster Station, Que.

12963—February 13—Approving location of G.T.P. Standard Station No. 6, at Tofield, Alta.

12964—February 13—Authorizing C.N.O.R. to cross public road at Concession 1, Township of Grenville, County Argenteuil, Que.

12965 to to 12995 Inc.—February 11—Authorizing Canadian Pacific to construct an additional main line track (double-track) across public highways in the municipalities of Portage La Prairie and Rosser, Manitoba, on Brandon subdivision. At mileage 54.6, 53.3, 12.5, 11.3, 10.2, 9.8, 9.1, 26.8, 25.7, 24.6, 28.7, 22.4, 19.1, 21.3, 20.2, 27.9, 23.3, 18.0, 16.9, 15.8, 15.05, 14.7, 13.5, 51.1, 4.7, 3.6, 3.1, 52.35, 52.3, 42.0, 41.05, 37.1.

12997—February 11—Approving C.N.O.R. revised location at Grenville,

12997—February 11—Approving C.N.O.R. revised location at Grenville, County of Argenteuil, Quebec.

12998—February 11—12999-13000—February 10—13001—February 13—13002—February 11—Authorizing C.P.R. to construct an additional main line track (double track) across public highways in the municipalities of Portage la Prairie and Rosser, Man., on Brandon Subdivision, at mileage 7.1, 44.8, 44.3, 50.2, 5.8.

13003—February 13—Authorizing C.P.R. to construct industrial spur to premises of Macleod Quarrying and Contracting Co., in Sections 16 and 17, in Township 10, Range 24, west 4th, Alta.

13004—February 7—Authorizing Township of Nepean and Police Village of Westboro, Ont., to extend Victoria Ave. to Pacific Ave., across track of C.P.R.

13005—February 13—Authorizing Denis J. Cyr, of Green River, N.B., to lay water pipe under C.P.R. ½ north of Green River, N.B.

13006—February 12—Relieving C.N.R. from further protection at highway crossing at Lloydminster.

13007-8—January 23-24—Approving Standard Tariff of Maximum Sleeping and Parlor Car Tolls of Maine Central Railroad and Central Vermont Railway Co.

13009—February 7—Authorizing C.N.O.R. to divert public road on Lots 5A and 4E, Concession 1, Township of Grenville, County of Argenteuil, Que. Compensation to be paid to one J. Kelly if any damages by reason of diversion.

13010—January 23-24—Approving Standard Tariff of Maximum Sleeping and Parlor Car Tolls of Esquimalt & Nanaimo Railway.

13011—February 14—Amending Order 12949, of February 10th, 1911, by providing as follows: "It being understood that in engaging watchman, the M.C.R. Co. is acting only as agent of the N. St. C. and Toronto Railway Co.

13012—February 14—Extending time for electric bell installation until 15th May, 1911, as provided for in Order 12321, of November 18th, 1910.

13013—February 14—Complant of Davidson, (Sask.), Board of Trade, directing that C.N.R. erect fences along right-of-way before 15th June, 1911, under penalty of $25 a day.

13014—February 7—Authorizing C.P.R. to divert highway between Concession "A" and Concession 1, Ottawa Front, Township of Nepean, County of Carleton, Ont., portion of highway to be deeded to township by C.P.R.

13015—February 7—Providing that G.T.R. maintain interlocking plant ordered n connection with N. St. C. & T. Co., by Order No. 9646, February 17th, 1910, and varying terms of Order No. 10310, of April 20th, 1910, in regard to working of interlocker, method of rendering bill, etc.

13016—February 15—Authorizing G.T.P. Branch Lines Co. to cross highway between Sections 23 and 26, Township 36, Range 27, west 2nd, district of Saskatoon, Saskatchewan.

13017—February 14—Authorizing C.P.R. to construct industrial spur to premises of International Harvester Co., in Lots 5 and 6, Block 165, Plan Q-7, Saskatoon, Sask.

13018 to 13021 Inc.—February 14—Authorizing M.C.R.R. to operate subways at Tecumseh Road, Township of Sandwich West, Essex County; at Dougall Road, near Windsor, Township of Sandwich West; at Charing Cross, County of Kent; at Ross St., in city of St. Thomas, Ont.

13022-23—February 14—Authorizing M.C.R.R. to use and operate drawbridge at Chippewa Creek, on Niagara Division, and at Chippewa Creek, near Montrose, Ont.

13024—February 15—Providing for interchange tracks between G.T.R. and N. St. C. and Toronto Ry., in city of St. Catharines, Ont., and authorizing crossing of John, Page, and an unopened Street.

13025—February 15—Authorizng G.T.P. Branch Lines Co. to cross highway between Section 33, Township 34, Range 27, and Section 3, Township 35, Range 27, west 2nd Meridian, District of Saskatoon, Sask.

13026—February 15—Approving plans of G.T.R. for change of location and details of construction of retaining wall at Exhibition Grounds, Toronto, Ont.

13027—January 21—Authorizing C.N.O.R. to cross Cotsmore Ave., (in Lot 14, Con. A), town of Cobourg, Ont.

13028—February 15—Authorizing South River Electric Co. to cross with its wires wires and track of G.T.R. about two miles south of South River Village, on Town Line between Townships of Strong and Machar, Ont.

13029—February 7—Approving plans of G.T.R. of Howard Ave. Subway, Toronto and Jane St. Subway, Township of York, Ont.

13030—February 7—Authorizing C.N.O.R. to construct bridge over North River, Parish of St. Andrews, P.Q., mileage 13.5, from Hawkesbury, Ont. Certain lands to be taken from H. Walsh.

13031—February 17—Authorizing Hydro-Electric Commission to cross with its wires wires of Bell Telephone Co. at Lot 2, Con. 11, Township of Downie, County of Perth, Ont.

13032-33—February 16—Relieving G.T.R. from further protection at crossing 1½ miles north of Paisley, Bruce Township, Bruce County, Ont., and at Versaille St., in city of Montreal.

13034—February 18—Approving C.N.O.R. location through unsurveyed territory, District of Algoma, mileage 260 to 280, from Sudbury Junction, Ontario.

13035—February 18—Approving location of C.P.R. Weyburn-to-Lethbridge Branch from a point in Sec. 29, Township 6, Range 13, west 4th Meridian, to a point on Lethbridge Subdivision, in Sec. 4, Township 9, Range 21, west 4th Meridian from mileage 400 to mileage 449.9, of Weyburn Branch.

13036—February 16—Correcting error in right-of-way plan registering as No. 678 R. of the Lacombe Branch of the C. & E. (C.P.R.).

13037—November 14—Approving location of G.T.R. Branch Lines Co. station at Yorkton, Sask.

13038—February 18—Authorizing C.P.R. to reconstruct bridge over the Eagle River, No. 18.1 Shuswap Subdivision, B.C. Division.

13039—February 16—Authorizing G.T.R. to construct spur to premises of Thornbury Transportation & Reduction Co., Ltd., across Bay St., (not open), in town of Thornbury, Ont.

13040 to 13044 Inc.—February 18—Authorizing G.T.P. Branch Lines Co. to cross with its railway highways in the Provinces of Saskatchewan and Alberta.

13045—February 20—Authorizing Hydro-Electric Commission to cross with its wire wires and track of G.T.R. at Lot 19, Con. 2, Township of East Oxford, Ont.

13046-47—February 20—Authorizing city of Nanaimo, B.C., to lay water main and sewer under track of Esquimalt & Nanaimo Railway.

13048—February 20—Authorizing city of Montreal to lay a sewer under track of G.T.R. on Etienne St., between Forfar and Mill Sts., Montreal.

13049—February 20—Approving revised location of C.N.R. mileage 55.78-57.16 and 57.85-58.45. District of Thunder Bay, Ont.

13050—February 20—Authorizing town of Bromptonville, Que., to lay a sewer under G.T.R. on Bridge Street.

13051—February 22—Authorizing Western Canada Power Co., Ltd., to cross with its wires track of C.P.R., on Lot 17, north-west bank of Pitt River, and rescinding Order No. 12389, November 25th, 1910.

13052—February 21—Authorizing town of Galt, Ont., to cross with wires track of C.P.R. on Stone Road, (known also as Macadamized Road), Galt.

13053 to 13057 Inc.—February 21—Authorizing Seymour Power & Electric Co. to cross with its wires wire of Bell Telephone Co. at various concessions and points in Township of Darlington, County of Northumberland, Ontario.

13058—February 21—Approving location of Alberta Central Railway Co.'s line from a point in Sec. 19, Township 33, Range 17, west 4th Meridian, to a point in Sec. 15, Township 32, Range 12, west 4th Meridian, mileage 80-120.

13059—February 21—Authorizing G.T.P.R. to construct bridge over Kyax River, east of Prince Rupert, B.C.

13060—February 21—Approving by-laws of M.C.R.R. for parties authorized to issue tariffs and rescinding Order No. 10917, of June 16th, 1910.

13061—February 20—Authorizing C.N.O.R. to divert and cross public road on Lot 230, Parish of St. Eustache, County of Two Mountains, Que.

13062—February 21—Authorizing C.P.R. to open for carriage of traffic portion of its Macklin Southeast Branch, from Macklin to Kerr Robert, a distance of 46 miles.

13063—February 20—Authorizing C.P.R. to construct bridge over the Scugog River near Lindsay, Ont.

13064—January 10—Authorizing C.P.R. to construct spur to premises of Ontario Wind Engine and Pump Co., Ltd., across Henry Ave., and block 27, city of Winnipeg, Man.

13065—February 20—Authorizing C.N.O.R. to divert road at Deer Lake, Lot 9, Con. 1, Township of Burton, District of Parry Sound, Ont.

13066—February 22—Directing that C.N.R. provide and construct a suitable crossing at Clark's Crossing, south side of Sec. 11, Township 38, Range 25, west 3rd, under penalty of $25 per day after 15th May, 1911. Complaint of Penner School District No. 1340, Saskatchewan.

13067—February 22—Authorizing C.N.O.R. to construct over and divert public road on Lots 578 and 581, South Rouge River Range, Parish of St. Andrews, County of Argenteuil, P.Q.

13068—February 21—Authorizing G.T.R. to replace with iron bridge, present bridge carrying highway known as Silver St., a "forced" road between Cons. 1 and 2, Township of South Dumfries, County of Brant, Province of Ontario.

13069—February 20—Authorizing G.T.R. to construct spur to premises of Ham & Nott Co., north side of Elgin St., Brantford, Ont.

13070-71—February 20—Approving Standard Tariff Maximum Passenger Tolls of Montreal Terminal Railway and Montreal Park & Island Railway, providing for maximum toll of 2½c. per mile in accordance with Orders of the Board No. 12852 and 12853, of January 25th, 1911.

13072—February 22—Authorizing Seymour Power & Electric Co. to cross with its wires wires of Bell Telephone Co at Lots 6 and 7, Broken Front Concession, Township of Darlington, Northumberland County, Ont.

13073—February 22—Authorizing C.P.R. to construct bridge No. 0.85 on Temiskaming Branch, Lake Superior Division.

13074—February 22—Re Order No. 12249, of October 12th, 1910, 20 per cent. of cost of installation of gates to be paid out of "Railway Grade Crossing Fund," remainder to be paid by railway companies interested, 20 per cent. by G.T.R., and 80 per cent. by T. H. & B. Gates to be operated day and night.

13075—February 23—Authorizing Red Mountain Ry. Co., Nelson & Fort Sheppard Ry. Co., Vancouver, Victoria & Eastern Ry. Co., to use forms of contract for transmitting and receiving messages as approved by Order No. 9777, dated March 31st, 1910. Forms approved for a period of four months from date of this Order.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, C. H. Rust; Secretary, Professor C. H. McLeod.

QUEBEC BRANCH—
Chairman, A. E. Doucet; Secretary, P. E. Parent. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, H. E. T. Haultain; Secretary, A. C. D. Blanchard, Engineering Building, Toronto University, Toronto. Meets last Thursday of the month.

MANITOBA BRANCH—
Secretary, E. Brydone Jack. Meets first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo. H. Webster; Secretary, H. K. Dutcher, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University

OTTAWA BRANCH—
Chairman, A. A. Dion, Ottawa; Secretary, H. Victor Brayley, N. T. Ry., Cory Bldg.

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UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Hopkins, Saskatoon, Secretary, Mr. J. Kelso Hunter, City Clerk, Regina, Sask.

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

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

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BUILDERS, CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

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

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

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ENGINEER'S CLUB OF TORONTO.—96 King Street West. President, Killaly Gamble; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

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NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, S. Fenn; Secretary, J. Lorne Allan, 15 Victoria Road, Halifax, N.S.

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WESTERN CANADA RAILWAY CLUB.—President, Grant Hall; Secretary, W. H. Rosevear, 199 Chestnut Street, 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.

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.
Calgary, Alta., business building	Mar. 10.	Mar. 2.	390
Calgary, Alta., concrete walks	Mar. 15.	Feb. 23.	54
Calgary, Alta., machinery and plant	Mar. 22.	Feb. 23.	69
Fort William, Ont., Nurses' Home	Mar. 11.	Mar. 2.	390
Fort William, Ont., alterations to school	Mar. 10.	Mar. 2.	390
Gleichen, Alta., waterworks and sewers	Mar. 16.	Feb. 16.	69
Hamilton, Ont., sewers	Mar. 9.	Feb. 23.	70
Hamilton, Ont., sewers	Mar. 9.	Feb. 23.	70
Minnitonas P.O., Man., bridge and piers	Apr. 15.	Feb. 23.	70
Kingston, Ont., Nicol Building	Mar. 10.	Mar. 2.	390
Moose Jaw, Sask., sewer and water extensions	Apr. 10.	Mar. 2.	70
Moose Jaw, Sask., main drainage works	Apr. 10.	Feb. 23.	66
Oak River, Man., debentures for hall	Mar. 29.	Feb. 23.	54
Ottawa, Ont., timber and plank	Mar. 20.	Mar. 2.	70
Ottawa, Ont., oil and oil fuel	Mar. 20.	Mar. 2.	389
Ottawa, Ont., coal and fuel wood	Mar. 11.	Mar. 2.	389
Ottawa, Ont., breakwater	Mar. 21.	Mar. 2.	389
Ottawa, Ont., concrete bridge	Mar. 31.	Mar. 2.	390
Ottawa, Ont., public building, Harriston	Mar. 13.	Feb. 23.	360
Ottawa, Ont., breakwater	Mar. 15.	Feb. 23.	360
Ottawa, Ont., motor trucks	Mar. **17.**	Feb. **9.**	**300**
Ottawa, Ont., wharf	Mar. 8.	Feb. 16.	329
Oshawa, Ont., asphalt block pavement	Mar. 18.	Feb. 23.	69
Quebec, Que., railway	Mar. 10.	Feb. 23.	360
Saskatoon, Sask., franchise for street railway	Apr. 3.	Mar. 2.	70
Saskatoon, Sask., municipal commissioner	Mar. 17.	Feb. 23.	67
Souris, Man., laying pipe	Mar. 20.	Feb. 23.	69
South Middleton, Ont., schoolhouse	Mar. 15.	Jan. 12.	163
St. John, N.B., debentures	Mar. 18.	Mar. 2.	389
Swan River, Man., steel bridge	Apr. 15.	Feb. 16.	66
Toronto, Ont., right to cut pulpwood	Apr. 10.	Jan. 19.	203
Toronto, Ont., rails and ties	Apr. 4.	Mar. 2.	64
Toronto, Ont., reinforced concrete pipe	Mar. 14.	Feb. 23.	66
Vancouver, B.C., supply of pipe, valves, etc.	Mar. 22.	Feb. 23.	54
Vancouver, B.C., clearing right of way	Mar. 15.	Mar 2.	390

TENDERS.

Kingston, Ont.—Tenders will be received until March 9th, 1911, for (1) the purchase of one stone crusher, one crusher screen and one rotary sweeper; (2) for the construction of plank walks and crossings for the year 1911. H. B. R. Craig, City Engineer, Kingston.

Kingston, Ont.—Tenders will be received until March 14th, 1911, for the several trades works required in the building of the school. Power & Son, Merchants Bank Chambers, Kingston.

Ottawa, Ont.—Tenders will be received until March 15, 1911, for hot water heating apparatus, Vernon, B.C. Plans and specifications to be seen at Mr. Wm. Henderson, resident architect, Victoria, B.C.; Mr. F. B. Cossett, clerk of Works, Vernon, B.C., and at the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

Ottawa, Ont.—Tenders will be received until March 25th, 1911, for the construction and erection of a brick and stone passenger station at Campbellton, N.B. Plans and specifications may be seen at the office of the station-master, Campbellton, N.B.; office of the chief engineer, Moncton, N.B., and at the office of the secretary of the Department of Railways and Canals, Ottawa. A. W. Campbell, chairman, Government Railways Managing Board, Ottawa.

Ottawa, Ont.—Tenders will be received until April 4th, 1911, for the construction of a wharf at Chateauguay, Chateauguay County, Que. Plans and specifications can be seen at the office of J. L. Michaud, Esq., district engineer, Merchants Bank Building, St. James Street, Montreal, and R. C. Desrochers, secretary, Department of Public Works, Ottawa.

Chapleau, Ont.—Tenders will be received until March 27th, 1911, for furnishing and erecting Duplex steam pumping engine and one return tubular boiler. For further information apply to Messrs. Chipman & Power, engineers, 204 Mail Building, Toronto, Ont.; Geo. B. Nicholson, Esq., mayor, Chapleau, and T. J. Godfrey, town clerk, Chapleau.

Haileybury, Ont.—Tenders will be received by R. P. Courbon, P.P., North Cobalt, Ont., until March 15th, 1911, for the erection of a Roman Catholic College at North Cobalt, Ont. Plans and specifications can be secured at the office of the architects, Moran & McPhail, Haileybury, Ont.

Brantford, Ont.—Tenders will be received by Robert McCormack, secretary of the Trustee Board, Paris, Ont., until March 18th, 1911, for the erection and completion of a school building. Plans and specifications may be seen at the office of Taylor & Taylor, architects, Hope Chambers, Brantford.

Eglinton, Ont.—Tenders for the supply of electric light poles for the town of North Toronto were opened by the town council and were as follows. All poles were to be 7-inch tops and of the lengths mentioned.

	30-ft.	35-ft.	40-ft.	45-ft.
Lindslay Bros., West	4.80	6.40	7.85	9.70
Lindslay Bros., East, Spokane, Wash.	4.22	6.71	8.60	10.75
W. C. Sterling, West	4.90	6.55	8.25	
W. C. Sterling, East, Munro, Mich.	3.50	6.10		
W. A. Houser, Earlton Ont.	3.20	4.45	5.75	
Northern Electric, Toronto	4.00	6.50	8.40	
Waddington & Grundy, Eglinton	4.00	5.25	6.50	10.00

Toronto, Ont.—Tenders will be received until March 14th, 1911, for electric vehicles. G. R. Geary (Mayor), chairman, Board of Control, City Hall, Toronto. (Advertisement in the Canadian Engineer).

Toronto, Ont.—Tenders will be received until March 14th, 1911, for pipe fittings in connection with street lamps. G. R. Geary (Mayor), chairman Board of Control, City Hall, Toronto. (Advertisement in the Canadian Engineer).

Toronto, Ont.—Tenders will be received until March 12, 1911, for the additions and alterations required to building No. 5 Queen's Park, Toronto. H. F. McNaughten, secretary, Department of Public Works, Toronto.

Toronto, Ont.—Tenders will be received until March 28th, 1911, for the supply of steel extensions for manholes on 6-ft. steel pipeline. Specifications may be seen at the office of the city engineer, Toronto. G. R. Geary (Mayor), chairman, Board of Control, City Hall, Toronto.

Toronto, Ont.—Tenders will be received until March 25, 1911, for the construction of a 22 stall engine house with machine and boiler shops, at London, Ont. A. L. Hertzberg, division engineer, Union Station, Toronto. (Advertisement in the Canadian Engineer).

Guelph, Ont.—Sealed tenders will be received until March 30th, 1911, for pavement construction. J. Hutcheon, city engineer; T. J. Moore, city clerk, Guelph, Ont. (Advertisement in the Canadian Engineer).

Hamilton, Ont.—Tenders will be received for sale of hydraulic sand dredge. City Engineer of Hamilton. (Advertisement in the Canadian Engineer).

Hamilton, Ont.—Tenders will be received at the office of the Public Library, up till March 11th, 1911, for the several works required in the erection of the new Public Library building, Main Street, Hamilton. Plans may be seen at the office of the architect, A. W. Peene, No. 2 King Street West. Adam Hunter, librarian.

New Liskeard, Ont.—Tenders will be received until March 20th, 1911, for pumps and motors. Geo. Taylor (mayor), Percy Craven, clerk, New Liskeard. (Advertisement in the Canadian Engineer.)

Niagara Falls, Ont.—Tenders will be received until March 28th, 1911, for the construction of (a) steel concrete bridges, and (b) a macadam roadway, with the necessary drainage. Plans and specifications for the several works on file at the Administration Building, Queen Victoria Park, Niagara Falls, and John H. Jackson, superintendent, Niagara Falls. (Advertisement in the Canadian Engineer).

Underwood, Ont.—Tenders will be received until March 18th, 1911, for the construction of a telephone system in the townships of Bruce, Saugeen, Greenock, Kincardine, and Elderslie, in the county of Bruce, Ont. Bruce Municipal Telephone System. (Signed) D. M'Naughton, president; J. B. Struthers, secretary, Underwood, Ont.

Fork River, Man.—Tenders will be received until March 18th, 1911, for the construction of a Howe truss bridge, 83 feet span, across the Fork River. Plans and specifications may be seen at the office of the Minister of Public Works, Winnipeg, and D. F. Wilson, secretary-treasurer, Massey River Municipality, Fork River. Man.

Brandon, Man.—Tenders will be received until March 11th, 1911, for the erection of the East Ward School. Drawings and specifications may be seen at the office of Thomas Sinclair, architect, Brandon.

Winnipeg, Man.—Tenders will be received until March 29th, 1911, for supply of quantity of cast iron water pipe, to be delivered f.o.b., city yards, Winnipeg. Specifications and forms of tender may be obtained at the office of the city engineer, 223 James Avenue. M. Peterson, secretary, Board of Control, Winnipeg.

Brandon, Man.—Tenders will be received until March 17th for waterworks supplies (brass goods, etc.) Specifications and further particulars can be obtained from the city engineer's office. R. E. Speakman, city engineer, Brandon.

Leeville, Sask.—Tenders will be received until April 15th, 1911, for the construction of the Weybridge schoolhouse and the outbuildings. Plans and specifications can be seen at the office of the Beaver Lumber Company. Fred Clark, secretary-treasurer, Leeville.

Saskatoon, Sask.—Tenders will be received until March 27th, 1911, for the following: (a) 750 K.W., 2,200 volts, 60 cycle, 120 R.P.M., 2-phase generator, exciter, switchboard and exciter switchboard exciter; (b) 1,250 h.p., 120 R.P.M., vertical cross compound Corliss engine; (c) direct connected exciter engine to run exciter for 750 K.W. generator; (d) one steel smoke stack with a height of 100 feet, and inside diameter of 80 inches, together with corresponding connection to boilers, each installed complete. Jas. Clinkskill, mayor, W. B. Neil, city commissioners, Saskatoon. (Advertisement in Canadian Engineer).

Saskatoon, Sask.—Tenders will be received until March 31st, 1911, for the installation of a water filtration plant for the city of Saskatoon. Jas. Clinkskill (Mayor), W. B. Neil, city commissioners, Saskatoon. (Advertisement in the Canadian Engineer).

Saskatoon, Sask.—Sealed tenders will be received until April 14th, 1911, for intercepting sewer. Jas. Clinkskill (Mayor), W. B. Neil, city commissioners, Saskatoon. (Advertisement in the Canadian Engineer).

Rouleau, Sask.—Tenders will be received until April 4th, 1911, for mains and valves. J. Darlington Whitmore, consulting engineer, 104 Willoughby and Duncan Block, Regina, Sask.; J. H. Craig, mayor; W. H. Stewart, secretary-treasurer; Rouleau, Sask. (Advertisement in the Canadian Engineer).

Calgary, Alta.—Tenders will be received until March 22, 1911, for the erection of different stations along the C.P.R. line. Plans, specifications and form of tenders can be seen at the office of assistant chief engineer, Winnipeg, resident engineer's office, Medicine Hat, and division engineer's office, Moose Jaw, Vancouver, and Calgary.

Vancouver, B.C.—Tenders will be received until March 15th, 1911, for the two standard station buildings at Abbotsford and Hammond. H. Rindal, division engineer, Vancouver.

CONTRACTS AWARDED.

Fort William, Ont.—Mr. W. J. Ross of the Northern Engineering Company will construct a fireproof theatre this season at a cost of about $60,000. It will be 60 x 115 feet and will have a seating capacity for 950. M. C. Worth is architect.

Winnipeg, Man.—The contract for the superstructure for sub-station 1, on King Street, near Notre Dame Avenue, was awarded to the J. McDiarmid Company, Winnipeg, at unit prices, estimated total $37,607.20.

Winnipeg, Man.—The contract for a conduit was awarded to Mr. H. B. Campl, Chicago, at 7.10 duo foot. The contract for the conduition was awarded to G. M. Gest, Montreal, at unit prices, estimated total $35,000.

Winnipeg, Man.—The Carter-Aldinger Company of Winnipeg has been awarded the contract for the new Manitoba Agricultural College, their bid being $229,000.

Regina, Sask.—Mr. L. V. Kerr has let the contract for a building 50 x 100, on Scarth Street. The contract was awarded to the Parsons Construction Company for $60,000. Storey & Van Egmond are the architects.

Regina, Sask.—The tender of the United States Steel Products Company for $35,959 was accepted for the supply of special intersection work. Their tender covers two classes of work: Guarantee Construction 108 lb. girder guard rail to be used in conjunction with 7-in. Loraine 80 lb. T. rail used in paved streets and regular construction to be used in connection with 60 lb. A.S.C.E. rail used in outlying districts. Tenders were also received from Messrs. Peacock Bros., The Montreal Steel Works, The Ramapo Iron Works, and J. L. Neilson & Company. The tender of the Monarch Lumber Co. for ties was accepted, viz: 5,900 fir ties, 6-in. x 8-in. x 7-ft. at 68c. each; 6,900 fir ties, 6-in. x 8-in. x 8-ft. at 77½c. each. The tender of the Northern Electric Company, for Eastern cedar poles, 30 ft. long was accepted, viz.: 520 poles at $4 each. Tenders were also received from Lindsley Bros., Spokane and M. Robson, Regina. L. A. Thornton, city engineer.

Pincher Creek, Alta.—The contract for $22,000 debentures for Pincher Creek was awarded to W. A. MacKenzie & Company, Toronto, for $23,241.00, with accrued interest. Other bidders, their addresses and prices were:—

Nay & James, Regina	$22,532.00
Wood, Gundy & Company, Toronto	22,531.00
Æmilius, Jarvis & Co, Toronto	22,706.00
H. O'Hara & Co., Winnipeg	22,903.00
Alloway & Champion, Winnipeg	22,120.00
National Finance Co., Regina	22,461.00
Burgess & Co., Toronto	22,814.00
Ontario Securities Co., Toronto	22,077.00
Brent, Noxon & Co., Toronto	22,429.00
Campbell Thomson & Co., Toronto	98.08%

Vancouver, B.C.—Messrs. McDonald & Wilson, contractors of Vancouver, have been awarded the contract for the erection of the proposed extra wing to the new court house building on Georgia Street, at a figure of $348,200.

Nanaimo, B.C.—Mr. Jeffrey Planta has been awarded the contract of building a convent on Wallace Street, the contract price being $25,000.

RAILWAYS—STEAM AND ELECTRIC.

Port Mann, B.C.—The first shipment of steel for British Columbia section, the Canadian Northern Railway Company, arrived at Port Mann recently. Five other shipments are on the way from Sydney to the Pacific coast. Contracts have been let for grading the line, and inside of twelve months contracts for its entire construction will be let.

SEWAGE AND WATER.

Vancouver, B.C.—The inspection of the sewer by-law accounts shows that since the fall of 1907 the city has expended or appropriated to date $1,258,029.81. In September, 1907, by-law No. 569 for $300,000 was passed, covering sewer extensions, on which $277,941.78 was realized. In February, 1909, by-law No. 653 was endorsed appropriating $500,000 for sewer work, on which $490,088.03 was obtained. Last year by-law No. 768 was passed, giving another vote of $500,000 for sewer work and it is estimated that $490,000 will be received from this measure. The total receipts of the three by-laws noted is $1,258,029.81 and expenditures and appropriations have been made from the fund amounting to $1,208,255.53, leaving a balance of only $49,774,28, available at the present time.

CURRENT NEWS.

Fort William, Ont.—Mr. Geo. P. Graham will erect a bank building for the Traders Bank of Canada; estimated cost, $75,000. Mr. Carl Wirth is architect.

Sault Ste. Marie, Ont.—The movable dam on Bridge Island, in the centre of the canal, is now practically completed, and is being tested. The dam is designed to regulate the flow of water so that the head gates of the canal can be closed in case the lock gates are accidentally carried away. It is the largest dam of the kind in the world.

London, Ont.—Statistical building report:

	Number of Permits.	Estimated Cost.
February, 1911	31	$13,195.00
" 1910	16	20,322.00
January and February, 1911	58	20,225.00
" " 1910	39	82,132.00

Arthur E. Nutter, Building Inspector.

Victoria, B.C.—Mr. C. H. Topp, former city engineer, has been appointed by the city council to make surveys at the north end of Sooke Lake, preliminary to the employment of a supervising engineering expert for the construction of the big waterworks system.

PERSONAL.

Mr. Arthur Heap, of the firm of Echstein, Heap & Company, Manchester, England, manufacturers of switch gear apparatus, was a visitor at the Canadian Engineer office this week. Mr. Heap is over here looking over the field with a view to appointing agents in Canada. He may be addressed, care of the Canadian Engineer, Toronto.

Mr. F. T. Wilson, C.P.R. resident engineer in Vancouver, has resigned to enter private practice in the city, and Mr. Thomas Lees, resident engineer at Brandon, Man., has been appointed to succeed him here. Mr. Lees left for the coast to-day. Mr. V. J. Melsted of Winnipeg has been appointed to succeed Mrs. Lees as resident engineer at Brandon.

Mr. P. Moar, a wire rope expert of the firm of Thos. & Wm. Smith, Limited, of Newcastle-on-Tyne, England, has sailed for home after spending a few weeks in Canada. Mr. Moar came to Canada to consult with Mr. D. W. Clark, of Toronto, the firm's Canadian representative, concerning several rope propositions on which they are estimating.

Mr. Wm. A. Clement, city engineer for Vancouver, tendered his resignation recently to take effect March 31st. Mr. Clement has been in office five years, coming from Toronto.

W. H. Wilson, secretary-treasurer of the Dominion Wood Pipe Co., Ltd., New Westminster, B.C., was a visitor at the office of the Canadian Engineer this week. Mr. Wilson is east on a business trip.

Mr. J. F. Cuay, who has been in the past, chief engineer of the Quebec & Saguenay Railway Company, is still occupying that position. Mr. Evans of Quebec is the consulting engineer. In our issue of March 2nd, personal notes, Mr. Arthur H. N. Bruce, C.E., is cited as being chief engineer, which we are informed is not his position. He has been appointed to represent the interest of the bondholders.

OBITUARY.

Wm. B. Mason, founder and late president of the Mason Regulator Company, Boston, Mass., died on February 4th 1911.

MARKET CONDITIONS.

Montreal, March 8th, 1911.

The United States continues the centre of interest just now. There are several factors at work, any of which may have considerable influence upon the situation. Among these may be mentioned the recent decision of the Interstate Commerce Commission concerning freight rates. Another surrounds the reciprocity question, and still another is the judgment in the case of the Standard Oil, and other large interests. Whether the influence of the rate decision has been fully felt as yet or not is a point which only the future can settle. A view which is frequently expressed is to the effect that the country as a whole will benefit, although the railways may not. Meantime, however, the iron and steel markets will derive little strength from such a view, inasmuch as upon the railways depends the bulk of the orders which have been looked forward to for some time past. Several of the companies seem to be giving out orders for equipment while others are reported to be withholding them. The question of reciprocity has little to do with the subject probably, but the political uncertainty which it occasions is bound to have an unsettling effect upon the business situation. Of consequence, also, is the uncertainty concerning the decision of the courts in the matter of the Standard Oil and Tobacco trusts. The decision upon this matter is expected every day, and the general feeling seems to be that it will not be favorable to the concerns mentioned. What the effect of this may be upon similar organizations and upon business as a whole in the immediate future is difficult to say. In view of the uncertainty occasioned by the factors just referred to it would be surprising to see the iron and steel markets show marked strength until there has been a general settling up of the points under dispute. Meantime the market is likely to be more or less depressed, and dullness is apt to prevail.

That pessimistic views do not prevail everywhere is shown in the following interviews:—

General Manager Bush, of St. Paul, says: "We are not planning any retrenchment in equipment or any reduction in wages or in the size of our working force."

Vice-President Melcher, of the Rock Island, says: "We are going ahead just the same as before the decision of the commission. We have cancelled no orders for equipment, and plan no changes in wages."

President Gardner, of Northwestern, says: "No men have been laid off, and no such step is contemplated."

Officials of the Santa Fe and other Western roads declare that no retrenchment plans are contemplated by them. Lake Shore officials have heard nothing of reported wage cuts in the East.

Prices of pig-iron are unchanged, although the higher levels are being maintained without difficulty. While there are no furnaces reported as going in blast, yet those which are working at present are reported to be in fair shape. This is an encouraging feature, according to the trade, and as one large operator puts it, there is no reason why pig-iron conditions should not pick up rapidly.

Stocks are being depleted in different parts of the country, and as soon as this is accomplished it is safe to say that prices will take a perceptible upward trend.

The English market has been rather weak recently, and declines have been reported both from England and Scotland. Notwithstanding the claim that stocks are being reduced, neither the demand at home nor for consumption abroad is very active.

The situation in Canada is affected to some extent by the firmer attitude which is being adopted towards the market by many purchasers in the United States. Some higher prices are being asked across the line, but it is doubtful if they are being realized. In Canada the demand from Canadian furnaces and also for iron from the United States is very good. There is also inquiry for English and Scotch iron upon the opening of navigation. It is expected that this business will show considerable increase from this out.

Bar Iron and Steel.—Trade is reported first-class. Bar iron, $1.90 per 100 pounds; best refined horseshoe, $2.15; forged iron, $2.05; mild steel, $1.95; sleigh shoe steel, $1.95 for 1 x ⅜ base; tire steel, $2.05 for 1 x ⅜-base; toe calk steel, $2.75; machine steel, iron finish, $2.00; imported, $2.05.

Antimony.—The market is steady at 8¼c.

Building Paper.—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; carpet felt, $2.50 per 100 pounds; tar sheathing, 36c. per roll of 400 square feet; dry sheathing, No. 1, 28c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

Cement.—Canadian cement is quotable, as follows, in car lots, f.o.b. Montreal:—$1.35 to $1.40 per 350-lb bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain.—The market is unchanged, being now per 100 lbs., as follows:—¼-in., $5.30; 5-16-in., $4.70; ⅜-in., $3.90; 7-16-in., $3.65; ½-in., $3.55; 9-16-in., $3.45; ⅝-in., $3.40; ¾-in., $3.35; ⅞-in., $3.35; 1-in., $3.35.

Coal and Coke.—Anthracite, egg, stove or chestnut coal, $7 per ton, net; furnace coal, $6.75, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal.

Copper.—Prices are easy at 13¾c.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; broken lots, $1; electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.10; Colborne Crown, $3.85; Apollo, 10¾ oz., $4.05. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe.—(See Pipe, Wrought and Galvanized).

Iron.—The following quotations are now given, basis of carloads, ex-store:—No. 1 Summerlee, $21.50 to $22 per ton; selected Summerlee, $21 to $21.50; soft Summerlee, $20.50 to $21; Carron special, $21 to $21.50; Carron soft, $20.50 to $21; Clarence, $18.50 to $19; Cleveland, $18.50 to $19.

Laths.—See Lumber, etc.

Lead.—Prices are firm at $3.65.

Lead Wool.—$10.50 per hundred, $200 per ton, f.o.b., factory.

Lumber, Etc.—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight of $1.50. Red pine, mill culls out, $17 to $21 per 1,000 feet; white pine, mill culls, $16 to $17. Spruce, 1-in. by 4-in. and up, $15 to $17 per 1,000 ft.; mill culls, $12 to $14. Hemlock, log run, culls out, $12 to $15. Railway Ties; Standard Railway Ties, hemlock or cedar, 35 to 45c. each, on a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carrying $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X. $1.50; XX, 2.50; XXX, $3.

Nails.—Demand for nails is steady and prices are: $2.40 per keg for cut, and $2.30 for wire, base prices. Wire roofing nails, 5c. lb.

Paints.—Roof, barn and fence paint, $1.25 to $1.45 per gallon; girder, bridge, and structural paint for steel or iron—shop or field— $1.45 to $1.55 per gallon, in barrels; liquid red lead in gallon cans, $2 per gallon.

Pipe.—Cast Iron.—The market shows a firm tone and trade is said to have been most satisfactory. Prices are firm, and approximately as follows:—$33 for 6 and 8-inch pipe and larger; $34 for 3-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.—Demand is about the same, and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27. On the following the discount is 73½ per cent. for black, and 63½ per cent. for galvanized: 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50. Discount on the following is 71½ per cent. off on black, and 61½ per cent. off for galvanized: 3½-inch, $95; 4-inch, $1.08.

Plates and Sheets.—Steel.—The market is steady. Quotations are: $2.20 for 3-16; $2.30 for ⅛, and $2.10 for ¼ and thicker; 12-gauge being $2.30; 14-gauge, $2.15; and 16-gauge, $2.10.

Rails.—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

Railway Ties.—See lumber, etc.

Roofing.—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. Roofing tin caps, 6c. lb.; wire roofing nails, 5c. lb. Roofing cement in bbls., of 40 gallons, 15c.; in 5-gallon tins, 20c. per gallon. (See Building Paper; Tar and Pitch; Nails, Roofing).

Rope.—Prices are steady, at 9c. per lb. for sisal, and 10½c. for Manila. Wire rope, crucible steeel, six-strands, nineteen wires; ¼-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $5.25; ⅝, $6.25; ¾, $8; ⅞. $10; 1-in., $12 per 100 feet.

Spikes.—Railway spikes are steady, at $2.45 per 100 pounds, base of 5½ x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

Steel Shafting.—Prices are steady at the list, less 25 per cent. Demand is on the dull side.

Telegraph Poles.—See lumber, etc.

Tar and Pitch.—Coal tar, $4 per barrel of 40 gallons, weighing about 500 pounds; roofing pitch, No. 1, 75c. per 100 pounds; No. 2, 55c. per 100 pounds; pine tar, $9.50 per barrel of 40 gallons; refined coal tar, $4.50 per barrel, pine pitch, 3c. per lb.; rosin, 3¼c. (See building paper, also roofing).

Tin.—Prices are firm at $44.

Zinc.—The tone is easy, at 6¼c.

CAMP SUPPLIES.

Beans.—Prime beans, $1.85 to $1.90.

Butter.—Fresh made creamery, 24 to 26c.

Canned Goods.—Per Dozen.—Corn, $1.00; peas, $1.20 to $2.00; beans, $1.00; tomatoes, $1.45; peaches, 2s, $1.90; and 3s, $2.90; pears, 2s, $1.80; and 3s, $2.40; salmon best brands, 1-lb. talls, $2.07, and flats, $2.25; other grades, $1.40 to $2 10.

Cheese.—The market ranges from 12 to 13c., covering all Canadian makes.

Coffee.—Mocha, 22 to 30c.; Santos, 18 to 21c.; Rio, 15 to 18c.

Dried Fruits.—Currants, Filiatras, 6¾ to 9¼c.; dates, 5½c.; raisins, Valentias, 7¾ to 8¼c.; prunes, 8¾ to 12c.

Eggs.—New laid eggs, 30 to 35c.; No. 1 candled, 17 to 18c.

Flour.—Manitoba, 1st patents, $5.60 per barrel; and patents, $5.10, strong bakers', $4.90.

Molasses and Syrup.—Molasses, New Orleans, 27 to 28c.; Barbados, 34 to 36c.; Porto Rico, 40 to 43c; syrup, barrels, 3c.; 2-lb. tins, 2 dozen to case, $2.25 per case.

Potatoes.—Per 90 lbs., good quality, $1.10 to $1.20.

Rice and Tapioca.—Rice, grade B, in 100-lb. bags, 3¼ to 3½; Tapioca, medium pearl, 5½ to 8c.

Rolled Oats.—Oatmeal $2.45 per bag; rolled oats, $2.20, bags.

Sugar.—Granulated, bags, $4.60; yellow, $4.20 to $4.45; Barrels 5c. above bag prices.

Tea.—Japans, 20 to 38c.; Ceylons, 20 to 40c.; Ceylon, greens, 19 to 25c., China, green, 14 to 50c.

Fish.—Salt fish.—No. 1 green cod, $8 to $9 per bbl.; herring, $4.50 per bbl.; salmon, $8.50 per half barrel. Smoked fish.—Bloaters, $1.25 per large box; haddies, 8c. per lb.; kippered herring, per box, $1.20 to $1.40.

Provisions.—Salt Pork.—$24 to $31 per bbl.; beef, $18 per bbl.; smoked hams, 14 to 19c. per lb.; lard, 14 to 15c. for pure, and 11½ to 12c. per lb. for compound; bacon, 13 to 18c.

Toronto, March 9th, 1911.

Neither hurdy-gurdies playing spring tunes, nor suburban crows cawing in the trees, nor boys spinning tops in the streets have sufficed to start much activity in the movement of goods, with the single exception of drainage goods and lime, which have been very active this week. Brick are scarce and higher. We have nothing to add to the alterations made last week in pipe and boiler tubes, etc.

Among camp supplies there are changes downward in meats and lard. Flour and feed are practically unchanged. Some people are asking $24, and even $25, for bran and shorts, but we have seen transactions in both at $23 per ton.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

Antimony.—The demand is less active, and the price remains unchanged at $8.50.

Axes.—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

Bar Iron.—$2.05 to $2.15, base, per 100 lbs., from stock to wholesale dealer. Free movement.

Bar Mild Steel.—Per 100 lbs., $2.15 to $2.25. Sleigh shoe and other take same relative advance.

Boiler Plates.—¼-inch and heavier $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per 10 foot; 2-inch, $8.50 to $9; 2¼-inch, $10; 2½-inch, $10.50; 3-inch, $12.10; 3½-inch, $15; 4-inch, $19.

Building Paper.—Plain, 27c. per roll; tarred, 35c. Nothing doing.

Bricks.—In active movement, with very firm tone. The price is $10.50 to $11.00 for half-and-half. Don Valley pressed brick are in request. Red and buff pressed are worth $18 delivered and $17 at works per 1,000.

Broken Stone.—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 70 to 75c. per ton of 2,000 lbs., either 1-inch, 2-inch, or larger, price all the same. Rubble stone, 55c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa, or Quebec Province. At Washago, $2.50 per ton for small and $1.15 for large; freight to Toronto, 60c.

Cement.—Car lots, $1.65 to $1.70 per barrel, without bags. In 1,000 barrel lots, $1.55. In smaller parcels $1.90 is asked by city dealers. Bags, 40c. extra.

Coal.—Anthracite egg and stove, $7.25 per ton; chestnut, scarce, $7.50; pea coal $6.00 per ton. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote: Youghiogheny lump coal on cars here, $3.75 to $3.80; mine run, $3.65 to $3.70; slack, $2.75 to $2.85; lump coal from other districts, $3.55 to $3.70; mine run 10c. less; slack, $2.60 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.75 to $6.00; Reynoldsville, $4.90 to $5.10; Connelsville, 72-hour coke, $5.00 to $5.25. Shipments falling off on account of season drawing to a close. Dealers are buying only such quantities as are actually required so as to facilitate stock taking on April 1st. Nut coal still continues scarce, being held at a premium by miners. The soft coal market is practically unchanged and prices continue stiff as shipments are somewhat blocked by storms.

Copper Ingot.—The market has reached a firm basis, and holders are quite stiff at $13.50 per 100 lbs. Demand is active, and a large quantity moving.

Detonator Caps.—75c. to $1 per 100; case lots; 75c. per 100; broken quantities, $1.

Dynamite.—The price is determined by the point at which it is to be delivered. Here we quote 21 to 25c. as to quantity.

Felt Roofing.—Not much moving, price continues as before, $1.80 per 100 lbs.

Fire Bricks.—English and Scotch, $30 to $35; American, $25 to $35 per 1,000. Fire clay, American, $8; Scotch, $12.

Fuses.—Electric Blasting.—Double strength 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet.

Iron Chain.—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40, per 100 lbs.

Iron Pipe.—At present quotations are lower, thus:—Black Pipe, ¼-inch, $2.03; ⅜-inch, $2.25; ½-inch, $2.63; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.54; 2½-inch, $15.24; 3-inch, $20.01; 3½-inch, $27.08; 4-inch, $30.78; 4½-inch, $35.75; 5-inch, $40.75; 6-inch, $52.85. Galvanized Pipe, ¼-inch, $2.86; ⅜-inch, $2.86; ½-inch, $3.48; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.14, per 100 feet.

Pig Iron.—We quote Clarence at $20.50, for No. 3; Cleveland, $20.50; Summerlee, $22; Hamilton quotes a little irregular, between $19 and $20. Any change must be upward.

Lead.—A fair business is doing at prices unaltered from $3.75 to $4.

Lime.—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 23c. per 100 lbs. f.o.b. car without freight. Demand is beginning.

Lumber.—Demand less brisk, because of the late season of the year, but prices are not materially altered. Pine is good value at $32 to $40 per M. for dressing, according to width required; common stock boards, $28 to $33; cull stocks, $20; cull sidings, $17.50. Southern pine dimension timber from $30 to $45, according to size and grade; finished Southern pine, according to thickness and width, $32 to $42.50; hemlock is in demand and held quite firmly, we quote $17.50 to $18.00; spruce flooring in car lots, $22 to $24; shingles, British Columbia, are steady, we quote $3.30; lath, No. 1, $4.60; white pine, 48-inch, No. 2, $3.75; for 32-inch, $1.85 is asked. The factories are all busy; the yard trade necessarily more slack, because of the season of the year.

Nails.—Wire, $2.35; cut, $2.60; spikes, $2.85 per keg of 100 lbs., base.

Pitch and Tar.—Pitch, unchanged at 70c. per 100 lbs. Coal tar, $3.50 per barrel. Season is over.

Plaster of Paris.—Calcined, New Brunswick, hammer brand, car lots, $1.95 to $2, f.o.b., cars, Toronto; retail, $2.15 per barrel of 300 lbs., delivered in 5 barrel lots; $2.10 at warehouse.

Putty.—In bladders, strictly pure, per 100 lbs., $2.60; in barrel lots, $2.10. Plasterer's, $2.15 per barrel of three bushels, at warehouse.

Ready Roofing.—Prices are as per catalogue.

Roofing Slate.—Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices But No. 1 Bangor slate 10 x 16 may be quoted at $7 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less. Mottled, $7.25; green, $7, with a prospect of advance. Dealers are fairly busy.

Rope.—Sisal, 9½c. per lb.; pure Manila, 10½c. per lb., Base.

Sand.—Sharp, for cement or brick work, $1.15 per ton f.o.b., cars, Toronto siding.

Sewer Pipe.—

	4-in.	6-in.	9-in.	12-in.	24-in.
Straight pipe, per foot	$0.25	$0.40	$0.65	$1.00	$3.25
Single junction, 1 or 2 ft. long	1.00	1.60	2.60	4.00	13.00
Double junctions	1.25	2.00	3.25	5.00	16.25
Increasers and reducers	....	1.60	2.60	4.00	13.00
P. & H. H. traps	2.00	3.20	6.50	15.00	.....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list, as changed. The retail price is less 65 per cent. off these figures on all sizes, 9 inches and under, or less 60 per cent. off these figures on anything over 9 inches. For car-load lots a greater discount.

Steel Beams and Channels.—Active.—We quote:—$2.75 per 100 lbs., according to size and quantity; if cut, $3 per 100 lbs.; angles, 1¼ by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

Sheet Steel.—American Bessemer, 10-gauge, $2.40; 12-gauge, $2.45; 14-gauge, $2.20; 17, 18, and 20-gauge, $2.45; 22 and 24-gauge, $2.55; 26-gauge, $2.65; 28-gauge, $2.80. A very active movement is reported at unchanged prices, and an advance is not unlikely.

Sheets Galvanized.—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.00; 12-14-gauge, $3.00; 16, 18, 20, $3.20; 22-24, $3.35; 26, $3.50; 28, $3.95; 29, $4.25; 10¾, $4.25 per 100 lbs. Fleur de Lis—28-gauge, $4.10; 26, $3.80 per 100 lbs. Active and firm at these prices.

Tank Plate.—3-16-inch, $2.40 per 100 lbs.

Tool Steel.—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

Tin.—Control of the market is still evident, and the upward trend continues. We now quote 47c. to 48c.

Wheelbarrows.—Navvy, steel wheel, Jewel pattern, knocked down, $21.60 per dozen; set up, $22.60. Pan Canadian, navvy, steel tray, steel wheel, $3.30 each; Pan American, steel tray, steel wheel, $4.25 each.

Zinc Spelter.—Demand not so brisk, and the market easier at $6.

CAMP SUPPLIES.

Beef.—By carcases, $8.50 to $9.50.

Butter.—Dairy prints are 18 to 22c.; creamery prints, 24 to 26c.; do. fresh made, 28 to 29c. Splendid demand for fresh made.

Canned Goods.—Peas, $1.35 to $1.75; tomatoes, 3s, $1.45 to $1.50; pumpkins, 3s, 97½c.; corn, 95c. to $1.00; peaches, 2s, $1.87½; yellow, $1.82½ to $1.87½; strawberries, 2s, heavy syrup, $1.80; raspberries 2s, $1.80 to $1.97½.

Cheese.—Moderately firm, large, 13¼ to 13½c.; twins, 13½ to 13¾c.

Coffee.—Rio, Green, 15½ to 16c.; Mocha, 23 to 25c.; Java, 25 to 31c.; Santos, 16 to 17c.

Dried Fruits.—Raisins, new, Valencia, 8 to 8½c.; seeded, 1-lb. packets, fancy, 8c.; 16-oz. packets, choice, 7½c.; Sultanas, good, 8½c.; fine, 9½c.; choice, 10 to 11c.; fancy, 12c.; Filiatras currants, cleaned, 7½ to 8c.; Vostizzas, 9 to 10c.; uncleaned currants, 7 to 7¼c.

Eggs.—Strictly new-laid, 23 to 24c.; storage, 15 to 17c.

Flour.—Prices unchanged thus far; thus, Manitoba flour, first patents, $5.20; second, $4.70; strong bakers', $4.60; Ontario flour winter wheat patents, $3.90; $4 per barrel.

Feed.—Bran, $22 to $23 per ton; shorts, $23 to $24 per ton.

Lard.—Tierces, we quote 11¼c. here; tubs, 11½c.; pails, 11¾c.

Molasses.—Barbados, barrels, 37 to 45c.; West Indian, 27 to 30c.; New Orleans, 30 to 33c. for medium.

Pork.—Not much doing, short cut, $26 to $26.50 per barrel; mess, $1 off, heavy, $22 to $22.50.

Rice.—B. grade, 3½c. per lb.; Patna, 5 to 5¾c.; Japan, 5 to 6c.

Salmon.—As before stated. We quote Fraser River, talls, $2.05; flats $2.20; River Inlet, $1.90; cohoes, $1.75.

Smoked and Dry Salt Meats.—Long clear bacon, 11 to 11½c. per lb., tuns and cases; hams, large, 12 to 13c.; small, 14 to 15c.; rolls, 12 to 13c.; breakfast bacon, 17 to 18c.; backs (plain), 18 to 19c.; backs (peameal), 19 to 20c.; shoulder hams, 13c.; green meats out of pickle, 1c. less than smoked.

Spices.—Allspice, 18 to 19c.; nutmegs, 30 to 75c.; cream tartar, 28 to 30c.; compound, 18 to 20c.; pepper, black, pure Singapore, 14 to 17c.; pepper, white, 25 to 30c.

Sugar.—Granulated, $4.35 per 100 lbs., in barrels; Acadia, $4.25; yellow, $3.95.

Syrup.—Corn syrup, special bright, 3¼c. per lb.

Teas.—Japans, 20 to 35c. per lb.; Young Hysons, 16 to 35c.; Ceylons, 17 to 38c. per lb.

Vegetables.—Potatoes—Ontario, $1 per bag, on railway track, Toronto; Ontario Delawares bring $1, and New Brunswick Delawares $1.10; onions by crate, Spanish, $3; Canadian, $1.85; cabbages bring from $1.25 to $1.50 per; barrel; carrots, 60c. per bag; beets, 75c. per bag; turnips, 40c. per bag.

Winnipeg, March 6th, 1911.

There is nothing of interest in the Winnipeg markets to mention, except that things are getting into splendid shape for spring trade in all lines. Building permits in are away ahead of what they were last year at this time, so that the outlook is very bright. Supply men are looking forward to a big year, and they do not anticipate any great change in prices. Cement is a little uncertain, and they are not very sure as to what it will do.

Local quotations remain steady, and are as follows:—

Anvils.—Per pound, 10 to 12½c.; Buckworth anvils, 80 lbs., and up, 10¾c.; anvil and vice combined, each, $5.50.

Axes.—Chopping axes, per dozen, $6 to $9; double bits, $12.10 per dozen.

Barbed Wire.—4 point and 2 point, common, $3.15 per cwt.; Baker, $3.20; Waukegan, $3.30.

Bar Iron.—$2.50 to $2.60.

Bars.—Crow, $4 per 100 pounds.

Beams and Channels.—$3 to $3.10 per 100 up to 15-inch, (4, 30, 41, 50, 118, 119, 127, 132, 145, 176.)

Boards.—No. 1 Common Pine, 8 in. to 12 in., $38 to $45; siding, No. 2 White Pine, 6 in., $55; cull red or white pine or spruce, $24.50; No. 1 Clear Cedar, 6 in., 8 to 16 ft., $60; Nos. 1 and 2 British Columbia spruce, 4 to 6in., $55; No. 3, $45.

Bricks.—$11, $12, $13 per M, three grades.

Building Paper.—4½ to 7c. per pound. No. 1 tarred, 84c. per roll; plain, 60c.; No. 2 tarred, 62½c.; plain, 56c.

Coal and Coke.—Anthracite, egg, stove or chestnut coal, $9.75 large lots to $10.50 ton lots, net; Alleghany soft coal; carload lots, basis, Winnipeg, f.o.b., cars, $6 per ton; cannel coal, $10.50 per ton; Galt coal, $2 f.o.b., carload lots, $9 single ton; coke, single ton, $7 at yard; large lots special rates. American coke, $11 to $11.50 a ton; Crow's Nest, $10 a ton.

Copper Wire.—Coppered market wire, No. 7, $4 per 100 lbs.; No. 6, $4; No. 10, $4.06; No. 12, $4.20; No. 14, $4.40; No. 16, $4.70.

Cement.—$2.40 to $2.75 per barrel in cotton bags.

Chain.—Coil, proof, ¼-inch, $7; 5-16-inch, $5.50; ⅜-inch, $4.90; 7-16-inch, $4.75; ½-inch, $4.40; ⅝-inch, $4.20; ¾-inch, $4.05; logging chain, 5-16-inch, $6.50; ⅜-inch, $6; ¼-inch, $8.50; jack iron, single, per dozen yards, 15c. to 75c.; double, 25c. to $1; trace-chains, per dozen, $5.25 to $6.

Copper.—Tinned, boiler, 26½c.; planished, 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent. discount.

Dynamite.—$11 to $13 per case.

Hair.—Plasterers', 90c. to $1.15 per bale.

Hinges.—Heavy T and strap, per 100 lbs., $6 to $7.50; light, do., 65 per cent.; screw hook and hinge, 6 to 10 inches, 5¼c. per lb.; 12 inches up, per lb., 4¼c.

Galvanized Iron.—Apollo, 10¾, $4.90; 28, $4.70; 26, $4.30; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90; Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

Iron.—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5.

Lumber.—No. 1 pine, spruce, tamarac, 2 x 4, 2 x 6, 2 x 8, 8 to 16 feet, except 10 feet, $29; British Columbia fir and cedar, 2 x 4, 2 x 6, and 2 x 8, 12 to 16 feet, $32; 2 x 20, 4 x 20, up to 32 feet, $42.

Nails.—$4 to $4.25 per 100. Wire base, $2.85; cut base, $2.90.

Picks.—Clay, $5 per dozen; pick mattocks, $6 per dozen; clevishes, 7c. per lb. (132.)

Pipe.—Iron, black, per 100 feet, ¼-inch, $2.50; ⅜-inch, $2.80; ½-inch, $3.40; ¾-inch, $4.60; 1-inch, $6.60; 1¼-inch, $9; 1½-inch, $10.75; 2-inch, $14.40; galvanized, ½-inch, $4.25; ¾-inch $5.75; 1-inch, $8.35; 1¼-inch, $11.35; 1½-inch, $13.60; 2-inch, $18.10. Lead, 6½c. per lb.

Pitch.—Pine, $6.50 per barrel; in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Plaster.—Per barrel, $3.25.

Roofing Paper.—60 to 67½cc. per roll.

Rope.—Cotton, ¼ to ½-in., and larger 23c. lb.; deep sea, 16½c.; lath yarn, 9½ to 9¾c.; pure Manila, per lb., 13¼c.; British Manila, 11¾c., sisal, 10½c.

Shingles.—No. 1 British Columbia cedar, $4; No. 2, $3.50; No. 1 dimension, $5; No. 1 band saw, $6.

Spikes.—Basis as follows:—1¼, 5 and 6, $4.75; 5-15 x 5 and 6, $4.40; ⅜ x 6, 7 and 8, $4.25; ½ x 8, 9, 10, and 12, $4.05; 25c. extra on other sides.

Steel Plates, Rolled.—3-16-in., $3.35 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50; cast share steel, $7.50; toe calk, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

Staples.—Fence, $3.40 per 190 lbs.

Timber.—Rough, 8 x 2 to 14 x 16 up to 32 feet, $38; 6 x 20, 8 x 20, up to 32 feet, $42.

Tool Steel.—8½ to 15c. per pound.

TENDERS CALLED FOR

CIVIC CAR LINES.

TENDERS FOR RAILS AND TIES.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, Canada, up to noon on Tuesday, April 4th, 1911, for delivery of thirteen hundred and forty (1,340) tons of open hearth steel rail, 80-lb. section, also thirty thousand (30,000) untreated wood ties, white cedar preferred, although other woods will be considered.

Envelopes containing tender must be plainly marked on the outside as to contents.

Specifications and forms of tender may be obtained upon application to the office of the City Engineer, Toronto.

The lowest or any tender not necessarily accepted.

G. R. GEARY (Mayor),
Chairman Board of Control.

City Hall, Toronto, February 28th, 1911.

TENDERS FOR A STEEL BRIDGE.

THE RURAL MUNICIPALITY OF SWAN RIVER, in Manitoba, invite tenders for one ninety-four (94) foot centre to centre of end bearings Steel-riveted Pratt Truss Bridge and two Concrete Piers with (Steel) Stringers, and three (3) inch Tamarac Plank Floor. To be erected over the Woody River, east side of Section 36, Township 37, Range 27, west of the Principal Meridian in Manitoba, in accordance with Specifications, which can be obtained from the Provincial Department of Public Works, Parliament Buildings, Winnipeg, Manitoba.

The bridge site is within one mile of Bowsman Station on the Canadian Northern Railway.

Sealed Tenders to be delivered to the undersigned on or before the 15th day of April, A.D., 1911.

JOSEPH ARMSTRONG,
Secretary-Treasurer, Municipal Council,
Swan River, Manitoba.

THE CITY OF CALGARY.

Tenders will be received by the City Commissioners up to 12 o'clock noon on the 22nd day of March, 1911, for the following machinery and plant:

One 1,500 K.W. Turbo Generator set with condenser, etc.
One 100 K.W. Exciter and Switchboards, complete.
Three 1,000 K.V.A. single-phase Transformers, 12,000 to 2,300 volts, with switching gear, etc.

An accepted cheque for 2 per cent. of the tender must accompany all bids. Cheques will be returned after the contract has been signed.

The successful tenderer will be obliged to enter into a bond with the City for the fulfilment of his contract on a date to be agreed upon by the City and Contractor.

The City reserves the right to accept any or reject the whole of the tenders submitted, or to depart from the specification as may be deemed advisable by the City.

W. D. SPENCE,
City Clerk.

Dated at Calgary, Feb. 9th, 1911.

TOWN OF SOURIS, MAN.

Sealed Tenders will be received by the undersigned until six (6.00) o'clock p.m., on March 20th, 1911, for the following work to be done during the season of 1911:

Excavation, laying and back filling for approximately 31,500 feet of Standard Vitrified Sewer Pipe (8 in. to 20 in.) and all necessary Tees, Wyes, etc., etc.

Excavation, laying and back filling for approximately 31,500 feet of Standard Cast Iron Water Pipe (4 in. to 12 in.) and all necessary Tees, Reducers, etc., etc., also setting Gate Valves and Valve Boxes.

Excavation, setting and back filling for seventy (70) Standard Fire Hydrants.

Construction of approximately seventy-five (75) Manholes, and setting covers and frames of same.

The construction of a Brick Building 60 ft. x 40 ft. x 14 ft., on Concrete Foundation, together with all necessary machinery, consisting of Compression Tanks, Gasoline Engines and Pumps, etc., etc.

Interested parties desiring to tender on any or all of the above work can obtain further information and forms for tender by applying to the Town Engineer or Secretary-Treasurer. Plans, profiles and specifications may be seen at the office of the Town Engineer, Souris, Manitoba.

V. H. WILLIAMS, Town Engineer.
J. W. BREAKEY, Secretary-Treasurer.

Souris, Man., February 14th, 1911.

CITY OF MOOSE JAW, SASKATCHEWAN.

Main Drainage Works.

Sealed tenders endorsed "Tender A" and "Tender B," will be received by the undersigned City Clerk until 8.30 o'clock p.m. on Monday, April 10th, 1911. Any tender received after the above stated time be declared informal.

Contract "A."

Supplying materials for and constructing a Sewage Disposal Plant complete, including a Pump House, Sedimentation Tanks and Percolating Filters, also the supplying of materials for and the laying of a Trunk Sewer and Water Main.

Contract "B."

Supplying two Electrically-driven Centrifugal Pumps and Auto Starters complete with all piping, connections, etc.

Plans and specifications for contract "A" may be obtained from the City Engineer, Moose Jaw, upon receipt of a marked cheque for the sum of $25, to be held until return of plans and specifications; and for contract "B" plans and specifications will be sent upon request.

The lowest or any tender not necessarily accepted.

J. M. WILSON, City Engineer.
W. F. HEAL, City Clerk.

Moose Jaw, February 18th, 1911.

TENDERS FOR A STEEL BRIDGE.

The Municipal Council of THE RURAL MUNICIPALITY OF MINNITONAS invite TENDERS for the supply and erection of a Steel Warren Truss Bridge, and Two Concrete Piers. Bridge to be 60 feet centre to centre, of end bearings with Steel Stringers and Three-inch Plank Floor in accordance with Plan (No. F 10), and specifications on file at this Office, and also at the Office of the Chief Engineer, Department of Public Works, Parliament Buildings, Winnipeg, Manitoba.

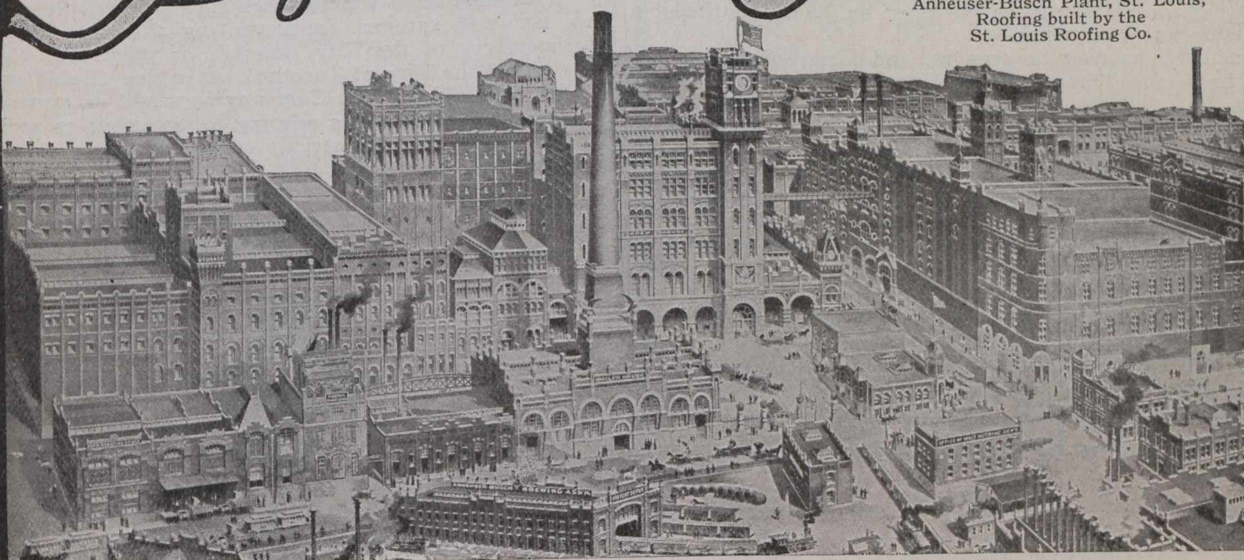
Tenders under Seal to be delivered to the undersigned on or before the 15th Day of April, A.D. 1911.

The lowest or any Tender not necessarily accepted.

E. WIDMEYER,
Secretary-Treasurer, Municipal Council,
Minnitonas, P.O., Manitoba.

(Tenders continued on Pages 64, 66 and 70.)

Barrett Specification Roofs



Anheuser-Busch Plant, St. Louis,
Roofing built by the
St. Louis Roofing Co.

Over 50 Years of Satisfaction

When big roofs are under consideration, ultimate costs are carefully figured. Barrett Specification Roofs win on the figures every time, and for that reason most of the large manufacturing plants in the country carry roofs laid along the lines of this Specification.

The enormous plant illustrated above is a typical instance. It is the Anheuser-Busch Brewery at St. Louis, covering 70 acres, equal to 35 city blocks. Ninety-nine per cent. of these buildings are roofed with coal tar pitch, tarred felt and gravel laid along the lines of the Barrett Specification, the other 1 per cent. being steep or ornamental roofs.

The durability of these roofs has averaged over twenty years, and the net cost per square foot per year of service has been lower than that of any other roofing material.

The Anheuser-Busch people have had plenty of time to find a better and more economical roof covering if there was any, for they have been using gravel roofs of this type since 1852.

Whenever the area is large enough to set engineers and architects to looking up ultimate roofing costs, Barrett Specification Roofs are invariably used.

The Barrett Specification will be furnished free on request to anyone interested. Address our nearest office.

The Paterson Manufacturing Co., Limited

Montreal Toronto Winnipeg Vancouver St. John, N.B. Halifax, N.S.

Tenders Called For

(Continued from Page 62.)

PURCHASE OF ELECTRIC VEHICLES.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, up to noon on Tuesday, March 14th, 1911, for Electric Vehicles.

Envelopes containing tenders must be plainly marked on the outside as to contents.

Specifications may be seen at, and forms of tender obtained from, the Toronto Hydro-Electric System, City Hall, Toronto.

Tenderers shall submit, with their tender, the names of two personal sureties (approved of by the City Treasurer), not members of the City Council, or officers of the Corporation of the City of Toronto, or in lieu of said sureties, the bond of a Guarantee Company approved as aforesaid.

The usual conditions relating to tendering as prescribed by city by-law must be strictly complied with or the tenders will not be entertained.

The lowest or any tender not necessarily accepted.

G. R. GEARY (Mayor),
Chairman, Board of Control.

City Hall, Toronto, February 28th, 1911.

TOWN OF ROULEAU, SASK.

TENDERS.

SEALED TENDERS addressed to W. H. Stewart, Secretary-Treasurer, will be received in the council chamber, up to 12 o'clock, noon, on April 4th, 1911, for the following:

"Contract E." Electrical machinery, pole line, etc.

"Contract F." Pumping machinery, compressed air system.

"Contract G." Producer Gas Plant.

"MAINS."

Cast iron or steel water mains, as follows:—

12,000 feet 6-inch C. I. water main, tested to 300 pounds hydrostatic pressure.

1,000 feet 4-inch C. I. water mains, tested to 300 pounds hydrostatic pressure.

1,400 feet 2-inch C. I. water main, tested to 300 pounds hydrostatic pressure.

Special castings, tees, etc., at per pound.

"VALVES."

Hydrants, valves, etc., as follows:—

22 6-inch hydrants, one steamer nozzle, and two 2¼-inch nozzles; 8 feet O-inch bury.

47 6-inch left-handed gate valves.

47 6-inch valve boxes extending 7 to 9 feet.

An accepted cheque equal to five per cent. of the amount of the tender must accompany each tender and envelopes must be endorsed with the letter of the contract referred to, or "Mains" and "Valves."

The council reserves the right to reject any or all tenders, and to waive any irregularities therein.

Plans and specifications may be seen at the Secretary-Treasurer's office, Rouleau, or at the office of the Engineer, Regina.

Copies of the plans and specifications will be forwarded from Regina, on receipt of an accepted cheque for $10.00, said cheque to be refunded upon return of the said plans and specifications.

J. DARLINGTON WHITMORE,
Consulting Engineer, 104 Willoughby and Duncan Block, Regina, Sask.
J. H. CRAIG, Mayor.
W. H. STEWART, Secretary-Treasurer.

TENDERS FOR PIPE FITTINGS.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, up to noon on Tuesday, March 14th, 1911, for pipe fittings in connection with street lamps.

Envelopes containing tenders must be plainly marked on the outside as to contents.

Specifications may be seen at, and forms of tender obtained from, the Hydro-Electric System, City Hall, Toronto.

Tenderers shall submit, with their tender, the names of two personal sureties (approved by the City Treasurer, not members of the City Council, or officers of the Corporation of the City of Toronto), or in lieu of said sureties, the bond of a Guarantee Company approved as aforesaid.

The usual conditions relating to tendering as prescribed by city by-law must be strictly complied with or the tenders may not be entertained.

The lowest or any tender not necessarily accepted.

G. R. GEARY (Mayor),
Chairman, Board of Control.

City Hall, Toronto, March 1st, 1911.

CITY OF SASKATOON.

Tenders Wanted for Electrical Unit.

Sealed tenders addressed to the undersigned City Commissioners, and marked "Tenders for Machinery," will be received until 4 o'clock p.m., Monday, March 27th, 1911, for the following:

A. 750 K.W. 2,200 Volts, 60 Cycle, 120 R.P.M., 2-Phase Generator, Exciter, Switchboard, and Exciter Switchboard, installed complete. Alternative tenders for the above are asked for in Three-Phase.

B. 1,250 H.P. 120 R.P.M., Vertical Cross Compound Corliss Engine, with necessary condensing apparatus, and feed water heaters, installed complete.

C. Direct connected Exciter Engine to run Exciter for 759 K.W. Generator, installed complete.

D. One Steel Smoke Stack with a height of 100 feet, and inside diameter of 80 inches, together with corresponding connections to Boilers, installed complete.

Specifications will be furnished on application to the City Commissioners, Saskatoon.

A marked cheque for 5 per cent. of tender submitted, must accompany each tender.

The lowest or any tender not necessarily accepted.

JAS. CLINKSKILL, Mayor.
JAS. CLINKSKILL, W. B. NEIL, City Commissioners.

Saskatoon, February 28th, 1911.

QUEEN VICTORIA NIAGARA FALLS PARK.

Boulevard Bridges.
Boulevard Roadway.

Sealed Proposals endorsed "Proposal for Boulevard Construction," will be received until Tuesday, March 28th, 1911, at noon, for the construction of (a) 5 Steel Concrete Bridges and (b) a Macadam Roadway, with the necessary drainage being Section 4B, 5,182 feet, commencing at Miller's Creek, and extending to the southerly limit of the Shipyard, according to plans and specifications for the several works on file at the Administration Building, Queen Victoria Park, Niagara Falls, Ontario.

JOHN H. JACKSON,
Superintendent.

Niagara Falls, Ontario, March 2nd, 1911.

(Tenders continued on Page 66.)

Tenders Called For

(Continued from Pages 62 and 64.)

TOWN OF OSHAWA.

ASPHALT BLOCK PAVEMENT.

Sealed tenders will be received up to and including the 18th day of March, 1911, for the construction of an Asphalt Block Pavement, on a concrete base, together with cement concrete curb, gutter and widening of sidewalk where necessary, upon the the following streets:

King Street, 1,750 lineal feet of width varying from 30 to 40 feet.

Simcoe Street, 1,650 lineal feet of width, varying from 30 to 40 feet.

The part to be paved will include that portion of the road occupied by the track of the Oshawa Street Railway Company.

Plans may be seen and specifications obtained from the Town Engineer's Office, Town Hall, Oshawa.

The lowest or any tender not necessarily accepted.

W. E. N. SINCLAIR, B.A., LL.B.,
Mayor.

FRANK CHAPPELL,
Town Engineer.

Oshawa.

NOTICE TO CONTRACTORS.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, up to noon on TUESDAY, MARCH 28th, 1911, for the supply of STEEL EXTENSIONS FOR MANHOLES ON 6-FT. STEEL PIPE-LINE.

Envelopes containing tenders must be plainly marked on the outside as to contents.

Specifications and forms of tender may be obtained at the office of the City Engineer, Toronto.

The tenderers shall submit with their tender the names of two personal sureties (approved of by the City Treasurer), not members of the City Council, or officers of the Corporation of the City of Toronto, or in lieu of said sureties the bond of a Guarantee Company, approved as aforesaid.

The usual conditions relating to tendering, as prescribed by City By-law, must be strictly complied with, or the tenders will not be entertained.

The lowest or any tender not necessarily accepted.

G. R. GEARY (Mayor),
Chairman Board of Control.

City Hall, Toronto, March 7th, 1911.

CITY OF GUELPH.

PAVEMENT CONSTRUCTION.

Sealed tenders addressed to the city clerk will be received up till noon on Thursday, March 30th, 1911, for the construction of approximately 26,000 square yards of pavement, with about 5,000 lineal feet of street railway track and approximately 13,000 lineal feet of combined curb and gutter.

Particulars may be obtained from the City Engineer.

A marked cheque for $1,000.00 must accompany each tender.

The lowest or any tender not necessarily accepted.

J. HUTCHEON,
City Engineer.

T. J. MOORE,
City Clerk.

Guelph, March 7th, 1911.

CITY OF SASKATOON.

INTERCEPTING SEWER.

Sealed tenders addressed to the undersigned city commissioners and marked as to contents, will be received until 12 o'clock noon on Friday, April 14th, 1911, for the following work:—

Contract No. 78—Pipelaying.
" " 79—Furnishing concrete sewer pipe.
" " 80—Furnishing cast-iron sewer pipe and specials.

Plans, specifications, etc., may be seen at the office of the City Engineer, Saskatoon, also at the following places:

The Canadian Engineer—62 Church St., Toronto.
" " " —315 Nanton Bldg., Winnipeg.
" " " —Board of Trade Bldg., Montreal.
Engineering News. —220 Broadway, New York City.

The lowest or any tender not necessarily accepted.

JAS. CLINKSKILL (Mayor),
W. B. NEIL,
City Commissioners.

Saskatoon, Saskatchewan, Canada,
March 1st, 1911.

CITY OF SASKATOON.

WATER FILTRATION.

Sealed tenders addressed to the undersigned and marked "Water Filtration," will be received until 12 o'clock noon on Friday, March 31st, 1911, for the installation of a Mechanical Water Filtration Plant for the city of Saskatoon.

All information may be obtained on application to the City Engineer.

The lowest or any tender not necessarily accepted.

JAS. CLINKSKILL (Mayor),
W. B. NEIL,
City Commissioners.

Saskatoon, Saskatchewan,
February 28th, 1911.

CANADIAN PACIFIC RAILWAY COMPANY.

ONTARIO DIVISION.

Sealed tenders addressed to the undersigned will be received before 12.00 noon, 25th March, 1911, for a 22 stall engine house with machine and boiler shops, to be constructed at London, Ontario. Plans and specifications can be seen in the Division Engineer's Office, Toronto, and also in the Resident Engineer's Office, London. The lowest or any tender not necessarily accepted.

A. L. HERTZBERG,
Division Engineer, Union Station,
Toronto.

Toronto, 6th March, 1911.

(Tenders continued on Page 70.)

Index to Advertisements

POSITIONS WANTED

POSITION WANTED.—Graduate Civil Engineer; ten years' experience, desires position with bridge or inspection company, as checker, designer, or inspector. Permanent position desired. Address Box 160, Canadian Engineer.

RAILROAD ENGINEER (26), 8 years' experience design and construction of railroads, retaining walls, roads, roof trusses and columns of steel, desires position, Winnipeg or west, permanent. Box A21, Canadian Engineer.

ENGINEER desires position on construction, considerable experience on water and sewerage works, permanent street paving, concrete and general construction works. First-class references. Apply Box 172, Canadian Engineer.

POSITIONS VACANT

ELECTRICAL SUPERINTENDENT.

Applications for the position of Electrical and Mechanical Superintendent for the City of Saskatoon, will be received up to 15th March, 1911.

Applications must be accompanied with references, and be addressed to City Clerk, Saskatoon, and marked "Electrical Superintendent."

JAS. CLINKSKILL, Mayor.
W. B. NEIL, Commissioner.

Saskatoon, Saskatchewan, February 21st, 1911.

WANTED.—Western Canada, first-class reinforced concrete designer and draughtsman. Steady reliable man, able to take charge of designing end of business. Apply, state age, experience, to Box 168, Canadian Engineer.

WANTED, as assistant to business manager, a technically trained man, experienced as commercial engineer and familiar with cost accounting system of Public Electric Utilities operating in large cities. Must have initiative and executive ability and show clearly that he has made good elsewhere. Application not considered unless it contains full details as to where born, age, education, positions held, salaries received and references. Address Box 170, Canadian Engineer.

FOR SALE

FOR SALE.

One second-hand No. 1 Smith Concrete Mixer, with engine and boiler complete.

One second-hand 7 x 12 hoisting engine, 3 drum D.C., and boiler complete, nearly new.

One 5-ton derrick with cables and sheaves.

One ¾-yard clam shell bucket, nearly new.

Apply to A. J. CROMAR,
Brantford, Ont.

FOR SALE.

A good 15-in. dumpy Berger level-erecting eyepiece, in perfect condition, nearly new. Price, $75.00. Address, Box 162, Canadian Engineer.

SAND DREDGE FOR SALE.

Hydraulic Sand Dredge in excellent condition, complete with necessary pumps, engines, boiler, "A" frame, spud cutter, etc.

Accessories include 500 feet of steel discharge pipe, of which 250 feet is fitted with flexible joints; also seven pontoons to carry same.

For further information and details apply to the City Engineer of Hamilton, Canada.

Hamilton, Canada, March 1st, 1911.

Tenders Called For

(Continued from Pages 62, 64 and 66.)

ELECTRIC STREET RAILWAY SYSTEM.

The Council of the City of Saskatoon is prepared to receive proposals for a Franchise for an Electric Street Railway System.

Communications giving full details to be addressed to the City Clerk marked "Street Railway," and will be received up to the 3rd of April, 1911.

JAS. CLINKSKILL, Mayor.
W. B. Neil, Commissioner

Saskatoon, Saskatchewan, 21st February, 1911.

CITY OF MOOSE JAW, SASKATCHEWAN.

SEWER AND WATER EXTENSIONS.

Sealed tenders endorsed "Tender 28," "Tender 29," "Tender 30," and "Tender 31," will be received by the undersigned City Clerk until 8.30 o'clock p.m., on Monday, April 10th, 1911.

Any tender received after the above stated time will be declared informal.

CONTRACT 28—

The laying of approximately 30,700 lineal feet of tile pipe sewer, building manholes, etc.

The laying of approximately 29,700 lineal feet of cast iron water main, placing valves, valve boxes, hydrants, etc.

CONTRACT 29—

The supplying of approximately:

29,600 lineal feet of 6-in. C.I. Water Pipe.
112 " " of 4-in. " " "
132 6-in. cast iron reverse curves.
34 6-in. cast iron crosses.
72 6-in. cast iron tees.
29 4-in. off 6-in. cast iron tees.
28 4-in. cast iron tees.
95 6-in. cast iron plugs.

CONTRACT 30—

The supply of approximately:

28,000 lineal feet of 6-in. Vitrified Tile Sewer Pipe.
26,600 " " of 8-in. " " "
5,225 " " of 10-in. " " " "
1,100 " " of 12-in. " " " "
25 8-in. Tees.
75 6-in. Tees.
25 8-in. ¼ Bends.
100 6-in. ⅛ Bends.
25 8-in. Stops.
25 10-in. Stops.
400 4-in. to 6-in. Increasers.

CONTRACT 31—

The supply of approximately:

65 6-in. 3-way Hydrants.
147 6-in. Gate Valves.
29 4-in. Gate Valves.
150 6-in. Valve Boxes.
29 4-in. Valve Boxes.
88 Manholes, Frames and Covers.

Plans and specifications for Contract 28 may be seen at the office of the City Engineer, Moose Jaw, Sask., and at the offices of the Canadian Engineer at Toronto and Winnipeg.

Plans and specifications for Contracts 29, 30, and 31 will be sent upon request.

The lowest or any tender not necessarily accepted.

J. M. WILSON, City Engineer.
W. F. HEAL, City Clerk.

Moose Jaw, 24th February, 1911.

RIDEAU CANAL.

NOTICE TO CONTRACTORS.

SEALED TENDERS addressed to the undersigned, and endorsed (a) "Tender for Timber," or (b) "Tender for Timber and Plank," will be received at this office until 16 o'clock on Monday, the 20th March, 1911, for the supply and delivery of British Columbia or "Douglas Fir" dimension timber and also for other Lumber and Timber required for use on the Rideau Canal for the year 1911-1912.

Specifications, Bills of Timber and full information can be obtained from the Purchasing Agent of the Department of Railways and Canals, Ottawa, on and after this date.

The lowest or any tender not necessarily accepted.

By order,

L. K. JONES, Secretary.

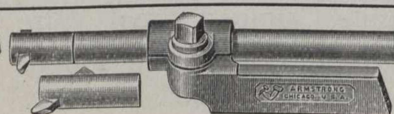
Department of Railways and Canals,
Ottawa, 22nd February, 1911.

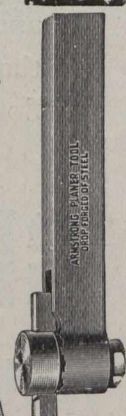
Newspapers inserting this advertisement without authority from the Department will not be paid for it.

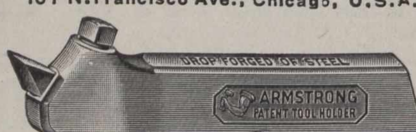
TOWN OF NEW LISKEARD.

Tenders will be received up to 1 o'clock p.m., of March 20th, 1911, for pumps and motors in duplicate, with connections, for sewage outfall works of the Town of New Liskeard. Plans and specifications may be obtained on application from C. H. Fullerton, Town Engineer.

GEO. TAYLOR, Mayor. PERCY CRAVEN, Clerk.







THE CANADIAN ENGINEER is the recognized engineering authority in all parts of Canada. Edited by technically trained men—a complete weekly summary of engineering news is given in each issue—If you have a friend whom you think would like a specimen copy give us the name and address. We will do the rest.

AMONG THE MANUFACTURERS

A department for the benefit of all readers to contain news from the manufacturer and inventor to the profession.

ELECTRIC ELEVATOR EQUIPMENT AT THE NEW POST-OFFICE IN LONDON, ENGLAND; KING EDWARD BUILDINGS.

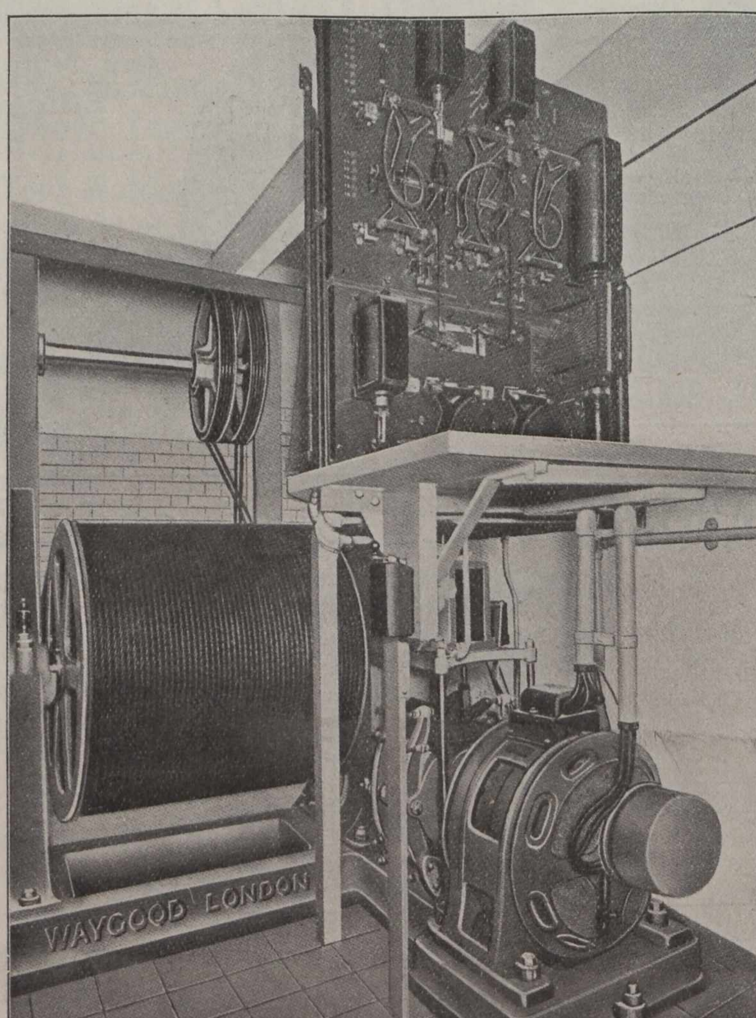
These buildings are believed to be the largest post office buildings in the world, and are fitted with most up-to-date machinery, appliances and organization for the despatch of business.

The building is constructed on the Ferro-concrete system throughout, thus gaining very largely in internal area by reduced thickness of the external walls, and at the same time is constructed with very great solidity and strength.

The motor and gear in each case are mounted on a solid cast-iron base-plate, which also carries the outer bearing for drum shaft.

To provide against damage through the ropes becoming slack on the drum, a patent slack cable safety switch is fitted, which is designed to stop the running of the motor and apply the brake in case of either the cage or weight meeting with any obstruction, which would slacken the ropes on the drum. This would also come into operation in case of the safety gear acting owing to failure of lifting ropes.

Main over-run limit switch is also provided in connection with each lift, which is operated by the movement of



The motors have been specially wound to suit the alternating current from which they are directly driven, and for the larger lifts are rated at 35 B.H.P., with overload capacity of 50 per cent. The motors were subjected to severe tests in accordance with the requirements of the Post Office Engineer.

Each winding gear is fitted with cast-iron winding drum of large diameter, turned to suit the steel wire lifting ropes, separate cage ropes and balance weight ropes being positively attached to drum.

The ropes in each case are designed to give a factor of safety of 20 to 1, taking into account the combined weight of load and cage.

cage, to cut off the main current and prevent over-travel in case of failure in the controlling apparatus.

The whole of the apparatus was subjected to severe tests by the Engineers of the Post Office and the whole of the work was carried out to their satisfaction.

The elevators were supplied by Messrs. R. Waygood & Company, Limited.

Any further information regarding the elevator or electrical equipment can be obtained from the Canada Ford Company, Montreal, the Canadian head office of the Brush Electrical Engineering Co., Ltd., of London and Loughborough, England, who built the entire motor equipment.

CATALOGUE INDEX

Some of the most valuable information on engineering and contracting subjects is to be found in the trade literature of the large supply houses.

The Canadian Engineer maintains a card index upon which is kept an up-to-date list of manufacturers of contractors supplies and engineering equipment. If you want the catalogues of any of these firms all you need do is to send us a postal giving your address and the list numbers (as printed below) of the catalogues you wish sent. This will save you time and labor and insure prompt service. This department can put you in direct communication with the principal manufacturers of and dealers in engineering equipment of all kinds.

1 Air compressors.
2 Air lift pumping machinery.
3 Alloys.
4 Aluminum.
5 Angles (see structural steel).
6 Architects' supplies.
7 Asbestos and Asbestos Products.
8 Asphalt.
9 Asphalt plants and tools.

10 Bars (steel)
11 Bearing Metals.
12 Bearings, ball and roller.
13 Belt dressing.
14 Belt tighteners.
15 Belting, chain, link, canvas, etc.
16 Benders (rail).
17 Blacksmiths' tools.
18 Blast furnaces and fittings.
19 Blasting powder.
20 Blocks and tackle.
21 Blowers.
22 Boiler fittings, mountings and tubes.
23 Boiler tubes.
24 Boilers (tubular).
25 Boilers (water-tube).
26 Bolts.
27 Bolts (machine).
27A Bonding for Concrete.
28 Bonds (Contractors').
29 Books (engineering and technical).
30 Boots.
31 Brackets and cross-arms.
32 Brick and tile.
33 Brick (paving).
34 Bridge builders.
35 Bridge engineers.
36 Bridges (concrete).
37 Buckets.
38 Buckets (clam shell).
39 Buckets (concrete).
40 Buckets (dredging and excavating).

41 Cables (manila).
42 Cableways.
43 Caisson Foundations.
44 Car replacers.
45 Carbolineum.
46 Cars (ballast).
47 Cars (concrete).
48 Cars (dumping).
49 Cars (industrial).
50 Cars (inspection).
51 Carts and wagons (ash and dump).
52 Carts (concrete).
53 Castings (malleable iron).
54 Castings (steel).
55 Cement.
56 Cement block and brick machines.
57 Cement-making machinery.
58 Cement testing machines.
59 Cement waterproofing.
60 Centers.
61 Chemists.
62 Chimneys (concrete).
63 Chimneys (steel).
64 Clutches (friction).
65 Coal and ore-handling machinery.
66 Cofferdams.
67 Compressed-air tools.
68 Concrete block machines
69 Concrete reinforcement.
70 Conduits (steel)
71 Conduits (vitrified clay).
72 Contractors' (general).
73 Conveying machinery.
74 Conveyers (belt).
75 Conveyers (cable).
76 Cordage.
77 Cranes and hoists.
78 Cranes (derrick).
79 Cranes (electric).
80 Cranes (hand-power).
81 Cranes (locomotive).
82 Cranes (travelling).
83 Crusher castings (rock).
84 Crushing rolls.
85 Culverts.
86 Curb (steel).

87 Dams (concrete).
88 Derails.
89 Derricks (pile driving).
90 Derricks (steam).
91 Drafting Instruments and supplies (see engineers' and surveyors' instruments and supplies).
92 Dredging machinery.
93 Drills (pneumatic).
94 Drills (rock).
95 Drums (hoisting).
96 Dryers (cement, asphalt and sand).
97 Dynamite.

98 Elevators (bucket).
99 Engineers and contractors.
100 Engineers' and surveyors' instruments and supplies.
101 Engines (compressed air).
102 Engines (gas, gasoline, oil).
103 Engines (high duty—pumping).
104 Engines (hoisting).
105 Engines (oil).
106 Engines (steam).
107 Engines (traction).
108 Excavating machinery.
109 Explosives.
110 Fans.
111 Fence, railing and posts
112 Filters (feed water).
113 Filters (water).
114 Fire brick and fire clay.
115 Forgings (steel).
116 Foundations.
117 Foundry equipment and supplies.
118 Frogs and switches (ry.).

119 Garbage crematories.
120 Gas producers.
121 Gates and valves.
122 Gauges (steam), (see steam specialties).
123 Generators (electric).
124 Governors (water-wheel).
125 Grain elevators and storage tanks.
126 Grinding & Mixing Machinery.

127 Hand cars.
128 Heating and ventilating machinery.
129 Hoists (chain and rope).
130 Hoists (pneumatic).
131 Hoists (steam).
132 Hydrants.

133 Ice and refrigerating machinery.
134 Incline cableway engines.
135 Inspection of materials.
136 Irrigation supplies.

137 Jacks (screw and lever)
138 Jacks (hydraulic).
139 Jacks (pneumatic).
140 Jacks (track).

141 Kilns (cement).

142 Lamp posts.
143 Levels.
143A Lights (Contractors' & Municipal).
144 Locomotives (industrial and light).
145 Locomotives (steam)
146 Locomotives (traction).

147 Manganese steel.
148 Manhole covers.
149 Meters (water, oil and gas).
150 Mixers (asphalt).

151 Oakum.

152 Paints and metal coatings.
153 Paving joint filter.
154 Penstocks.
155 Pile driving machinery.
156 Pile protection.
157 Piling (interlocking steel).
158 Pipe (galvanized iron).
159 Pipe (reinforced concrete).
160 Pipe (riveted steel).
161 Pipe (wood).
162 Portland cement.
163 Pulverizers.
164 Pumps (pneumatic).
165 Pumps (centrifugal).
166 Pumps (diaphragm).
167 Pumps (waterworks).

168 Rail joints, fastenings and specialties.
169 Railroad track supplies.
170 Rails and track.
171 Rails, second-hand.
172 Railways, industrial and narrow-gauge.
173 Reinforcement steel for concrete structures.
174 Riveting hammers.
175 Riveting machines.
176 Road machinery.
177 Road oils.
178 Road rollers.
179 Roofing.
180 Rope (wire).
181 Rubber boots.

182 Sand-blast machines.
183 Scarifiers.
184 Schools and colleges.
185 Scrapers, road.
186 Second-hand machinery and supplies.
187 Sewage disposal.
188 Sewer braces.
189 Sewer buckets.
190 Sewer flushers (automatic).
191 Sewer pipe.
192 Shovels (steam).
193 Shovels and picks (hand).
194 Sluice gates.
195 Steam specialties.
196 Steel substructures for tanks.
197 Street-cleaning implements, machinery and snow plows
198 Street sprinklers.
199 Structural materi
200 Structural steel.

201 Testing laboratories (chemists, etc.).
202 Ties (steel and wood).
203 Tile.
204 Track tools.
205 Traction ditching machines.
206 Transits.
207 Trench excavating machi
208 Turbine pumps.
209 Turntables (overhead).

210 Valves (sluice).

211 Wagons (contracto
212 Wagons (garbage).
213 Wagons (oil).
214 Well-drilling machin-
215 Wheelbarrows.
216 Winches.