Canadian Engineer

(Including THE CANADIAN CEMENT & CONCRETE REVIEW)

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Hopkins & Co., F. H.
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The Canadian Fairbanks Co., Ltd.

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CONSULTING ENGINEERS

CONSULTING ENGINEERS

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Any contractor can have his name and address in this list. Terms for such insertion can be obtained on application to the office of "The Canadian Engineer," 62 Church Street, Toronto; 315 Nanton Building, Winnipeg; Room 33B, Board of Trade Building, Montreal, Que.

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CONTRACTORS SHOULD INQUIRE ABOUT OUR ADVANCE NEWS SERVICE.

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THE CANADIAN ENGINEER

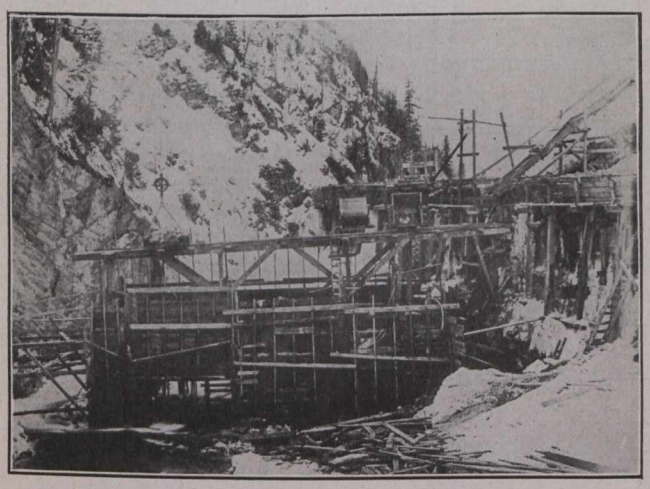
An Engineering Weekly.

HYDRO-ELECTRIC POWER DEVELOPMENT AT REVELSTOKE, B.C.

The power plant nearing completion on the Illicillewaet River, near Revelstoke, British Columbia, is an example of a municipally owned plant purchased from a private company, and now forming a valuable asset to a growing city. It also is interesting from a construction standpoint, illustrating the building of a large concrete dam in a narrow canyon, and from a designer's standpoint on account of the means adopted to handle very severe frazil ice conditions.

Present Power Plant.

About fifteen years ago a private company built the present power plant on the Illicillewaet River, about two miles west of the centre of the city, generating there 125 kilowatt by means of a timber dam at the head of a canyon, down which a square flume was built for a distance of fifteen



Cofferdam on Left Overflow.

hundred feet, about half of which was under pressure, terminating in a steel casing in a wooden power house. On one side of this casing was a 500 horse-power Samson turbine, designed to operate under a head of thirty-seven feet. The single phase, belt-driven generator was next duplicated on the other side of the turbine, and later a three-phase machine of 150 k.w. was installed on the same shaft to carry the power load. This plant was bought by the city in 1903.

Auxiliary Gas Plant.

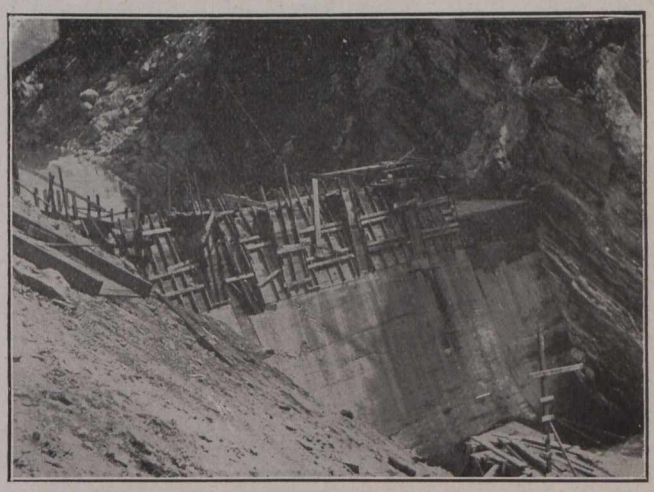
On account of severe frazil and slush ice conditions peculiar to this turbulent mountain stream it was decided, about five years ago, to install an ordinary gas-producer plant with a 125 horse-power engine, belt-connected to the same shaft as the turbine. (See Fig. .) The turbine shaft operated at a speed of 275 revolutions, and the engine at 175.

Conditions on River.

In the winter slush ice would sometimes block the Illicilliwaet for a distance of three miles to its junction with the Columbia and back into the tailrace, which was connected with the river by a short channel, and about eight feet above low water. The discharge of the river has a very large variation (as far as has been determined to date being estimated as high as forty to one). Owing to landslides and avalanches it is estimated that the discharge has been as high as twelve thousand cubic feet per second for a short time, while its low-water flow is estimated to be as low as three hundred. The main line of the Canadian Pacific Railway is built in the north wall of the canyon overlooking the old dam and flume (see Fig.), and any proposed development had to keep the water level at flood at a safe distance below the rails. The scour of water over the old dam had eaten away a large portion of the schistose rock below the dam, undermining the timber apron and carrying away timber crib supports and protection for the flume immediately below the dam.

New Development.

In November, 1909, it was decided to construct a new permanent dam at a point about two hundred feet below the old one on a roof in the bottom of the river extending between an overhanging canyon wall on the south and a solid rock point on the north side of the canyon. It was decided



Dam before Turning Water Over for Flood Season. Ten-inch Board on Sluice.

to build this dam to a height sufficient to create as large a pool as possible above for handling the frazil ice; to provide sluices to maintain a constant head at a safe distance below the railway, and to connect the power-house and old machinery with a new six-foot wooden pipe line replacing the old flume.

It was later decided to raise enough money at the same time to install a new unit and change from single-phase to three-phase for distribution in the city, remodelling, so far as possible, the distribution system therein.

The accompanying plans show the dam as built with large construction sluiceway, blow-off for handling silt and anchor ice close to the rack-bars with an intake at right angles to the stream, provided with two sets of rack-bars and provision for steam heating of same in very severe conditions, together with stop-log sluiceway, taking the ice raked from the rack-bars.

Power-House Layout.

The power-house layout was designed to meet existing conditions and allow of gradual replacement of old plant without interfering with operation. In Fig. is shown the proposed development without any reference to the old plant

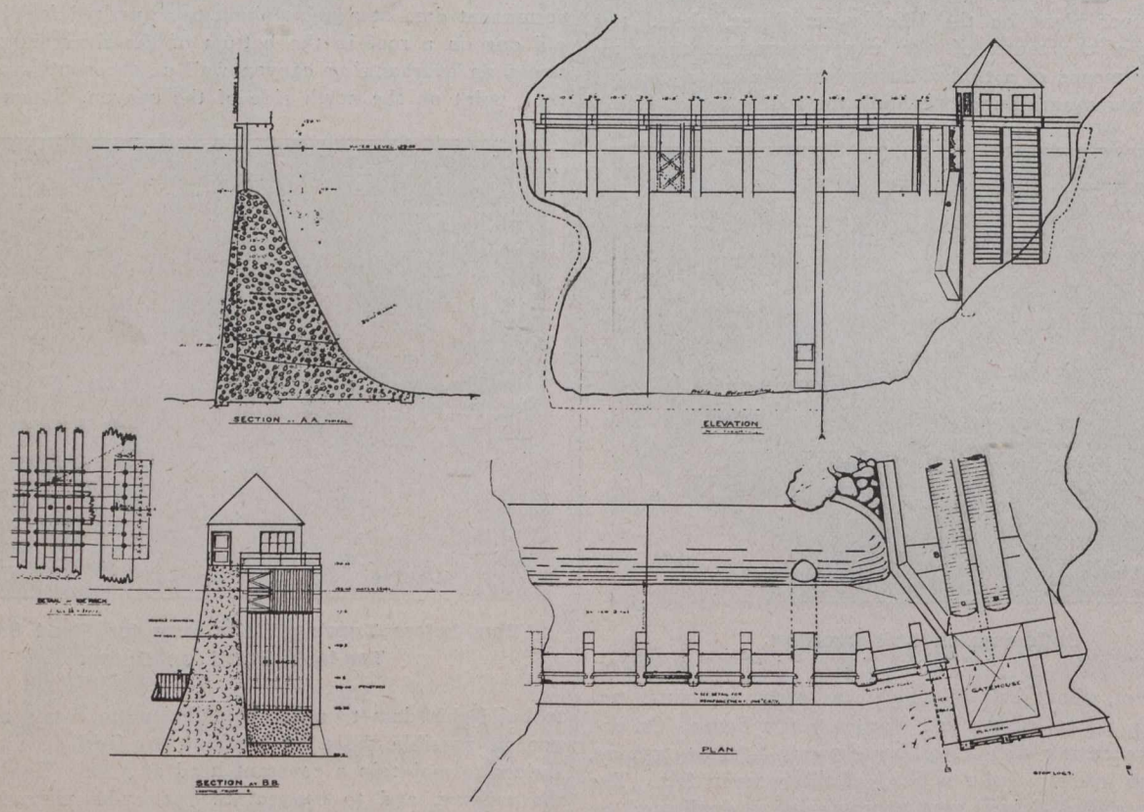
except that the old power-house is shown in full lines. The 1910 addition to the power-house is of brick or concrete foundation, and the proposed extensions of this to take in the three additional units as shown in dotted lines. Penstock No. 1 was built to serve units No. 1 and No. 2, and the connections were so constructed that the blow-off at the end of the penstock could be moved when No. 2 was installed and placed at the end of the penstock, while unit No. 2 will be connected to the penstock, and No. 1 by four-foot pipe and gate-valve.

No. 1 is gated from the penstock by 48-inch horizontal valve. The old flume enters the power-house on the line of Penstock No. 2, which will replace it, and will serve units No. 3 and No. 4, which will be duplicates of No. 1 and No. 2, and will, in addition, have a connection to No. 2. The next step in development will be the addition of Penstock No. 2 and completion of unit No. 2; units No. 3 and No. 4 may be added when the load increases. The 150 k.w. generator at present operating from the jack-shaft from turbine or gas engine will be finally moved and belted direct to the gas engine as shown on plan. No details in regard to switchboard gallery, machine shop and boiler-room have as yet been worked out. Unit No. 1 has been built in a separate building, and the new switchboards for it placed therein temporarily.

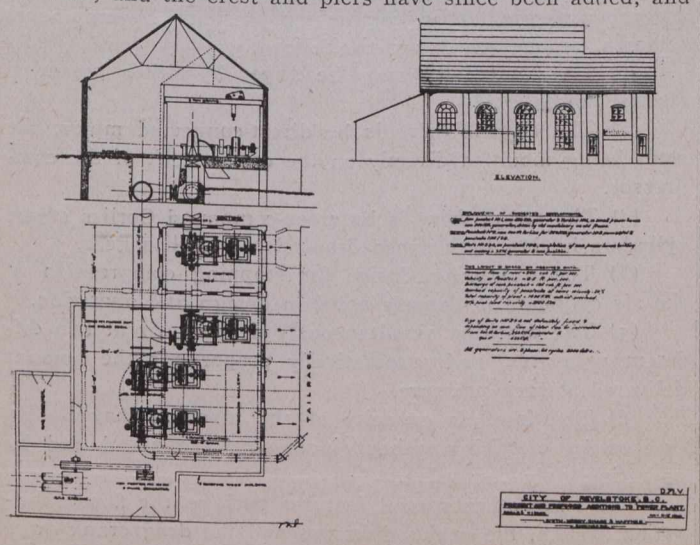
The old plant had a rated capacity of 400 k.w., 250 k.w. of which was single-phase and 150 k.w. three-phase. The old casing and turbine are still able to operate from the old flume, and a new 250 K.V.A. three-phase machine has been installed on the old foundations to replace the single-phase machines, which will now be sold. Unit No. 1 consists of a 900 horse-power single runner spiral casing turbine, manufactured by the Jenckes Machine Company, direct connected to a 450 K.V.A. three-phase, sixty cycle Westinghouse generator, with outboard exciter operating at a speed of 600 R.P.M. This unit was designed to operate under a head of seventy-three feet and carry the full lighting and power load. With overload this would carry the normal increase of the city lighting and some additional power for another year or two. The balance of the plant was designed to operate as an auxiliary until the old flume was useless, at which time Penstock No. 2 would be built and connected up with a new turbine to 250 K.V.A. unit, which will then complete unit No. 2. The other extensions have already been explained.

Construction.

The construction of the dam in the canyon was interesting and difficult, owing to the fact that the work had to be done during low water in the winter time with only limited time for completion, and the difficulties which obtain, due to necessity for keeping the present power plant running and carrying that water and additional water diverted by temporary flume through and over the site of the new dam while the footings were being excavated and concreted in. Added to this, avalanches above, causing sudden rises and falls, for which the stream is noted, and unusually high water during the winter, were a constant menace to the progress of the work. Water was diverted by coffer dam to the south side of the expansion joint and the central part of the dam built up to an elevation of one hundred between the expansion joint and the power and diversion flumes. These were built on the slide rock from the railway cutting above, and it was a difficult problem to carry them over the dam-site. A concrete cut-off wall under the unwatering flumes was built on the line of the upper toe connecting the central portion of the dam to the north wall. It was found impossible to complete this portion of the dam further until the last thing in the spring, after the footings on the south side had been obtained by diverting the water by a second coffer-dam into the 8 x 12 sluice above mentioned. Serious delays when this stage of the work had been reached caused grave apprehension that it would not be possible to complete the dam before high water; and it was necessary to carry on the work with this possibility in view so as not to jeopardize the safety of the supply of power for the city until high water had subsided. A short



shut down of the power plant was necessary when the power flume was cut and the footings under the loose rock slide, immediately below the railway track on the downstream side of the dam, were being excavated and concreted. This work it was necessary to push forward in the early spring night and day. Twice the water rose in the river, filling the 8 x 12 sluice and threatening to get beyond control. Finally the new penstocks were built in and the north and south sides raised alternately to the level of the central completed portion. The gate-house was under construction when a flood, the result of hot weather, caused a rise of twenty feet in the water against he dam in one day, brought down a large amount of old crib and loosened the old power flume, and this driftwood was forced against the incompleted gate-house pier, bending the steel and rendering its completion before the floods doubtful. The water poured over the incompleted dam to a depth of three feet; and it will be remembered that at this time the 8 x 12 sluice was under a head of thirtyfive feet, and the large 18-inch timbergate, designed to close it and turn the water over the top of the dam, had not yet been placed in the groove which was prepared for it. This was an anxious time for everyone concerned, and when the water subsided on the second day, gradually falling again to within six feet of the top of the sluiceway, it was decided to endeavor to force the bulkhead into place. This was accomplished by loading it with rails and letting it go with a run. It fell to within eighteen inches of the bottom of the opening, and the water was successfully turned over the top of the dam, which it had been decided to leave for the summer incomplete, but sufficiently high to take the water through the new penstock, one of which was then connected with the old flume, and operation under water power again resumed. It was unfortunate that it was found impossible to complete the gate-house at that time, and the gate to the 8 x 12 sluiceway had to be blown out during the next low-water period and the gate-house foundations built in the dry. The dam withstood the summer floods in spite of its incomplete condition and flat crest, showing little sign of wear, and the crest and piers have since been added, and



it is expected that the gate-house will be completed, the bulkhead put in place and the full head be put on the dam by the time this article appears.

On account of the location of the 6-foot wooden stave pipe line, above the old flume along the foot of the railway embankment, its construction, without interfering with the operation of the old flume, was difficult and expensive. On it there are a number of sharp curves, one of which is less than one in fourteen. The timber in the flume is Douglas fir, kiln-dried, and is of the very best quality. Both it and the sills are painted with preservative coats of asphaltum paint. This part of the work was successfully done by day labor.

On the pipe line are two one-way poppet valves, a mandoor at its lower end, and a relief valve on the turbine casing just outside of the power-house, discharging into the tailrace.

Looking Down Stream Shows Construction Layout.

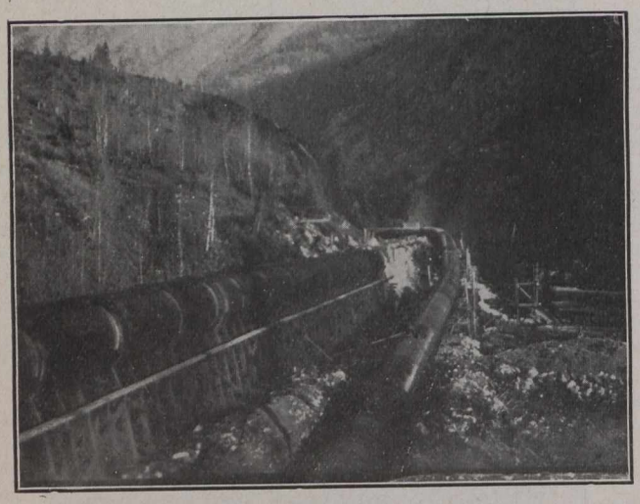
Design.

The design of the dam is interesting in view of its location upon a micaceous schistose rock on the north side, which was seamed with quartzite, and very treacherous and faulty, and in the centre of the stream came in contact with a later intrusion of more evenly laminated layers of diorite. This south wall of the canyon was precipitous; its top overhung the base about twelve feet. The dam was located on the roof connecting the two walls, and given the form of an arch upstream by the bend in the dam near the north end. In this way, and taking advantage of the position of the wall on the south side, it was possible to lighten the section of the dam, to take the penstocks out at right angles to the abutment, and at the same time obtain a suitable angle for the rack-bars in reference to the current.

The structure was built with the least expenditure possible, and to this end the favorable location in reference to gravel and rock and ability to handle these by a compact and overhead traveller were advantages not often obtained. The Illicillewaet is one of the most difficult streams of the province to handle in flood, due to the immense amount of silt carried in suspension and the large quantities of logs which come down the canyon. It is intended to handle these latter by booms in the pond above. The most difficult problem in design was to obtain satisfactory sluices at a minimum cost which would satisfactorily permit of quick operation and maintain a constant head during flood. The location of the dam in the canyon is so situated in reference to the railway track and with no possibility of enlargement of spillway area, without tunneling on the south side, had to be met by construction of gates which could be lifted clear—were not too large—and yet would permit of

passage of drift through them over the crest. The piers, therefore, had to be made as small as consistent with strength, and are heavily reinforced with the best steel obtainable. The full head in low water will not be required for some years, and until that time the sluice-gates will not be installed in all of the openings.

The handling of the frazil ice was, as above indicated, one of the chief points in design, and the gate-house with the rack-bars will indicate the method adopted. Water is



Portrait of New Six-foot W.S. Pipe; Old Flume to Left.

taken in between eight and twenty-five feet below the surface, and the rack-bars are situated so as to take advantage of a minimum amount of water to slush the accumulated ice through the 4.5 foot sluiceway. The blow-off is situated at the foot of the rack-bars under a head of forty feet, and will handle small amounts of anchor ice and keep them clear of silt. Unit No. 1 is now in operation under a head of sixty feet.

The plant was designed and built by Smith, Kerry & Chace, engineers, through their Vancouver office (H. J. Haffner, manager), and the contract for the dam was let to William Newman & Co., of Winnipeg, and for the power-house to E. C. Fromey, of Revelstoke.

SNOW PLOW FOR ELECTRIC LINE.

The Toronto and York Radial Railway control three suburban lines running into the city of Toronto. The longest of these lines is fifty-five miles, and runs through the

Snow-Plow For Interurban Lines.

Ridges of King, which are high hills in which the snow fall is large, and because of the location of the road, the cuts deep.

The problem of snow removal is frequently an expensive one to the company each winter. This winter they have ordered from the Russell Car & Snow-Plow Company, of Ridgway, Pa., one of their newest models of plows suitable for electric lines.

The principal dimensions of this plow are:—

Height over all	12′
Height of mould board	8′ 5″
Length over all	32′
Extreme width of body	10′ 1″
Width of bit	9′ 4″
Total width of clearance when wings are extended	14′ 1″

Equipped with air brakes.
Wings and flanger operated by air.
Approximate weight ..... 50,000 lbs.

This plow is mounted on Russell B-6 all-steel trucks, which are arranged for inside hanging of motors.

A UNIQUE AIR COMPRESSOR.

A machine having alternate steam and direct-electric drive and delivering air at two pressures simultaneously.

By H. V. Haight.*

The new plant of the Standard Sanitary Manufacturing Company at Toronto is a most modern and complete plant for the manufacturing of sanitary enamel ware. Compressed air is extensively used throughout the works, a large quantity at 25 pounds pressure being used for operating oil fires, while a smaller amount at 100 pounds pressure is used for sand rammers ,enamel shakers, air hoists, pneumatic tools and appliances generally. Air at both of these pressures, 25 pounds and 100 pounds, is supplied from one compressor, which automatically proportions the amount of air delivered at each pressure. This compressor presents several novel features, among which are the following:—

(1) The compressor may be driven by either steam or electric power.

(2) The electric drive is by direct-connected motor, the rotor being mounted directly on the crank shaft of the compressor.

(3) The steam drive is by cross-compound Corliss steam cylinders having high speed drop-release Corliss gear.

(4) The unloading device for stopping compression in the air cylinders is entirely novel in design and operation.

(5) The machine simultaneously delivers air at two different pressures, and automatically proportions the amount delivered at each pressure.

(6) The free air capacity of the machine may be increased by one-third without increasing the speed and by operating only one valve.

There are other special features such as the flood lubrication system, the enclosed frames and the drag crank drive for the air gear which will be described later.

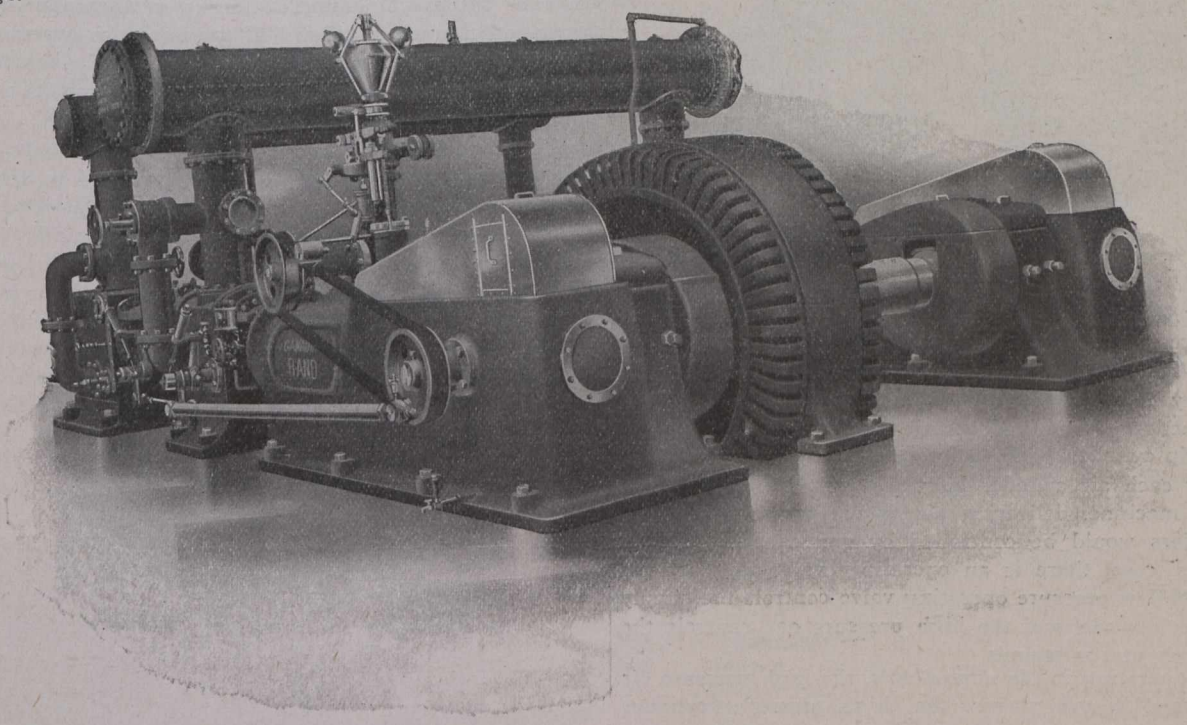
Principal Dimensions.—The following are the principal dimensions of the machine:—

Diameter of high pressure steam cylinder	14 inches.
Diameter of low pressure steam cylinder	24 inches.
Diameter of low pressure air cylinder	22 inches.
Diameter of high pressure air cylinder	13 inches.

*Chief Engineer, Canadian Rand Company,, Limited Sherbrooke, Que.

Stroke of all cylinders .....24 inches.
Normal full load speed (electric) .....144 r.p.m.
Displacement of L. P. Air Cylinder, cubic feet per minute 1,519
Displacement of H.P. Air Cylinder, cubic feet per minute 529
Total Displacement, running compound 1,519
Total Displacement, running single stage 2,048
Electric motor, 250 horse-power, 2,200 volts, 25 cycles, 3 phase, 20 poles, ...144 r.p.m.
Steam pressure 125 pounds, non-condensing.
Air pressures, 25 and 100 pounds.

Motor.—The motor is of the induction type with wound rotor. The rotor is mounted directly on the compressor shaft. When running by steam the rotor acts as a fly-wheel and has sufficient fly-wheel effect to enable the machine to be run as slow as 25 per cent. of full load speed. The machine is made extra wide between the main frames to permit of moving the stator clear of the rotor to give access to the windings.



As the air gap between the rotor and the stator of an induction motor is very small, in this case only slightly over one sixteenth of an inch, it is necessary to keep the deflection of the shaft, due to the weight of the rotor and possible unbalanced magnetic field, within a few thousandths of an inch. On this account the main shaft is made very large and stiff and the main bearings are made very large so that there will be no appreciable wear. This is further helped by the flood lubrication system which keeps a constant film of oil between the bearing surfaces so that the wear comes on the oil instead of on the metal.

Steam Cylinders.—The steam cylinders are of the Corliss type, the high pressure cylinder having drop-release gear, and the low pressure cylinder having a quick-opening positive gear with fixed cut-off. Both cylinders have separate steam and exhaust eccentrics. Attention is drawn to the location of the steam receiver above the cylinders, where it is accessible, self-draining, easily insulated, and does not require a channel in the foundation. The air intercooler being located overhead in the same manner enables the foundation to be made practically a solid block of concrete.

The high pressure steam gear is of the familiar drop-release Corliss type, but of novel design. The engaging hook is designed so that the momentum of the hook itself assists both in picking up and in releasing. Friction is much reduced by omitting the usual stuffing box and soft packing around the valve stem, and using a special form of metallic packing instead. The dash pots are also nearly frictionless, being ground to fit, and without packing. As a result of these special features, the momentum hook, the metallic packed valve stem, and the quick-acting dash pots, the gear can be run at much higher speeds than ordinarily used. Under test the gear has been run successfully at speeds above 200 revolutions per minute.

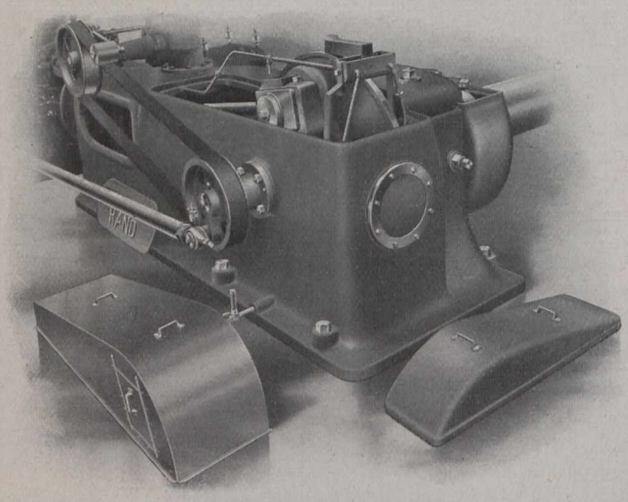
Air Cylinders.—The air cylinders are water-jacketed, and large hand holes are provided for washing out any mud which may accumulate in the jackets.

The air valves are located in the heads, to reduce the clearance to a minimum. The inlet valves are of the semi-rotary or Corliss type, while the outlet valves are of the direct-lift poppet type. A large number of small outlet valves are used to give ample valve area without the use of heavy valves. The valves are made of a special grade of nickel steel, oil treated and annealed, and finished by grinding.

Drag Crank Drive.—The Corliss air gear is driven by a drag crank on a short shaft driven from the crank pin. On the high pressure side this drag crank also forms the belt pulley which drives the governor. The drive from the crank pin is by a universal joint, so that any alteration in the position of the main shaft, due to adjustment of the bearings, does not affect the drive for the valve gear. The driving of the air gear by drag crank on the outside instead of by eccentrics on the shaft enables the air gear to be kept quite clear of the steam gear and readily accessible. The driving strains are also reduced by the larger permissible travel of the valve rods. Removing two eccentrics and a governor pulley from the shaft also permits the shaft to be shortened.

Unloading System.—The method of unloading consists briefly in opening a supplementary port in each Corliss inlet valve, thus letting the air pass out of the cylinder again instead of being compressed. Each of the Corliss inlet

valves has within it a second Corliss valve of about half the diameter. The inner valve normally covers a supplementary port in the outer valve, and the two valves move together as one valve. In unloading, the inner valve is shifted to uncover this supplementary port and the air is then blown out again into the intake passage, instead of being compressed. The mechanism for shifting the interior valve consists of a trip cylinder, shown in an inclined position in the photo-



graph. Air to operate this trip cylinder is admitted or exhausted by the weighted operating valve, shown attached to the distance piece in the photo of the low pressure air cylinder. The operating valve is connected to the two trip cylinders by ¼-in. copper tubing, not shown in the photo. The connections from the operating valve are so arranged that one trip cylinder works before the other, thus unloading or loading each air cylinder in two stages. In an ordinary two stage machine, delivering air at one pressure, all four trip cylinders would be controlled by one operating valve, but in this case there is an operating valve for each air cylinder, the low pressure operating valve controls the supply of air at 25 pounds, and the high pressure one controls the supply of air at 100 pounds.

When operating in the normal way, the high pressure air is compressed in two stages, the high pressure cylinder drawing its supply of air from the intercooler. Under these conditions the free air capacity is about 1,500 cubic feet per minute. The unloaders will proportion this amount as required between low pressure air and high pressure air, giving say 100 feet at 25 pounds, and 1,400 feet at 100 pounds, or 1,400 feet at 25 pounds, and 100 feet at 100 pounds, or any proportions between these two, or any less quantity of air in the proportions required.

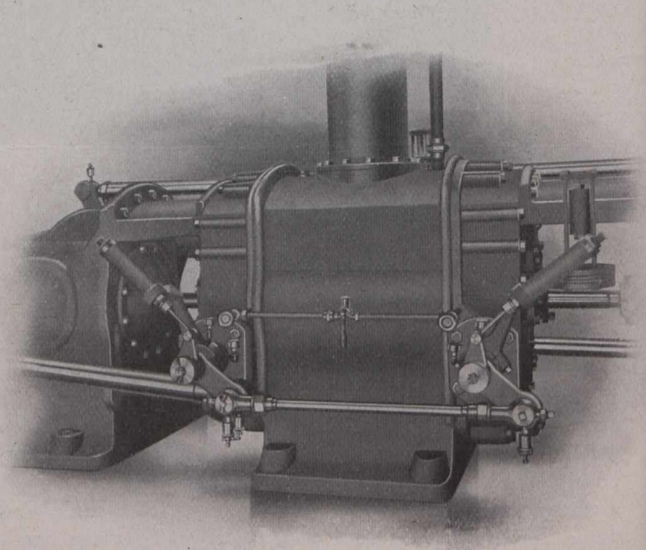
Change Valve.—Should the demand for air exceed 1,500 feet, the change valve, shown just below the end of the intercooler in the general views of the machine, may be screwed in so that the connection from the intercooler to the high pressure cylinder is closed, and a connection to the atmosphere is opened. Under these conditions the high pressure air is compressed in a single stage. The capacity of the compressor then becomes about 500 cubic feet per minute to 100 pounds, and 1,500 cubic feet per minute to 25 pounds, a total of 2,000 feet. The unloaders will control the capacity for any less quantities that may be required. It is not possible under these conditions, however, to get say 800 feet of air at 100 pounds, and 1,200 feet of air at 25 pounds. Such proportioning is only done when the machine is running two-stage.

Governor and Regulator.—The centrifugal element of the governor is of a familiar type for Corliss engines, having a heavy central bob weight between the arms of the balls. If the speed becomes too high the centrifugal force of the revolving balls lifts the bob weight and, through the side link and bell crank, pulls on the long trip rod. This in turn shortens the cut-off in the high pressure steam cylinders. If the bob weight goes clear up to the collar, the steam valves will not be picked up at all and no steam will be admitted to the cylinder.

The action of the governor is modified by the air regulator. When air cylinders are unloaded air is also admitted to the small cylinder shown on the side of the governor. This lifts against the bob-weight so that the balls will lift the bob-weight at much slower speed. The machine accordingly slows down but still remains under the control of the centrifugal governor. The result is that the machine slows down when the air cylinders are unloaded which is just the opposite of what it would naturally do. If there were no governor the machine would run away when the load was thrown off the air cylinders. If there were a governor only, the machine would speed up a few revolutions when the load was thrown off, but with governor and regulator the machine slows down when the load is thrown off.

For a machine to deliver air at one pressure only, the air regulator on the governor would be arranged to act somewhat differently.

The safety stop on the governor, to shut off steam in case of the governor belt breaking, deserves special note. A small heavy pulley is shown riding on the governor belt, and acting as a belt tightener. This is connected by levers and links to a cam located just below a roller on the near arm of the bell crank. The slotted links shown on the side of the



governor post permit this arm to be raised independently of the governor. If the governor belt should break the tightener pulley would drop, the cam would shove up the short lever, the bell-crank would pull on the long trip rod, and the steam hooks would not pick up the valves. The result is that steam is shut off instantly. This device was tested at the power-house of the Standard Sanitary Company with the above result.

The safety stop commonly used on Corliss engines is operated as follows:—The trip cams on the steam cylinders have, besides the regular trip toes, extra or safety toes, which engage the hooks when the governor is in its lowest position and prevent the hooks from picking up the cams. In ordin

ary running the governor is prevented from dropping to its lowest position by a cam, controlled by a belt tightener pulley. If the governor belt should break, the cut-off is first lengthened and not until the cut-off has been lengthened to its extreme, and the governor has slowed down and dropped below its regular position, is steam cut off. The ordinary safety device thus acts by first admitting more steam to the cylinders, which would tend to make the machine run faster and steam is only shut off when the slight friction of the governor bearings has slowed the governor down considerably The safety device on this compressor, on the other hand, instantly shortens the cut-off to zero independent of the governor or of friction.

Intercooler.—The intercooler is of the water-tube type, the air circulating around the tubes. This gives a large air space, making the fluctuations of air pressure in the intercooler very small. The air is directed by baffle plates to pass back and forth across the tubes, and as the tubes are are staggered this causes the air to strike each tube at right-angles several times. The circulation is on the counter-current principle, that is the water enters at the end at which the air leaves, so that the coldest water is in contact with the air just before it leaves the intercooler. By this means the temperature of the air is reduced to within a few degrees of the temperature of the water supply, and may be actually lower than the temperature of the water overflow.

Lubrication.—The frames are completely enclosed and the lower part of the crank case forms an oil reservoir. The edge of the crank disc runs in this oil, and oil is thus carried up on the rim of the disc, and at the top it is scraped off and runs into an oil reservoir. From this reservoir it is distributed by pipes to the main bearing, crank pin, crosshead pin, crosshead slides and drag crank shaft. The oil from these bearings is returned again to the crank case and used over, so that no oil is wasted. The steam eccentrics are lubricated from the overflow of the main bearings, the oil being caught by a groove in the eccentric hub and passing to the bearing faces by drilled holes, being carried out by centrifugal force. Guards around the eccentrics return the used oil again to the crank case.

The large amount of oil supplied by this system to the principal bearings, not only reduces friction and wear and saves oil, but the cushion of oil permits the bearings to be run much looser without knocking. This further reduces the wear an practically eliminates any chance for a hot bearing.

The air and steam cylinders are lubricated by mechanical force feed oil pumps, so that the amount of oil supplied is in proportion to the speed of the machine.

Distance Pieces.—The distance pieces are located at top and bottom instead of at the sides as in older machines. This converts the lower distance pieces into very efficient pans to catch any drip of condensation or oil from the stuffing boxes.

Changing to Electric Drive.—The change to electric drive is made as follows:—The steam cylinders are disconnected by removing the coupling nuts on the steam piston rods. The steam gear is disconnected by taking the straps off the eccentrics. The governor is disconnected by taking off the belt and the air regulator by closing a cock in its supply pipe. The machine is then ready to throw on the electric power.

Alternate Steam and Power Drive.—This machine is of special interest on account of the rapid introduction of electric power throughout all parts of Canada. For instance, in Cobalt about a score of steam-driven machines were rendered useless by the introduction of electric power. If these had been designed for alternate steam or power drive they could have been readily converted to use the electric power. Even in the coal mines the question of electric power is now active, and the Dominion Coal Company is putting in electric driven compressors operated by electric power from a central steam plant. The lesson would appear to be that all steam-driven compressors, except for very temporary plants should be of a type readily convertible to efficient power-driven machines.

CANADA'S COMMERCE PER CAPITA

Canada's commerce per capita is greater than that of any other country in the world, with the exception of Great Britain. Here are the figures:—

Country.	Commerce per capita.
Great Britain	$105.25
Canada	92.42
United States	35.59

In the ten years ended 1909, the increase of Canadian trade was 88.14 per cent. This compares as follows:—

Country.	Increase of trade, 1898-1909. Per Cent.
Canada	88.14
United States	55.19
Great Britain	37.81

The only country in the world whose trade increased in a greater ratio than that of Canada was Argentina, with a percentage of 164.88 per cent.

Our manufacturing interests are keeping pace with and helping this commercial development. The following figures show, at a glance, the rapid growth in our manufacturing industries, since 1871:—

	1871.	1881.	1905.	Increase or decrease per cent. 1871-1905.
Food production	$ 56,689,227	$ 75,137,755	$173,359,431	307.56
Textiles	24,768,976	41,090,551	85,982,979	347.15
Iron and steel products	13,928,855	16,943,321	53,125,265	395.78
Timber and lumber	41,065,971	55,407,540	112,494,072	273.93
Leather and products of	27,913,809	36,455,776	42,123,007	150.08
Paper and printing	5,199,964	9,560,497	33,738,772	648.82
Liquors and beverages	6,459,443	7,054,050	14,394,319	222.85
Chemicals, etc.	5,815,504	8,189,559	15,703,306	270.04
Clay, stone and glass	3,482,427	5,729,556	13,986,000	364.23
Metals and products	4,312,720	8,954,032	50,828,968	1,178.57
Tobacco and manufactures of	2,435,343	3,060,306	15,274,923	627.31
Vehicles for land	5,361,234	10,535,443	37,396,302	699.60
Vessels for water	5,410,109	4,317,670	1,943,195	64.08 Dec.
Miscellaneous	9,483,637	15,866,759	66,294,869	699.08
Hand trades	9,250,534	11,379,250	1,698,195	81.64 Dec.
Capital employed	77,964,020	165,302,623	833,916,155	1,069.60
Employees, number	187,942	254,935	383,920	204.41
Salaries and wages	40,851,009	59,400,700	162,175,578	396.99
Value of products	221,617,773	309,676,068	706,446,518	318.39

CONCRETE SECTION

SOME THERMAL PROPERTIES OF CONCRETE.*

By Charles L. Norton.

During the last three years a series of experiments have been carried on in the Laboratory of Heat Measurements of the Massachusetts Institute of Technology, having for their object the study of those physical properties of Portland cement concrete which affect its value as a fire resistant material. While these researches are by no means complete, it is perhaps of interest at this time to discuss some of the results obtained.

It was proposed at the outset to make a study of the various physical properties of concrete over as wide a range of temperatures as possible, and among those selected were the following:

1. Co-efficient of linear expansion.
2. Diminution of mechanical strength after heating.
3. Specific heat.
4. The co-efficient of thermal conductivity.

The measurements of the co-efficient of linear expansion are practically complete, but the uncertainty attaching to some of the high temperature values, though slight, makes it seem wise not to report in detail until one or two check measurements can be made. This uncertainty arises from the great difficulty which attends the measurement of the temperature of the interior of a large block of cement concrete so as to be sure of its absolute uniformity at high temperatures. Thermal junctions embedded in the block at distances of three inches from one another are not sufficiently close to give the desired precision.

The method adopted for the measurements of the elongation caused by heating was the common so-called "telescope" method. The specimens in the shape of 6 inch or 10 inch cubes were slowly heated in a double gas muffle or an electric resistance furnace. The temperature of the furnace and of a number of points in the concrete was taken by means of platinum-rhodium couples.

Near the furnace were mounted two telescopes which might be sighted through holes in the furnace wall upon reference points on the surface of the block. At low temperatures an arc light and a system of mirrors were used to furnish adequate illumination. One of the telescopes was provided with a micrometer eye piece by means of which a movement of the reference mark of .0001 inch could be measured.

The values obtained at low temperatures agree very well with the commonly accepted value of .0000055 for the elongation per unit of length per degree of Fahrenheit. Apparently this value increases slightly up to 575 degrees F. Above this point the co-efficient becomes smaller; at 1500 degrees F. the co-efficient becomes zero, and above this point slightly negative. On cooling the blocks which had been heated to 1500 degrees they did not return to their original dimension, their permanent elongation being about 75 per cent. of their maximum elongation. On a second heating the specimens all returned to the same dimensions, there being no sensible permanent elongation resulting from the second heating.

All of the specimens tested for expansion were of stone concrete, of the proportions 1-2-5. The stone was clean, the sand sharp, the cement of good quality, and every precaution was taken to secure a concrete of the first order. The specimens weighed on the average 150 pounds per cubic foot.

*A Paper given before the Convention of the National Association of Cement Users.

In order to study the effect of high temperatures upon the compression strength of concrete several scores of 6 inch cubes were made and allowed to set for 90 days or slightly longer. These blocks were then heated for different lengths of time at different temperatures in a gas furnace similar to that used for the expansion experiments.

The cubes which were not heated showed an average compression strength of 2,700 pounds per square inch. Those which were heated at 932 degrees for two hours lost only 15 per cent. of their original strength, and when this temperature was prolonged for four hours the loss was 43 per cent. If the blocks were heated to 1500 degrees for two hours the loss of compression strength was 38 per cent., and at the end of four hours the loss was 66 per cent. The most important information secured from these tests was to the effect that even after the exposure to a fire in which the concrete block, small in size, was subjected to flames at a temperature of 1500 degrees for four hours, it was still able to carry twice its normal safe load in compression. The larger beams, with their great masses, are not often exposed for so long a time to so great a hazard.

It should be noted, however, that there was a considerably greater deformation under load of the heated blocks than of those not heated.

A large number of small beams were next made, some with and some without reinforcement. Most of these were either 6x6x48 inches or 8x8x48 inches. The specimens which were reinforced contained four ½ inch round steel rods situated near the corners, equidistant from the two faces of the beam. In some the distance from the steel to the face of the beam was 1 inch, in others 1½ inches, and a few beams had a 2 inch protection to the steel. Not many of these specimens have been tested as yet, but from a few we are able to get a general idea of what happens to beams of this type in case of exposure to fire.

A set of three beams, for instance, each 6x6x48 inches, in which the reinforcing rods were one inch from the face of the beams, were broken by center load, the first beam not having been heated at all, the second heated for one hour in a fire that fused the surface of the concrete, and the third being similarly heated for two hours. The beam which was not heated broke under a load of 5,700 pounds; the second, heated for one hour, broke at 2,750 pounds, while the third, heated for two hours, broke at 1,950. I consider this a most remarkable showing under severe conditions. It should be borne in mind that these small beams were so slow in cooling down that they were in effect heated much longer than the time mentioned. The flames, moreover surrounded the beams on all sides.

Several similar tests were made with concrete beams of the same dimensions, 6x6x48 inches, with no reinforcement. These were heated for two and four hours at 1700 degrees F. After this exposure all of the beams were very frail; not one of them showed any cracking or spalling, however. It was not considered necessary to break any of these beams, as it was apparent that the concrete on the tension side of the beam was much weakened. Some of the more recent experiments made on beams 8x8x48 inches show that these larger beams are much less weakened, proportionally, as would be expected to be the case.

A series of similar beams were next made up of cinder concrete, the proportions of the mixture being 1-2-5. A portion of these were mixed with clean cinders, which showed upon analysis but little carbon; a second part was mixed with cinders to which ten per cent. of fine bituminous coal

had been added and the other beams were mixed with cinders to which had been added 25 per cent. of fine coal.

The 25 per cent. mixture can be disposed of in a word. When once thoroughly heated it burned until it fell to pieces. With the 10 per cent. mixture, however, no such action occurred; there was no indication that the concrete would support its own combustion even for a short time. It was apparent that the 10 per cent. mixture was not so good a fire-resisting material as that which contained no added carbon. From the few specimens containing less than 10 per cent. which have been examined up to the present, it seems probable that the safe limit is close to 5 per cent. More data is now being secured on this point.

The study of the specific heat of concrete was made by the ordinary calorimeter method, the "method of mixtures" of Regnault. Specimens of the concrete, usually fragments of the larger test pieces, were heated slowly in an electric resistance furnace to the desired temperature and then plunged into the calorimeter. The weight of the water and its rise in temperature give the amount of heat given off by the body in cooling.

Extraordinary precautions were taken in getting the exact average temperature of the specimen in the furnace, and to insure its rapid transfer to the calorimeter. In most of the experiments a double calorimeter was used so that the specimen did not come in contact with the water of the calorimeter, so that any evolution of heat by hydration of the cement was avoided. The following tables give the specific heat of concrete:

SPECIFIC HEAT.

Temperature.	Stone Concrete. 1-2-5.	Stone Concrete. 1-2-4.	Cinder Concrete. 1-2-4.
72° to 212°	.156	.154	....
72° to 372°	.192	.190	.180
72° to 1172°	.201	.210	.206
72° to 1472°	.219	.214	.218
72° to 2172°	....	....	....

The measurements of thermal conductivity were made by a number of methods and have taken far more time and energy than all the others put together. The thermal conductivity is that property which determines how rapidly heat will travel through a substance and how rapidly, therefore, objects beyond will be heated by transmission. The conductivity becomes of prime importance in all questions of protection of the steel in reinforced concrete buildings. There is very little data to be found as to this important property of any of the common materials of engineering, and such data as is to be found is not at all concordant. As to the conductivity of concrete or its variation with temperature and with composition, practically nothing has been known.

The methods adopted for the measurement will be described in full in papers now being submitted to one of the scientific societies for publication, and it probably will not be of interest here to more than outline them.

The formula showing the relation of the temperature upon the two sides of a plate to the amount of heat which would flow through it is as follows:

$$Q = \frac{K\ (t_1 - t_2)\ s\ A}{d}$$

or

$$K = \frac{Q\ d}{(t_1 - t_2)\ A\ s}$$

where

K = the co-efficient of thermal conductivity dependent upon the nature of the material and its temperature.

Q = the quantity of heat flowing through the plate in the area measured.

A = the area.

t_1 = the temperature of the hotter side of the plate.

t_2 = the temperature of the cooler side of the plate.

d = the thickness of the plate.

s = the time during which Q units flow through the area A.

The formula will be seen to be merely an expression of the following relations: that the flow of heat is proportional to the area, to the temperature, and the time, and that it is inversely proportional to the thickness.

After spending many months in developing other methods, the electrical method used by the writer for the past fifteen years in studying the flow of heat through steam pipe coverings was adopted. The value Q of the heat flowing was determined by supplying the heat by means of the heating of a conductor carrying a current of electricity. By measuring the electrical energy supplied the quantity of heat developed may be known with great precision. Further, if this heat is passed through the plate under test and into a calorimeter on the far side, a check upon the value Q may be had. For the determination of the temperature difference thermal couples, resistance thermometers, and mercury thermometers were used, but thermal junctions made of thin strips of copper and nickel or of platinum and platinum-rhodium were generally found most serviceable.

The apparatus used for the lower temperatures consisted of a thin electrically heated plate to the two sides and edges of which concrete could be applied. Outside of the concrete there was then placed heavy copper or brass plates, which could be kept at a constant temperature by an internal circulation of water. Thermal junctions were placed at several points on each surface of each concrete plate. The electrical input was measured by calibrated Weston instruments; the calibrated thermal junctions gave the value of the temperature difference to the nearest one one-hundredth of a degree. For the thickness, numerous measurements were made by a pair of flat-nosed calipers, and averaged.

It was necessary to keep this apparatus running for several days before it could be balanced, that is, before the rate of flow of heat outward through the plates became constant and equal to the electrical input. The number of measurements has now reached many hundreds, and it seems apparent that the precision of the method depends on the accuracy with which the thickness of the specimens can be maintained constant. Otherwise the accuracy is better than 1 per cent. This apparatus has been named by my assistants the "flat plate tester," and perhaps it is well to so designate it here.

Later, in order to make tests on plates as thick as some of the walls in common use, another method was adopted. Cubical boxes 36 inches in outside dimension were built with walls of several thicknesses. Inside the boxes were placed electric heaters which served to raise the inside surface to a temperature above that of the surroundings. A small fan served to keep the air in the box stirred to insure uniformity of temperature throughout. The boxes were tightly sealed. The power supplied to both heater and fan was measured as before. Mercury thermometers and thermal junctions, as well as a Callender recording resistance thermometer, were used to measure the difference in the temperatures inside and outside of the box. Data has been

secured on scores of specimens and it is practically identical with the results obtained by the flat plate tester.

For the high temperature a modification of the entire process was found necessary. The concrete to be tested was cast in the form of a cylinder on the outer surface of and concentric with a steel bar which could be heated to a high temperature by the passage of a heavy current. Outside of the cylinder of concrete was applied a closely fitting "continuous" calorimeter. The temperature of the bar and of the calorimeter was measured by thermal junctions, and the amount of water and its rise in temperature gave the value of Q.

In order to guard against the uncertainty of the temperature at the end of the bar, the calorimeter was made so as to enclose only about one-half the length of the bar, the rest being covered by guard rings similar to the calorimeter, but without any provision for the measurement of the quantity of water.

The heating of the bars required a considerable amount of special apparatus, since it was necessary to provide a current of upwards of 2,000 amperes for the high temperatures, and to be able to vary its amount to any desired value below that point. For this purpose there were installed three 15 K.W. transformers connected on the primary side with a three-phase 2,300 volt circuit. By means of divided secondaries and a rather elaborate arrangement of switches, the secondary voltage could be varied from 190 volts down to 55 volts. This secondary voltage was applied to the primary of a second step-down transformer, whose secondary was divided into twenty coils. By means of a switchboard the entire output of the transformer could be had at almost any desired low voltage. This enables us to heat bars insulated by materials of different composition and of different thicknesses to any desired temperature up to 2,800 degrees F. With this arrangement both the steel and the concrete can easily be melted.

The results obtained are tabulated below. It is to be regretted that there is no uniformity of practice as to the units to be adopted in reporting the measure of effectiveness of insulators. While the physicist renders his report in calories per square centimetre, per centimetre thickness, per 1 degree Centigrade per second, the steam engineer confines his observations to B.T.U. per hour per square foot per inch of thickness per 1 degree F., and the refrigerating engineer reports on the basis of a 24-hour time unit. I have even seen a report in terms of hogsheads of water raised to the boiling point, time not stated.

THERMAL CONDUCTIVITY OF CONCRETE.

Temperature of hot side of plate. C.	F.	Mixture.	Co-efficient Calories per 1°C. per sq. cm. per second	Co-efficient B. T. U.per 1°F. per.sq. ft.per. in. thick per 24-h.
35°	95°	Stone 1-2-5.....	.00216	150.
50°	122°	Stone 1-2-4 not tamped	.00110 to .00160	76. to 114.
50°	95°	Cinder 1-2-4.....	.00081	56.
200°	392°	Stone 1-2-4.....	.0021	146.
400°	752°	Stone 1-2-4.....	.0022	153.
500°	932°	Stone 1-2-4.....	.0023	160.
1000°	1832°	Stone 1-2-4.....	.0027	188.
1100°	2012°	Stone 1-2-4.....	.0029	202.

A brief comparison of these values with those for other materials may be interesting.

The specific heat of concrete is slightly less than that of either red brick or fire brick, hence the same amount of heat needed to raise the temperature of a pound of brick is about 10 per cent. more than for a pound of concrete. But the density of concrete is enough greater than that of brick to raise the heat capacity of a cubic foot of concrete above that of brick. The difference is not large, however.

While the expansion data is not complete, it seems clear that for a time after the beginning of exposure to fire the concrete and its reinforcement will expand at much the same rate, but that the further expansion of the surface will not proceed at so rapid a rate. This will tend to reduce the stresses which the expansion of the heated surface would otherwise set up in the cooler interior. It is perhaps because of the failure of the concrete to return to its original dimensions that the small amount of surface cracking found after a fire is due.

The experiments made with coal and cinder mixtures indicate the necessity of added care in the selection of cinders for this purpose.

The tables of thermal conductivities give us data as to the rate at which heat will travel through concrete. It is interesting to note the great difference between the tamped and the untamped concretes made from stone. The one was as porous as possible, and the other as dense. One transmits nearly twice as much heat as the other. The cinder concrete, as is commonly believed, is much better as a heat insulator than the stone concrete, being nearly three times as effective as the denser stone concrete in retarding the flow of heat. It may be interesting to call attention to the heat insulation afforded by other materials. The best of the commercial articles used for this purpose is compressed cork, which is nearly 25 times as effective as stone concrete. Steel, on the other hand, transmits heat from 75 to 100 times as fast as the densest of the stone concrete.

TEST LONDON'S WATER.

The annual report of the local Government Board contains the usual particulars relating to the water supply of London. Year by year the amount of water consumed in the area supplied by the Metropolitan Water Board shows a considerable increase. In the year 1909 the average number of people supplied was 7,064,013, or about 30,000 more than in 1908. The total average daily supply in 1908 and 1909, respectively, was 223,777,747 and 226,481,907 gallons, the average daily consumption per head being 31.98 gallons per head in 1908 and 32.06 gallons per head in 1909.

During the year 1909 no fewer than 13,888 samples of water were examined in the Water Board's laboratories, mostly by bacteriological methods. The results are briefly summarized in the appendix to the report under review, which also gives an interesting résumé of Dr. Houston's report to the Water Board on his experiments to determine the effect of storage on the life of cholera germs artificially introduced into samples of various kinds of water. In the board's report for 1908 similar information was supplied as to the effect of storage on typhoid germs. The result is said to form another link in the chain of evidence which Dr. Houston has sought to establish, namely, "that by adequately storing the raw impure river waters, which constitute the chief sources of London's water supply, antecedent to their filtration, the safety of the metropolis as regards water-borne epidemic disease (apart from the possibility of accidental infection of the works, or subsequently in the pipes) is almost, if not quite, assured."

METHOD AND COST OF FORM WORK FOR GROINED ARCH RESERVOIR AND CONDUITS, PITTSBURG FILTRATION WORKS.*

In building the Pittsburg Filtration Works there were used about 334,000 cubic yards of concrete. This concrete varied from heavy mass work in foundations for machinery to reinforced concrete in walls and floor slabs, and from straight way work on walls and floors to the more intricate work necessary for ground arch vaulting. The forms varied as greatly as the concrete due to the many different conditions under which work had to be performed, and the work offered many problems in forms for solution.

During the three years of active concrete work many different engineers, superintendents, foremen, carpenters and laborers were affiliated with the work, and in this way were brought together many different ideas and experiences. The object of this paper is to describe the various methods used and the results secured rather than to give a description of the work as a whole. Some of the items may be rather elementary to one having just this experience, but may be of interest and instructive to many other readers.

Material for Forms.—Probably the first thing to consider in the building of forms is what material to use. The choice will be influenced very largely by the number of times the forms may be used. They may be constructed of wood or metal; the latter was used chiefly in conduits and piers or forms having curved or irregular surfaces, while wood was used in all classes of work, and almost entirely in walls and structures having plain surfaces.

The kind of lumber is influenced greatly by the cost and supply. White pine lumber is probably the easiest worked, and will give the smooth face essential to the best work. The pine will prove very expensive for ordinary work, and spruce, fir, Norway pine and some grades of southern pine are more commonly used. For braces and uprights the quality is not of great importance. There is a point, however, where an inferior grade of lumber is not economical, as the increased number of times a piece of lumber may be used and the lesser quantity due to greater strength will outweigh the savings in first cost due to inferior quality.

Kiln-dried lumber is not best, as it will swell too much when wet, and green lumber is not good, as it will not swell sufficiently to make the forms tight. The best quality is a middle grade or partly dry.

When the contract is large, comparable in size to the Filtration Works, it will facilitate the work to buy the lumber in the rough and mill it on the site. This will often save delay due to delivery, will save in cost, and the waste can be kept at a minimum.

The proper thickness for the lumber (this applies chiefly to the sheathing) is a question which varies greatly with the contractor. Curved and irregular shaped forms can be made more easily with 1-inch lumber, and where there is much cutting the waste is less. On the other hand, if a form is to be used but once the loss in wrecking thin boards is much greater than will occur with thicker, and more uprights or studs will be necessary to support 1-inch sheathing than 2-inch. It was found more satisfactory in the majority of work to use 1.5 or 2-inch sheathing in preference to thinner wood. The thickness and spacing of studs and braces is entirely a question of load to be carried, and can be easily proportioned to the particular piece of work.

Design of Forms.—It is advisable to have the form and braces designed by a competent man, as often the foreman or carpenter in the field does not have the knowledge or experience necessary. It is often the case that a piece of form work will be over-braced, or by reason of inexperience the bracing will be so arranged as not to secure the maximum results from the minimum labor and material. Frequently also the forms are under-braced and give away during filling. All this can be best remedied with a design made by a competent man, which can be done at a small cost.

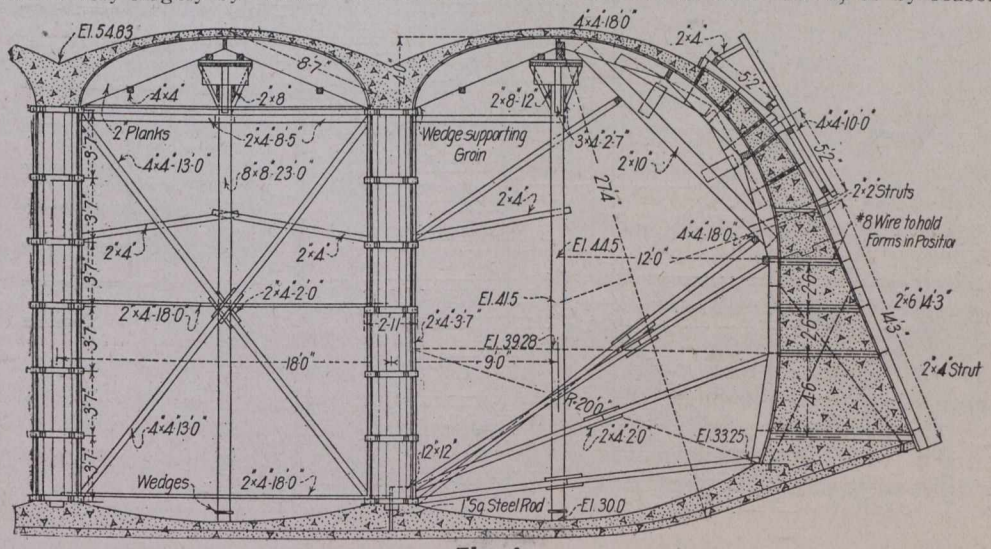


Fig. 1.

Where the forms are used but once and wrecked it is advisable to have the joints between boards V-shaped, with the vertex towards the concrete, known as a beveled joint, as the boards can be removed much more easily and with less waste due to breakage than if a tongue-and groove joint had been used; and if the lumber is not too green the joints will swell shut and be just as tight. For forms used a number of times best results will be had from tongue-and groove joints. The tongue and groove tends to make the several boards act more as a unit, and the force necessary to break the bond between the concrete and form, which is applied more or less on a single board, will not distort the face of the form as quickly as without this unit action. The alternate swelling and shrinking due to the wetting and drying will not cause the trouble in a tongue-and-groove joint that would be experienced in a beveled joint.

In the design of forms, it is of importance to look to their removal, as upon the speed of removing and the

*A paper by J. D. Stevenson, Bureau of Filtration, Pittsburg, Pa., read before the Engineers' Society of Western Pennsylvania.

number of times forms can be used with the minimum amount of repairs, rests the economy of the design. The forms should be designed in as large sections as can be conveniently handled. In deciding size, the removal of forms will have a greater bearing than the placing, as the removing of forms must largely be done by hand, often in cramped places, while the placing or building will be in the open and can be facilitated by cableway or derrick. It will be found very difficult at times to break the bond between a form and the concrete without damaging the form. Often it was necessary to have as many as twelve men pulling on a block and falls, and then the ribs pulled from the sheathing before the bond could be broken.

In forms to be wrecked, spikes and nails should be very sparingly used; sufficient nails to hold the form together is all that is required, as the concrete will furnish all the pressure necessary to hold the sheathing to the studs. It will not then be necessary to use sledges and bars in wrecking, and when the forms are removed the lumber will be in much better shape and can be more economically worked. The building of forms without nails has been tried. The studs were placed and the sheathing, consisting of 6-inch boards with tongue and groove joints, were placed as the work progressed. The experiment was on conduit, and the advantage claimed was easy removal of forms and complete access to all parts during filling. The results showed delay in placing concrete due to waiting on the placing of the sheathing and a rough and very unsatisfactory surface after removal. It is best to completely set up the forms, nailing just sufficiently to hold in place, and, if advisable, to remove certain parts to facilitate filling, they having been once fitted can easily be replaced.

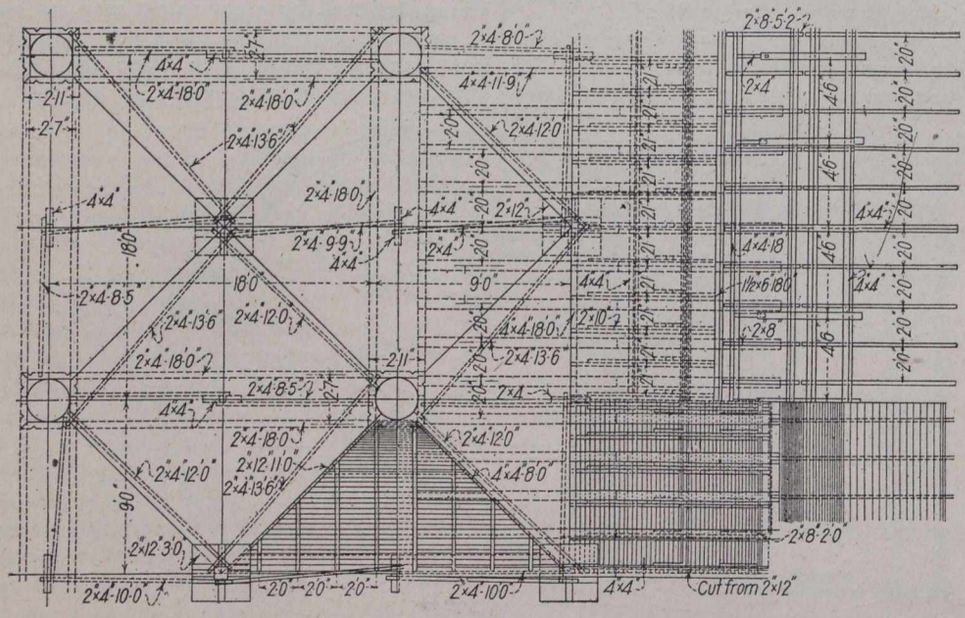


Fig. 2.

Support of Forms.—There are a number of methods for supporting the forms from the interior while filling; by means of wooden struts, bolts, concrete struts, and wiring. A very satisfactory method is the use of wooden struts and wire; the struts to maintain the proper distance and the wire to tie the forms together. The struts must always be placed where the sheathing is supported by a stud, and the wire should loop to the stud; then by twisting the wire with a short bar, the forms can be drawn tight and held rigidly in place during filling. When the concrete has been placed to the level of the strut it can be removed, and the weight of the concrete will then hold the forms apart. In first placing the struts they should be lightly nailed, the wiring will hold them in place, and they will be more easily removed.

On removing the forms the wires should be cut close to the concrete, the ends stoved in with a punch and the surface smoothed over. The finishing is the one point more or less open to criticism, as it takes considerable care to make a good job, and unless the contractor is watched this part of the work will be shirked and ugly rust streaks will deface the concrete. A great advantage in the use of wire lies in the fact that a form can be tied down to prevent floating, and can be tied and cross-tied at any angle. No. 8 wire will fulfill the requirements of most work.

When the space between forms is so narrow that the removal of the struts becomes a troublesome task, concrete struts can be used. Concrete struts are previously cast and placed in the same manner as wooden, and can either be broken with a tamper when the concrete is placed to the proper level, or if they have been cast with a water-stop they can remain in the wall. The greatest difficulty is in preventing a void immediately under the strut. The breaking will do away with this possibility. Care must be exercised to avoid a water channel along the side of the strut.

Bolts are used in several ways. In one method a pair of bolts is screwed into a nut, which is placed in the central portion of the concrete, and when the concrete has partly set the bolts are removed, the nut being allowed to remain. The space which was occupied by the bolt is filled with grout. Another method is to fit the bolt with threads and a cap on either end. The cap screws on the bolt and extends about three inches into the concrete; the cap is removed and the bolt allowed to remain. The latter is much more expensive than the first-mentioned method. In large work involving the using of the same forms a great many times the use of the bolts is very satisfactory, and the small nut lost each time is of little value.

The forms, in addition to the interior bracing, should be braced on the outside; this is generally accomplished by bracing to the earth or to adjoining structures. The number of braces and the size are points peculiar to each individual piece of work. This portion of the form work is probably

(Continued on page 317.)

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MECHANICAL WATER FILTRATION, HARRISBURG, PA.

We have received from Mr. Geo. G. Kennedy the annual report for 1910, this being the twenty-third annual report of the Water and Lighting Department.

It is always with considerable interest that we turn to that part of the report which deals with what has proven in the past to be one of the most efficient water filtration plants on the American continent.

We find that the average bacterial removal for the year is 99.94 per cent., while all turbidity and color has been totally removed from the water.

Turbidity in the river water has ranged from three parts per million to 450 parts, with an average of 29 parts; color, from 3 to 22.3 parts, and bacteria from 68,800 per c.c. to 150.

While 100 per cent. of the turbidity and color have been removed, only an average of five bacteria per c.c. have shown in the filtered water. One thousand six hundred and eighty samples of the water have undergone bacterial analysis, and but one-third of one per cent. of the samples have shown the presence of B. Coli.

It would appear that the city of Harrisburg has arrived at a point as near absolute efficiency as it is possible to obtain in water purification.

It is interesting to find that the plant has shown a gradual increase in efficiency with a corresponding decrease in cost for coagulant per million gallons delivered to the pump-house. This result has only been obtained by scientific study and diligence in observation and experiment upon a water constantly varying in character.

The cost per million gallons for chemicals was in 1906 as much as $1.40, while in 1910 it has been reduced to $1.06.

The average bacterial elimination
For 1906 was 99.24;
For 1907, 99.59;
For 1908, 99.62;
For 1909, 99.68;
For 1910, 99.94.

The Coli removal during the same period was:—
1906, 2.6 per cent. positive;
1907, 1.0;
1908, 1.0;
1909, 1.0;
1910, 35.

The report goes on to say: "The excellent record made this year and the saving in the chemical cost has been due in a great measure to the use of hypochlorite, and its benefit as an adjunct to the operation of a mechanical filter has been so clearly demonstrated that it would be difficult now to discontinue its use." We must confess to a certain amount of gratification here, as The Canadian Engineer has held strongly the opinion that hypochlorite disinfection puts the mechanical filter in the first place as compared with all other methods of efficiently and economically treating water.

The report goes on to say: "It seems that the action of chlorine, or the property that does the work, has obliterated a great many of the difficulties that were encountered at the plant. Its benefits can further be seen in the difference in the chemical cost per million gallons in the increased periods of service between washes, and the consequent saving in waste water and in the regularity of the results."

Whereas, in the past it has been found necessary to add clay to the water at times when the natural tur-

bidity was low and the water so cold that the coagulant would not react satisfactorily, it has been found that with the use of hypochlorite any such addition of turbidity has been quite unnecessary.

At Harrisburg the chlorine is added to the water previous to filtration; in fact before it enters the sedimentation basin. The effect of the chlorine is practically instantaneous in the removal of about 90 per cent. of the bacteria. The amount of available chlorine used has ranged from .05 to .075 grains per gallon, and the lime is mixed in a half of one per cent. solution.

In articles which have recently appeared in the "Municipal and County Engineer and Surveyor" (England) the advisability of applying hypochlorite before filtration rather than as a final process to filtration has been seriously questioned. It would certainly appear that the efficiency of any disinfection treatment depending on the liberation of nascent oxygen would be greater after the organic matter has been successfully removed than before. On the other hand, at Harrisburg hypochlorite treatment appears to have been accepted as having a steadying influence upon the various factors connected with the filter plant. The fact that the use of the cheaper chemical (hypochlorite) in minute quantities lowers the amount of coagulant otherwise required appears to be the chief factor in determining the question as to whether the disinfection process be previous to or after filtration.

CHOOSING PAVING MATERIAL.

In the selection of paving material two questions have received their general consideration. The first is the cost of that material. Sometimes the first cost has had considerable to do with the selection. At other times the cost per annum, figured upon the probable life of the pavement, has been the guiding factor.

The wearing qualities of the pavement with regard to the traffic it is to sustain have been fully investigated.

To our mind the most important feature in pavements—the effect of the pavement on the human being—has not been fully enough considered.

The pavement that causes the least wear and worry to the travelling public is the one that will make the most successful pavement for locality. We are designing our pavements with a view to the comfort of the people rather than cheapness of construction.

THE LICENSING OF ENGINEERS.

The question of making engineering a close profession has been much discussed in the United States, and in some States the profession is closed to residents from other States. Fearing that this sectionalism would work injury to the profession and to the community, the American Society of Civil Engineers took up the problem with a view of preventing certain States being closed, or, if the profession is to become a closed profession, then making it a national restriction.

The feeling of the New York Convention in January was that it was a mistake to make it a closed profession, but, recognizing that in certain sections this was being done, the following resolutions were passed:—

"Whereas: There are national societies of engineers in the United States, membership in which can only be secured after rigid examination of the fitness of applicants to practice as engineers; and

"Whereas: The public has ample protection if they will employ only those who have thus demonstrated their ability; be it

"Resolved: That the Board of Direction of the American Society of Civil Engineers does not deem it necessary or desirable that civil engineers should be licensed in any State; and be it further

"Resolved: That if, notwithstanding this, the Legislature of any State deems the passage of a statute covering the practice of civil engineering desirable for the protection of the public, the accompanying draft of such a statute, which has been prepared by the Board as embodying proper requirements for that purpose, is recommended."

Several of the clauses were in the draft bill which the Society requested the legislative bodies of each State to consider are of general interest. Section 2 defines what the Society means by civil engineering. This section reads as follows:—

"Section 2.—Practice of Civil Engineering.—Civil engineering, within the meaning of this Act, is the practice of any branch of the profession of engineering other than military. Said profession embraces the design and supervision of the construction of public or private utilities, such as railroads, bridges, highways, roads, canals, harbors, river improvements, lighthouses, irrigation works, water supplies, sanitary and drainage works, of works for the development, transmission and application of power, and of electrical, mechanical, mining, industrial, hydraulic, municipal, sanitary, structural and other works which require experience and the same technical knowledge as engineering schools of recognized reputation prescribe for graduation.

"The enumeration of any public or private utilities or works in this section shall not be held to exclude from said profession the design and supervision of other public or private utilities or works which require experience and like technical knowledge."

Following these are clauses governing the selection of the Board of Examiners, the main feature of it all being that the engineers acting under the Governor of the State shall have control of examinations and the issuing of certificates, and also that where the standard examinations in another State is as high as any other State there shall be exchange of registration.

TESTING DEPARTMENTS.

The Inspection of construction work has long been considered necessary, and the number of inspection bureaus which employ experts to conduct inspection in the various departments is evidence of the necessity of such work.

The testing departments of each manufacturing concern are fast becoming one of the most necessary departments in the modern factory.

Every engineer who has to do with the installation of machinery can tell amusing stories of the shipment of uncompleted machinery; of runners of turbine pumps moving in the wrong direction; of compound engines with but one cylinder working, etc. The proper place to correct errors in design or construction is in the factory before the machinery has been shipped, for not only does this mean a saving to the manufacturer and is a convenience to the purchaser, but prevents the unkind remarks which competitors make when they hear of a blunder which concerns the output of the competitor.

Not only will testing departments prevent these errors, but they will be found useful in developing and in testing out suggestions that come from the customer and the salesman, showing their practicability or otherwise, and will keep the producing end working to a high pitch of efficiency.

THE AMERICAN INSTITUTE OF CONSULTING ENGINEERS.

The annual meeting of the American Institute of Consulting Engineers was held in New York city late in January.

The main object of the Institute is to promote the business interests of the consulting engineer; by advocating a code of ethics, professional practice and schedule of charges; by acting in pertinent legislative matters, and by urging the separation of the contractor from the designing engineer. The membership is limited to those actively engaged in the independent practice of the profession of engineering in any of its branches as consulting engineers, and who are not engaged in contracting. Included in the membership are some of the foremost engineers of America, representatives of the different branches of the profession, and many with international reputations.

The Institute is the outgrowth of a local association of consulting engineers, organized in New York city in 1905, now expanded into one of national scope. At a meeting held last December the constitution was amended and the name (originally "The Association of Consulting Engineers") changed to its present title.

Mr. E. W. Stern, of 103 Park Avenue, New York, is the secretary of this organization, which is so distinctly different from other engineering societies in America that, although its membership may not increase rapidly, yet the high standing required for membership will always make it an organization in which the engineer will desire to be a member.

EDITORIAL NOTE.

The Provincial Board of Health of the Province of Ontario will hold a Public Health Exhibit in connection with the Canadian National Fair, held annually in the city of Toronto, beginning about the end of August. In addition to the exhibit there will be daily fifteen-minute lectures, with lantern demonstrations, upon various subjects relating to public health and prevention of disease. Firms desiring to contribute are advised to communicate with the undersigned at the earliest possible date as space is limited. John W. S. McCullough, M.D., Chief Health Officer of Ontario, Parliament Buildings, Toronto, Canada.

PRECIPITATION FOR JANUARY, 1911.

In British Columbia the precipitation was above the average over the greater portion of the province, the snowfall in Cariboo exceeding the usual quantity by some 32 inches. Throughout the Western provinces, except in one or two isolated districts, the snowfall was above the average amount, the positive departure being locally pronounced, noticeably in Northern Alberta, Saskatchewan and parts of Manitoba. In Ontario and over Western Quebec the precipitation was deficient, being from one third to less than a half the average quantity, except very locally in the Lake Superior district where the snowfall appears to have been in excess of the normal amount. In Eastern Quebec the precipitation was a little above the average in some places and below in others, and in the Maritime Provinces everywhere below Cape Breton, the negative departure being very marked in New Brunswick.

Snow on the Ground.

At the close of the month the ground was covered with snow from the Maritime Provinces to the Rocky Mountains, with the exception of the extreme southwestern counties of Ont., where in many places only patches of snow were to be seen. In Alberta the depth was not generally in excess of 4 to 10 inches, while over the greater portion of Saskatchewan and Western Manitoba it varied from 20 to 30 inches. From Winnipeg eastward to the Lake Superior districts it was less than 10 inches. In the Georgian Bay district the depth was generally more than 10 inches, and in Haliburton County exceeded 30. In Eastern Quebec the depth varied from 33 inches at Quebec City to 54 at Father Point. In the southern districts of the Maritime Provinces from 2 to 10 inches were reported.

The table shows for fifteen stations included in the report of the Meteorological Office, Toronto, the total precipitation of these stations for January, 1911.

Ten inches of snow is calculated as being the equivalent of one inch of rain:—

Station.	Depth in inches.	Departure from the average of twenty years.
Calgary, Alta.	0.50	+ 0.04
Edmonton, Alta.	1.20	+ 0.49
Swift Current, Sask.	0.70	+ 0.04
Winnipeg, Man.	0.50	— 0.47
Port Stanley, Ont.	2.80	— 0.53
Toronto, Ont.	2.10	— 0.73
Parry Sound, Ont.	2.70	— 1.76
Ottawa, Ont.	1.80	— 1.19
Kingston, Ont.	1.50	— 1.37
Montreal, Que.	2.40	— 1.35
Quebec, Que.	3.20	— .00
Chatham, N.B.	3.50	— 0.08
Halifax, N.S.	5.40	— 0.45
Victoria, B.C.	5.00	+ 0.46
Kamloops, B.C.	0.50	— 0.45

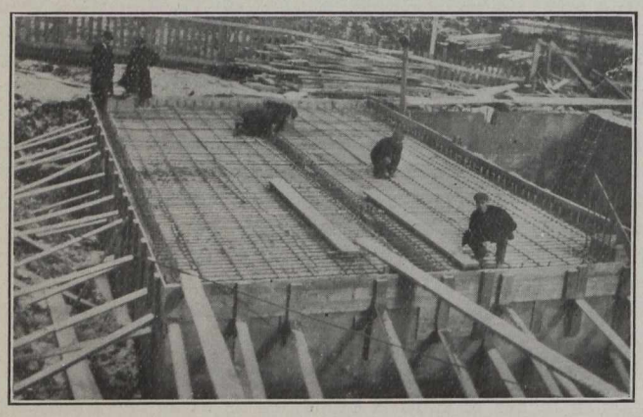
THE DESIGN AND CONSTRUCTION OF REINFORCED CONCRETE OIL TANKS.

Reinforced concrete structures are said to have been first introduced into Europe by Joseph Monier, about forty years ago. His first attempt was the construction of tubs for holding plants and shrubs. Since that time reinforced concrete has been applied to the building of water reservoirs and large tanks for holding liquids and also solids such as cement, coal and grain. To-day, such structures are rapidly superceding steel construction, and in the near future, one may look for concrete to take the place steel has held in the past with storage tanks.

Four reinforced concrete tanks rectangular in shape were built last fall for the Queen City Oil Company, of Toronto, at their West Toronto yards. These tanks were for the storage of the lighter products of petroleum. They are, to

the knowledge of the writer, the first of their kind to be built in Canada. The design and construction will be dealt with briefly as follows:—

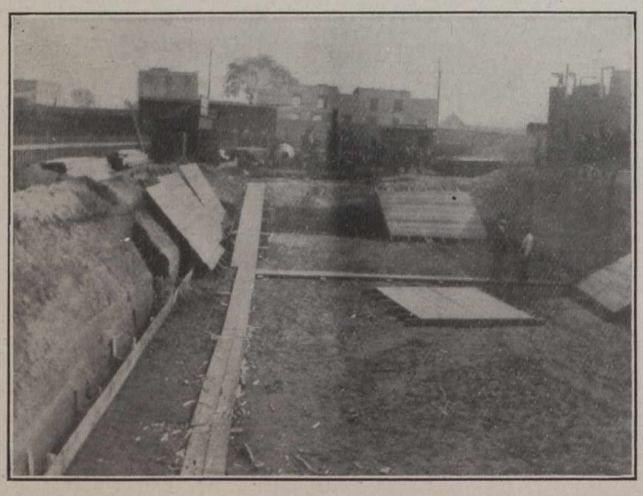
Owing to the confined space, the tanks were placed side by side, but each independent of the other. The general inside dimensions for each tank were 21-ft. 6-in. wide by 38-ft. long, and 9-ft. 6-in. high. The total length of the four tanks was 94-ft. by 40-ft. wide. They were placed under ground and a covering of three feet of earth was placed on top of them. The tanks are filled by gravity from tank cars on a siding that runs into the yard. Two manholes were placed in each tank through which the intake and discharge pipes run. A tile drain, surrounded by broken stone, was



View of Tanks, Showing Reinforcement.

placed around the bottom of the walls draining into two sumps, one on each side in the centre of the four tanks. Square reinforcing rods of medium steel were used throughout the job.

Each tank was built separately and entirely independent from the other. A wet mix was used of a very strong concrete rich in cement. The walls and floor were poured continuously. This was done to form a homogeneous mass. As



View of Pit.

soon as it was thought advisable the forms were stripped and cement grout painted and troweled onto the green concrete. After the walls had hardened sufficiently the roof and supporting column forms were placed and the roof slab was poured. Gravel was used in preference to stone on account of the dense formation gravel concrete will give.

The contract called for a water test to be put on the tanks. This was successfully carried out to the satisfaction of the Oil Company, and the contractors.

Similar tanks have been constructed for the Standard Oil Company in the United States, and have proved to be very efficient, economic and safe.

The reinforced concrete tanks for the Queen City Oil Company were designed and built by the Foundation Co., Limited, of Montreal, L. W. Klingner being superintendent in charge of the construction.

THE ENGLISH TELEPHONE SITUATION.

The present telephone situation in England has assumed new interest by the retaining of an American firm of engineers, D .C .and Wm. B. Jackson, to assist the Government in valueing the private system it is soon to take over. But apart from this patriotic appeal, the case in England has important technical and social aspects.

The causes of the present situation date back to 1880, when the telephone first became of practical importance in England. In that year an information was filed against the Edison Telephone Company of London, which was the predecessor of the present National Telephone Company, whose property is now to be taken over by the Government. This section was bought by the Postmaster-General with the purpose of establishing a rule that telephone communications were to be considered as telegrams within the monopoly of the post-office, and the case was so decided by the High Court of Justice in December, 1880.

Having acquired the right to make telephone service a Government monopoly, the Postmaster-General of that day decided that it was not desirable to undertake to provide a new service for the whole country, and in place of that action licenses to carry on the telephone service were granted to various companies. All these licenses having expired, with the exception of that with the National Telephone Company, Limited, whose license was granted in 1884, and holds good for a period of thirty-one years from January, 1881. It expires, therefore, on December 31st, 1911.

This license to the National Company allowed it to transact telephone business of any kind throughout the United Kingdom, but in 1896 the company surrendered portions of its rights by turning over the trunk line business, or what would be called in this country "long-distance" and "toll-line" communication, to the Government; and retaining the telephone business within exchange areas. Under this arrangement the Postmaster-General bought the trunk wires of the company at a price agreed on between the engineer-in-chief of the post-office at that time, and the then engineer-in-chief of the company. The price was a little less than £460,000 ($2,300,000), for about 14,500 miles of metallic circuit. Since the purchase of the trunk lines the post-office has carried on all the trunk communications of the country, and has established local engineers, mainly in rural districts which the National Company did not provide with adequate service. In 1898 the Postmaster-General granted licenses for transacting telephone business to some half-dozen cities, the business in each case being confined to the area in and around the district of the municipal corporation. Three of these licenses are still oustanding.

At about the same time the post-office established exchanges in London, and laid down an expensive underground system of telephones within the city area; this area includes the County of London and surrounding districts, roughly about 640 square miles. Within this large district the National Company and the post-office are competitors, but except in the centre of London, arrangements have been made to develop certain districts by the company and certain other districts by the post-office. The rates charged to new

(Continued on page 327.)

METHOD AND COST OF FORM WORK FOR GROINED ARCH RESERVOIR AND CONDUITS, PITTSBURG FILTRATION WORKS.

(Continued from page 312).

more neglected than any other. Forms are either underbraced, or the braces which are placed do not assist in the support. Often during the filling, when a strain has been placed on the forms, many of the braces will be found loose. The exterior bracing must be relied on for holding the form to alignment. On the filtration works alignment was necessary only within very liberal limits. Butt bracing is more secure than splices, the salvage will be greater, and the cost of reworking the lumber less.

In building a structure in a number of lifts it will often be found advantageous to terminate each lift of forms in a short section, say, three feet high. This section, which is tied together by wires and securely held to the concrete by the bond, can be left, upon removing the forms, as a base upon which to build the next lift.

Coating Forms.—Forms are covered, or coated, to decrease the bond between the form and the concrete, and thus permit easy removal or to give the concrete surface a smooth finish. The latter is important in the case of conduits, where the friction loss is a factor.

Covering wooden forms with metal has a number of objections; it is an added expense and does not increase the life, as the metal readily breaks and tears when removing, and if the form is strained in the handling the metal covering makes it harder to put back in shape. The rents, although smoothed down, still have irregularities which will catch in the concrete, and the next removing will leave them in far worse shape. If metal is necessary a complete metal form is more economical.

Painting the forms greatl facilitates their removal, and also increases the life of the forms and makes them much easier to clean. The pores of the wood and the cracks are filled with the paint and the grout is thus prevented from entering. A satisfactory method is to coat the forms after cleaning with cold water paint, and after they have been erected give another coat. This is particularly applicable to conduit forms, and was used very satisfactorily on the by pass conduit.

Forms were often oiled on the filtration work and for walls and roof vaulting this was very satisfactory. Other dressings composed of various proportions and combinations of soap, paraffine, kerosene, etc., are used, but are more expensive and more troublesome to prepare and apply, and have little advantage over oil or cold water paint.

Buoyancy of Forms.—The tendency of a form to lift during filling will cause much trouble if not properly cared for. In a wall section which has considerable batter, a hook made of reinforcing steel, imbedded in the foundation, offers an admirable arrangement to which to tie the forms, the tie being made with No. 8 wire.

Conduit forms and box forms are often loaded with pig iron, lead or other heavy material. As this is always more or less expensive and troublesome, the contractor is liable to take chances by underloading. A form failing in this way is a very serious problem, as it is impossible to force it back in shape without removing part, if not all, of the concrete placed. Under this same heading comes the rolling of forms, which applies more to conduits, and is mostly caused by uneven filling; that is, filling higher on one side of the barrel than on the other. The best method of preventing this is by care in filling, to keep a uniform level on both sides of the barrel. In trench work where there is sufficient depth the upward or side movement of forms can be cared for by bracing to the sides of the trench.

Joints Between Monoliths.—The placing of joints and the method of making joints is generally decided by the engineer, and often proper consideration is not given the contractor in making the decision. The location of joints will govern to a large extent the possibility of cracks, and this is a large factor in the design of the work, and it may also greatly affect the cost of the form work, and in this way the contractor. A study from both the engineering and construction point of view as to the effects of placing joints should be carefully made.

In the filtered water reservoir the location of joints was made after thorough study. The sides converge at the rate of one span of the arch in width, or 18 feet in every nine spans in length. By this arrangement one set of forms could be used seven times, or practically the life of the forms. Referring to Figs. 1 and 2, the joints between sections of wall were placed directly over joints in the floor, joints in the barrel arch over joints in the wall and joints in roof groins were in line with joints in the barrel. Thus all joints were on centre of bay lines, although all centres of bays did not have a joint, as often two bays, or 36 feet, were built monolithic. This located definitely the points to be affected by expansion and contraction and proper arrangement of keying could be made so as to prevent leakage. It also was the most economical design for the contractor.

The design of a key between monolithic blocks varies a great deal. Some keys are to prevent slipping of one surface on another, while in other places the key is for watertightness. A key similar to a tongue and groove in lumber, the sides being slightly battered, is more generally used; it varies in size with the bulk of the structure. For vertical joints the groove will be constructed in the forms, and is generally designated as a depressed key. On horizontal joints it will be found that a raised key, or the tongue, is more easily constructed for the reasons that the forms for it will not float, it is more easily held to a fixed location and removed, and can be cleaned better when placing the next section. Keys of the tongue-and-groove type are not necessarily watertight; they only make the path to be travelled by the water longer and change the direction of travel.

For work requiring a large degree of water-tightness a sheet of metal will give best results; sheet lead, copper, galvanized iron or similar metal embedded three or four inches in one monolith, doubled back on itself and extending the same distance into the next monolith. The doubling back is for the purpose of allowing for movement due to expansion and contraction.

Care of Forms While Filling.—In filling forms the platform for mixing or dumping should be independent of the forms. This will prevent a shock caused by dumping. In no case should the concrete be dumped from a bucket directly into the forms, unless a bucket especially adapted to spreading is used, as this is likely to distort the forms and will often affect the uniformity of the finished concrete. By dumping a bucket on the platform the shock is taken up by the platform, and at the same time the concrete will receive a mixing which will tend to remove any stratification which has occurred in transportation.

Before filling it is advisable to turn a hose on the forms, thoroughly wetting them. This will not only wash the foreign matter from the forms, but will cause them to swell and prevent leakage. During the filling a carpenter should be constantly in attendance calking with cotton or jute any leaks and seeing that the braces are not loosened or disturbed.

Often trouble will arise in the removing of the struts, especially in thin walls heavily reinforced, as the available

room for the removal of the struts is small, and usually the forms and steel are covered with mortar, making a most disagreeable place in which to work. The struts should be removed as they are reached and careful watch kept so as to remove all.

Removing of Forms.—The time for the removal of the forms cannot but be left to discretion of the engineer, as the time required for concrete to set varies greatly, and largely depends on weather conditions and the particular brand of cement used; also the bulk of the structure will affect the removal. Often in cases of walls and structures requiring treatment of the surfaces to produce a finish it is necessary to remove the forms at the earliest possible date and while the concrete is green. The question of length of time in cases of this nature can only be solved by previous experience.

Partly as an experiment and partly to facilitate the work, the forms for a few piers 20 in. in diameter, 8.5 ft. high, on the new filters were used twice in one day. That

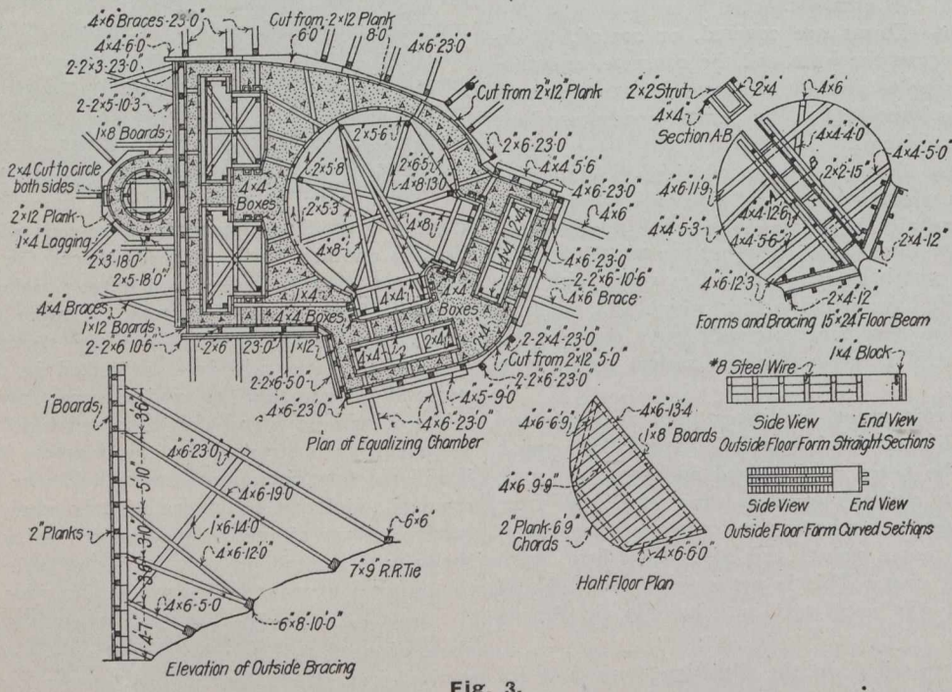


Fig. 3.

is the forms were filled in the morning, removed and again set up and filled about noon; removed and again set at close of day, ready for filling the first thing the following morning. The piers were not loaded for three weeks after casting. They have now been in use over 1½ years and no trouble has been experienced. The general custom was, however, to remove the bracing from the forms the following day and to allow the forms to remain up 72 hours. A schedule of time for removing forms under average conditions on the filtration work was as follows:—

Floor forms—The following day.
Pier forms—After the third day.
Wall forms—After the second day.
Vaulting forms on reservoir—After ten days.
Vaulting forms on filters—After six days.

Conduit forms varied from the following day to three days.

The work of removing forms is frequently, and unfortunately, placed in the hands of laborers, and, as a result, the forms are broken and destroyed to the extent of costly repairs. In taking down forms the bracing or props should never be knocked out and the forms allowed to fall. This is not only liable to damage the forms, but the impact is liable to damage other work. The forms should always be easied down by a cable or other similar method. In roof vaulting the method of cable and drum, described more in detail in another portion of this paper, is very satisfactory. Sledges and bars should be used with the greatest of care, if at all. It will at times be very difficult to break the bond between the concrete and forms and the use of block and falls will be necessary. This will have to be done in a careful manner to prevent the twisting or distortion of the form. It is well to start a form by use of a wooden wedge rather than exert a great force by block and falls.

The forms upon removal should be thoroughly cleaned of all cement. This can be done by scraping, and will prove rather costly, but the thoroughness of this cleaning will greatly affect the speed of removal and the surface finish of the concrete in later work; so the additional cost spent in scraping is saved in other ways. It is much easier to remove the concrete which has adhered to the forms immediately upon the removal of the forms, and the longer a form stands the harder it will be to thoroughly clean it. As soon as the forms are removed they should be cleaned and any necessary repairs made and the forms piled in some convenient place. The piling, although a small matter, will often cause much trouble; if the forms are carelessly piled, having bearings at points that will allow them to sag, the forms are liable to set to this untrue shape, and endless trouble in setting them to line and grades will be experienced.

Steel Reinforcement.—There is no particular choice in the kind of a bar best to use as being easiest to hold in place, except that a bar having a twisted or irregular surface will hold without slipping better than a smooth, straight bar.

An example of a method of placing and holding steel can be presented in a brief description of the equalizing chamber built at the Brilliant Pumping Station. This chamber, 38 ft. deep, contained 445 cubic yards of concrete and 20,000 pounds of steel, or about 0.0034 per cent. reinforcement, based upon the sectional area. Some of the walls were only 18 in. thick throughout the entire height. Figure 3 shows the form work.

The vertical rods in the walls of the chamber, numbering about 200 rods, being for the most part ½ in., were to extend into the foundation sufficiently, 20 diameters, to develop the

strength of the rod. Joints between successive days' work were made at the level of the floor, and, to avoid having these rods extending up in the way of the form building and the necessity of supporting the rods at the top, which supports would be greatly in the way, bars 40 diameters long were placed one-half in the foundation concrete and one-half extending above the concrete foundation, to which, after the second lift forms were completed, were wired the vertical bars.

The inner and outer forms were wired together and spacers of wood used. The location of the wires was made with an eye to the placing of the reinforcement so that as many as possible of the vertical rods could be tied to the wires. The horizontal reinforcement, which was largely in the shape of hoops, varied from 1 in. to 0.375 in., was tied to the vertical bars, and where possible laid on the tie-wires. It was also necessary in several places to add 0.375 in. or 0.25 in. bars for support. This arrangement of steel proved very satisfactory. The test was very severe, as, due to the narrowness of the space between forms, the ramming affected the steel, and the removing of the spacers often necessitated a man using the steel as a ladder to go down in the forms.

The method used in the gate chambers was somewhat different. Here mostly horizontal bars were used. After the form was checked for trueness nails were driven in the side of the forms at the location of the bar. The bars were all cut and placed in racks easy for access. When the concrete was placed level with a nail a bar was laid in the concrete. This method involves close inspection and maintaining the concrete level to insure proper construction. In the floors and beams a similar method was followed; the bars were all cut and fitted, then laid to one side. A layer of concrete was placed slightly in excess of the distance from face to steel. The steel was then laid on the concrete and the bars tied together and the remainder of concrete placed.

In the equalizing chamber the steel required careful bending. There were twenty-seven different shapes. A record kept by the writer on the bending of 10,325 pounds, extending over a period of ten days, showed a cost of: 0.88 man hours per 100 pounds for blacksmith and of 1.66 man nours per 100 pounds for helpers. At the prices paid, or 25 cents per hour for blacksmith and 16 cents for helper, this cost was 48.9 cents. per 100 pounds. In addition to this was chargeable .024 man hours per 100 pounds for the layer out, which work was done by the boss carpenter at a cost of 20 cents per 100 pounds, the total cost being 68.9 cents per 100 pounds. In bending the steel a large platform was built and all shapes laid out full size; cleats were nailed at points of curvature and the rods bent to fit.

Description of Piers.—Fig. 1 shows the form work for a 21.5 ft. circular pier 27 in. in diameter, being one of 720 piers supporting the roof of the reservoir. The sketch is fully demensioned. The forms are in three sections, each 7 ft. 2 in. long. Each section consists of two semi-circular pieces of No. 16 galvanized steel, flanged on the vertical edge, the flanges of the two halves being bolted together between two pieces of 2 x 4-in. lumber. The sections are clamped at top, bottom and middle point by a wooden collar made in four pieces and held by bolts.

The first intention was to make up the 7-ft. 2-in. sections on the ground and build them into place in the pier. About twenty piers were built in this way and proved very unsatisfactory, as the third points, or joints, were not rigid enough. The remaining pier forms were built complete on their sides and raised into place by the cable way.

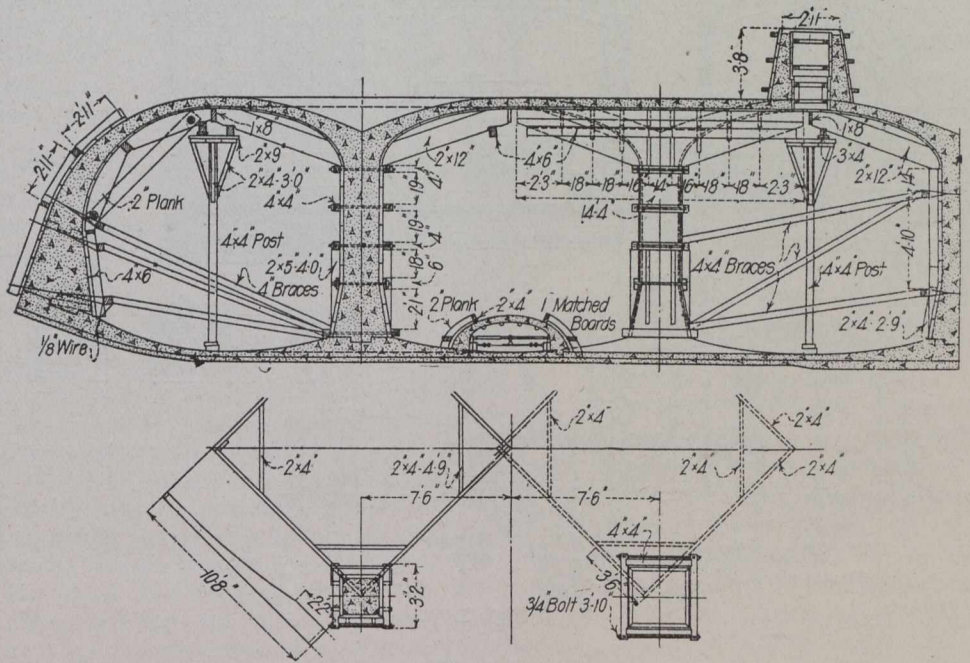


Fig. 4.

The carpenters plumbed the forms with plumb bobs and the engineer corps checked the work with a transit. The piers were braced in sets of four, horizontally at top, bottom and centre and cross-braced from top to bottom. This allowed an unobstructed passage between the sets of four piers for the moving of the filling platform.

The removal of the forms was accomplished by removing all the collars and loosening all the bolts in the flanges, working from the top down. The lower section of metal was then removed and the upper two allowed to slide down the pier; the second was removed, allowing the top to slide down and be removed. Thus a large amount of work was accomplished from the floor, which saved considerable time. Before using the metal again it was thoroughly scraped and cleaned.

The metal and collars were renewed at intervals; in some cases they were used twenty times. The greatest trouble was caused by the indenting of the edges, permitting leaks, which caused wash streaks in the surface of the piers. As the pier forms became older this trouble increased, and it became necessary to calk with yarn around the bottom and at joints.

At first the forms were built to the neat required height and filled level with the top of form. The concrete when setting would shrink from 1 to 1.5 in., and it was found necessary to make the forms higher so as to allow for this shrinkage. It was then found advisable to build the forms to a greater height, so that the finished pier would be 1 or 2 in. higher than required. This allowed the roof forms to butt against the pier and prevent lateral movement.

The pier forms contain 488 ft. of lumber and 688 sq. ft. of metal. The bracing contained 507 ft. of lumber. The cost as compiled by the writer for form work on four piers 12.68 cu. yds., is given in Table I. This is an average from a number of observations taken at random and extending over a period of eight months.

The piers in the last filters built were molded in a steel form, which offered a great many advantages. The form was very different from that used on the reservoir. They were used twenty times with practically no repairs, and were very easily and quickly removed and reset. In part of this work piers were built separate from the roof; the remainder were built monolithic with the roof. The piers built separate from the vaulting were braced from pier to pier at the top. A pair of rails were hung to the piers, and on these rails were set kegs of bolts, which happened to be on hand, to load down the pier and prevent floating. The piers built monolithic with the roof did not require any greater loads than that furnished by the vaulting.

On the first filter beds the piers were square, and built of wood. Fig. 5 shows the design of these pier forms. They were all built monolithic, with groined arch vaulting. The forms were used on an average of ten times, and consisted of four sides held together by bolts; the removal of the bolts allowed the form to collapse.

Barrel Arch.—Figs. 1 and 2 show the design of what was known as the barrel arch form. This form was for that portion of the wall from the springing line of the arch to the centre of the first bay. The inside shape was a quarter of a 12 ft. circle and the outside an arc of a 15 ft. circle. These forms caused more trouble than any others on the reservoir. The inside was built in three equal sections, each 9 ft. long and 5 ft. 10 in. wide on the chord. The ribs, 2 x 12 in., were placed on 21-in. centres, and lagging was 1 x 3 in., Southern pine, tongue and grooved, and dressed on both sides.

The outside forms were built in three sections, the first section being 3 ft. of the wall form, which was left wired to the wall when removing the back wall form; this gave a solid base upon which to build. The second was placed before filling and fastened to the inner form by wires and wooden interior struts, and held on the outside by an outrigging extending up from the wall. The third was placed after the filling had reached the top of the second form, and was wired to the iner form.

The remainder of the arch, or a little over one-third of it, was screeded, no form being used on the outside.

Some trouble developed after the third using, and was entirely due to the manner of removal. The bracing extending from the top to bottom, shown in Fig. 1, was not removed, and the forms were not taken down in three sections, but the entire form was removed at one time. The method of removing was to hitch a set of falls to one of the upper corners to break the bond, and at times twelve men broke the rope before the form left the concrete. It was not uncommon to pull off several ribs in an attempt to break this bond. The result was that this pulling greatly distorted the form. This first showed up in the inability to make a good joint between forms, and finally necessitated rebuilding the forms. The trouble could have been eliminated by removing the forms in three pieces rather than in one. The barrel arches on the filters (Fig. 4) were similar, but one-half the length. On these there was no particular trouble.

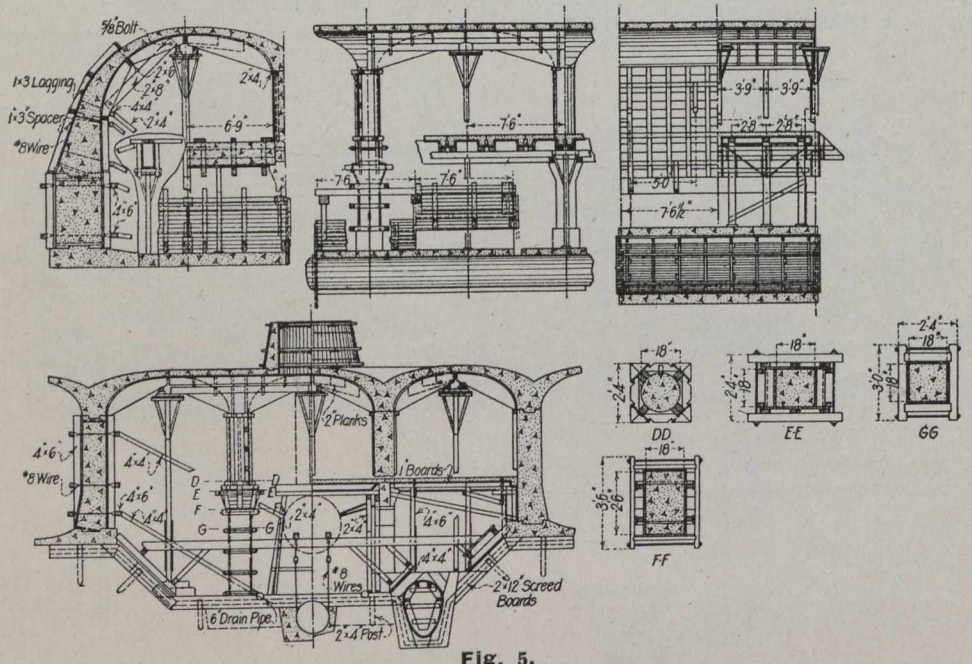


Fig. 5.

The barrel arch in filtered water reservoir contained 0.90⅓ cu. yd. per running foot, and the units placed were 36 ft. long, or 33¼ cu. yds. The cost of forms is given in Table II.

The cost is an average from a number of observations made by the writer. The cost of hauling out is rather high and unusual; the forms, however, were of awkward shape and very large, and had to be hauled on a truck by hand a distance as great as 300 ft. The floor over which they were hauled consisted of inverted groins, with piers every 18 ft. The trimming and trueing at 58 cents a yard is due to the trouble previously explained in this paper.

Walls.—The wall forms shown in Fig. 1 are in accordance with the general practice in such work. All forms were made in 9-ft. sections, and from top to bottom in one unit. The method for preventing the forms from rising is shown

in the illustration, and consisted of hooks set in the first laver of concrete and wires tying the forms to these hooks.

The forms were used on an average of ten times, and the only repairs made were a board now and then, where the bar in removing had splintered or broken the forms. The edges of the forms become more or less frayed, and this was cared for by a metal strip tacked over the joint. This practice was permissible in this work, as the face would not be exposed. In finished surfaces it should never be used, as the metal leaves a surface entirely different from the wood and very readily noticed.

The regular wall in the reservoir contained 2.33½ cu. yds. per running foot, and as a rule the wall was built in 36-ft. sections, or 84 cu. yds. This amount varied within a yard, as the point where the wall ceased and the barrel started was not closely defined. The cost of forms is given in Table III. This cost is a weighted average, as in this work there was a great amount of variance. Often the cable way was used in removing forms, and the cost cut down; then again the forms would be in bad shape and require much repairing. As an example on the

21st wall forms cost	$0 73 per cu. yd.
23rd wall forms cost	53 per cu. yd.
24th wall forms cost	55 per cu. yd.
25th wall forms cost	42 per cu. yd.
26th wall forms cost	49 per cu. yd.

Groined Arch Forms.—Figs. 1 and 2 show groined arch forms in elevation and plan. Each pier top was molded on forms built in four triangular sections, the joints between sections being on centres of arches and on diagonal lines between piers. The ribs were 2-in. white pine, placed on the diagonal line, and on 2-ft. centres between the diagonals; the decking was 1-in. Southern pine, tongue and grooved. The forms were well oiled before filling.

The pier edge of each form rested on a collar bolted to the piers. The piers, having been built 2 in. higher than the springing line of the arch, prevented any horizontal movement in the form. The four corners were supported by 8 x 8 in. posts, and midway between corner posts were placed 4 x 4 in. posts. The proper elevation on the top of arch was first secured by placing wedges between the top of post and form. Later it was found that dumping the concrete disarranged these wedges, and their use was discontinued, and 0.5-in. boards were used and toenailed. This allowed only an adjustment of 0.5 in., which was considered close enough.

The joint between forms on the top was made by a crown strip, which varied from 2 to 4 in. wide. The corner joints were finished by a 1-in. triangular strip, which relieved the rough corner. The forms being square anl piers round, required a filler in the corners. This filler was first made of plaster paris mixed with excelsior, but was unsatisfactory, as the breakage was high and it was impossible to use it a second time. The cost of the fillers in plaster paris was about 27 cents each. Later wood was used, and the work was finished using wood. On contract 11 the contractor used a metal filler cut from No. 16 gauge sheet iron. This filler was used over anl over, the first cost being 10 cents each. Figs. 4 and 5 show the forms used in filter work, which are very similar to those of the reservoir. The roof and pier were placed monolithic in this work.

The method followed in placing forms was to first erect the shoring on the piers, then by cableway erect the corner posts and brace them to the piers. The arches were then lifted by cableway and placed in position, resting on the piers and the corner posts. Most of this work was done at noon, in the evening, or on Sunday, as at these times the cableway was not in use on the concrete. The crown strip was placed between the forms on the top so as to allow adjustment. This strip had to be ripped from boards, and this was done by hand, requiring considerable time.

Removing the forms on the reservoir was done by means of a cable allowed to slip over a drum placed on the roof, a hole having been left in the concrete over the centre of gravity of the form. It was necessary to resort to a set of blocks and falls to break the bond beween concrete and forms.

In placing the concrete in the vaulting some trouble was experienced in securing the proper thickness. The concrete from the sides would occasionally work down into the centre over the pier. This trouble was experienced in Columbus, O., where in place of 6-in. thickness they found only 2 in. of concrete, and a test was made on one of the weakest arches. A load of earth was placed to the depth of 4 ft., when cracks developed in a vertical plane passing through two piers, and a deflection of 13-32 in. was recorded. The work was remedied by placing a patch on the upper surface 4 in. thick.

This same trouble was encountered on the Pittsburg work to a lesser extent. The maximum occurred where in place of 7.25 in. we had 4.75 in. of concrete. The error was

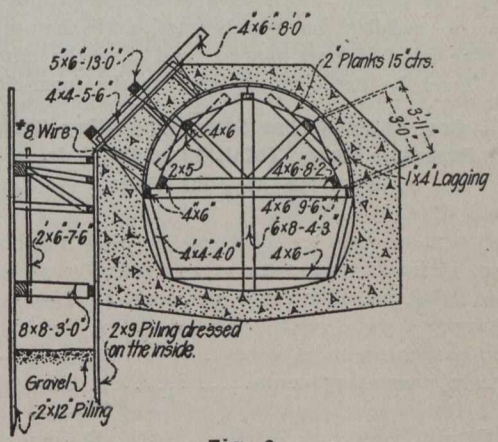


Fig. 6.

discovered in 10 sides out of the 64 first placed, and was remedied by patching, and further trouble of the same nature was prevented by using a screed board at right angles to the line of piers instead of on the diagonal as had previously been used.

On Contract No. 1, the filters, the total amount of arch centering placed was 2,130,012 sq. ft. There were 240,000 sq. ft. of forms actually made to complete the work, an average of ten times use for each form. The actual cost was $0.0435 per sq. ft. placed; this cost includes plant charges, administration charges, material, etc.

On Contract No. 2, the reservoir, there were placed 243,390 s. ft. of vaulting forms, and there was actually made about 20,000 sq. ft. The cost was $0.096 per sq. ft. placed, or about $3.50 per cu. yd. of concrete placed. This cost is a final cost, including everything chargeable to the forms.

For a detailed cost Table IV. was prepared from information gathered by the writer:—

Four forms made one pier top or	8.1864 cu. yd.
Lumber in one pier top	1,000 ft.
Lumber in posts and bracing	400 ft.
Lumber in shoring on piers	150 ft.

To the above cost must be added a charge for hauling the forms from the place of removal to the place of setting.

This varied greatly, and from observations cost 15 man hours per 100 ft. hauled.

Gate Chambers.—The forms for gate chambers throughout the work were more or less similar, and the same principle in form work was used throughout. The structures were rather irregular in shape; some portions of the forms could be used twice, but the greater portion had to be wrecked and the lumber partly used in rebuilding. The greater portion of the forms were built of 1.5-in. Southern pine lumber, surfaced on both sides, the portions plain in shape were decked horizontally and the portions curved or irregular were decked vertically. The forms were wired together and the exterior and interior braced. The dumping platform was built independent of the forms. The placing of reinforcement is explained in detail elsewhere in this paper. The first section was built to the sub-floor level; the second to a point about 3 ft. above the top of the gates, and the third up to the floor level, including beams. The floor slabs were placed later.

Conduit.—The construction of conduit forms was governed greatly by the place they were to be installed and the surroundings. A conduit in a trench offers different requirements than conduit in the open. Fig. 6 shows six conduits and the forms used on each. The inner form or barrel is generally first placed. This is held to the proper elevation by piers, or saddles, separately cast, and the tops set to grade. The steel is next placed, and then the outer forms.

Care must be exercised to prevent the form floating or rolling and in filling the bottom. The bottom is sometimes cared for by placing grout tubes, or by simply smoothing up after the removal of the forms. In a number of conduits on the reservoir work a board was left off the outside forms just above the invert, and through this opening the bottom was successfully filled by tamping. The filling of one side and allowing the concrete to run under and seek its level on the opposite side, thus assuring filling in the bottom, is rather dangerous practice as there is great chance of moving the inside form or barrel.

The by pass conduit, shown in Fig. 6, is 7 ft. in diameter and about 1,200 ft. long, built in 36-ft. sections, contained 48.8 cu. yds. and 3,600 pounds steel per section, and was built after the roof of the reservoir was in place, the piers and roof being used to brace against. The barrel was placed on concrete saddles and painted with cold water paint. The reinforcement was next placed, and then the outside forms. The braces were all fitted and marked, and they, together with all except the bottom outside form, were removed and stored conveniently for easy access. The barrel was held down by braces to the roof and held laterally by braces to stringers placed along the piers. When the concrete reached the level of the top of the bottom form, the second form was placed, and so on until the top was reached. After the concrete was placed to a depth level with the top of the barrel it was found that there was no tendency to rise and the braces to the roof were removed.

Trouble was experienced with the first three forms; they

Table I.—Cost of Forms for Piers Supporting Groined Arch Reservoir Roof; Total, 12.68 Cu. Yds. of Concrete in Four Piers.

Item.	Total.	Per Cu. yd.
Stripping, 13 hours, carpenter at 25 cents	$ 3 25	$0 27
Cleaning, 15 hours, laborer at 15 cents..	2 25	$0 18
Making:		
15 hours, carpenter at 30 cents.....	$ 4 50	
15 hours, laborer at 15 cents.....	2 20	
Total	$ 6 75	$0 53
Setting:		
¾ hour, carpenter at 30 cents.....	$ 0 23	
1¼ hours, laborer at 15 cents.....	19	
¼ hour, cableway at 50 cents.....	12	
Total	$ 0 54	$0 04
Plumbing and bracing, 15 hours, carpenter at 30 cents	4 50	0 35
Grand total	$17 29	$1 37

Table II.—Cost of Forms for Barrel Arch Filtered Water Reservoir, Pittsburg, Pa.

Fabrication at Mill:	Total.	Per Cu. yd.
240 hours at 35 cents.....	$84 00	$0 31
Taking Down:		
1 foreman, 2 hours at 30 cents.....	0 60	
9 laborers, 18 hours at 20 cents.....	3 60	
Total	$ 4 20	$0 13
Hauling Out:		
1 foreman, 1½ hours at 30 cents.....	$ 0 40	
12 laborers, 16 hours at 20 cents.....	3 20	
Total	$ 3 60	$0 11
Cleaning and Repairs:		
1 foreman, 5 hours at 35 cents.....	$ 1 75	
4 carpenters, 20 hours at 30 cents.....	6 00	
2 helpers, 10 hours at 20 cents.....	2 00	
Total	$ 9 75	$0 30
Placing:		
Cableway, ⅓ hour at $2.....	$ 0 66	
1 foreman, ⅓ hour at 40 cents.....	0 13	
3 carpenters, 1 hour at 35 cents.....	0 35	
5 laborers, 1⅔hours at 15 cents.....	0 25	
Total	$ 1 39	$0 04
Trimming and Trueing:		
1 foreman, 10 hours at 35 cents.....	$ 3 50	
4 carpenters, 40 hours at 30 cents.....	12 00	
2 helpers, 20 hours at 20 cents.....	4 00	
Total	$19 50	$0 58
Grand total	$48 94	1 47

Table III.—Cost of Wall Forms, Filtered Water Reservoir, Pittsburg, Pa.

Fabrication in Mill:	Total.	Per Cu. yd.
110 hours, carpenters at 35 cents.....	$38 50*	$0.038
Taking Down:		
1 foreman, 10 hours at 35 cents.....	$ 3 50	
2 carpenters, 20 hours at 30 cents.....	6 00	
4 laborers, 40 hours at 20 cents.....	8 00	
Total	$17 50	$0.208
Setting Up:		
1 foreman, 10 hours at 35 cents.....	$ 3 50	
6 carpenters, 60 hours at 30 cents.....	18 00	
4 helpers, 40 hours at 20 cents.....	8 00	
Total	$29 50	$0.350
†Grand total	50 20	$0.596

† This does not include cost of material. * Used twelve times.

started to give during filling, but the knowledge gained in those mishaps was sufficient to show the weak points, and work progressed nicely until a change of superintendents placed a man in charge who decided to cut expenses, and the first forms built gave way. After that the work proceeded to completion without a mishap, and the test showed up very satisfactorily.

The forms in this conduit were all bolted together; the inside or barrel form collapses by dropping the top section. The time required to build one section was three days, and the time to fill it was seven hours.

The forms, including bracing, contained 6,350 ft. of lumber. The lagging was 1 in. Southern pine and the ribs 2 in. white pine. The cost of a 36-ft. section as compiled from a number of observations was:—

	Time	Rate	Cost	Times used	Cost per cu. yd.
Building forms at mill	489	$0.35	$171.15	10	$0.36
Carpenter work in field—					
Carpenter	227¼	.35			
Helpers	19¼	.20	83 39	1	1.70

including taking down, placing steel, etc.

Table IV.—Cost of Vaulting Forms for Filtered Water Reservoir, Pittsburg, Pa.

Making of Groins at Mill:	Total.	Per Cu. yd.
120 hours at 35 cents	$42 00*	$0 42
Setting Groins:		
1 foreman, ¼ hour at 35 cents	$ 0 09	
3 carpenters, ¾ hour at 30 cents	0 225	
6 laborers, 1½ hours at 20 cents	0 30	
1 cableway, ¼ hour at $2	0 50	
	$1.115	$0 14
Setting Corner Posts:		
Cableway, 1-10 hours at $2	$ 0 20	
3 carpenters, 3-10 hours at 30 cents	0 09	
	$ 0 29	$0 03
Intermediate posts, 3 carpenters, 1½ hours at 30 cents	$ 0 45	
Shoring piers, 2 carpenters, 3 hours at 30 cents	0 90	$0 11
Trimming and trueing, 4 carpenters, 3 hours at 30 cents	1 20	$0 15
Taking Down Groins:		
1 foreman, 1⅓ hours at 30 cents	$ 0 40	
5 laborers, 6⅔ hours at 20 cents	1 35	
5 laborers, 6⅔ hours a 15 cents	1 00	
Total	$ 2 75	$0 33
Grand total	$10 20	$1 22

The forms for the seven-foot filtered water conduit, shown in Fig. 6, is a good example of form work for a conduit in a trench. In this conduit no outside forms except one on either side of the top was necessary. The sections were 30 ft. in length, contained 22 cu. yds. of concrete and 2,660 pounds of steel. One foreman, four carpenters and four helpers took down the back forms, set them up ahead and placed the steel ready for filling at the rate of one section a day. Two sets of forms were used, and they were removed the following day as early as ten o'clock, thus while filling one section another was being prepared. The cost of setting up the forms and placing steel was $1.15 per cu. yd. and the cost of bending steel 40 cents per 100 pounds.

The 48-in. conduit was a plain circle inside with perpendicular sides and semicircular top outside. The drain was located in a 21-ft. fill, placed in sections varying from 20 ft. to 50 ft. in length, and contained 0.387 cu. yd. of concrete and 35 pounds steel per lineal foot of conduit. The forms were built in the mill and used six times in the field:—

	Per Cu. yd.
Lumber	$0 72
Mill work	30
Bending steel	26
Carpenter work in field	2 13
Total	$3 41
Total cu. ft. of drain	1.59

DEVELOPMENT OF STEAM POWER PLANT MACHINERY.

E. H. Sniffin.

The year 1910 has witnessed a very substantial progress in the development of power plant machinery. The Westinghouse Machine Company's contribution to this development has been in new designs of steam turbines, in the extension of its condenser work, and in the application of small turbines to auxiliary purposes, such as operating small generators, boiler feed pumps, etc. It has also brought out the Melville-Macalpine gear for use between turbines and direct-current generators. This device makes possible the use of exhaust steam turbines in connection with slow speed direct-current apparatus. It also enables high-pressure condensing turbines to be employed for driving large sized direct-current generators. Embodying, as it does, very small mechanical loss, two per cent. or less, it permits of the use of the most efficient design of turbine in connection with an efficient direct-current generator. Ordinarily, if the turbine and direct-current generator are direct-connected, it must be at some sacrifice of turbine efficiency, or if the direct current be derived from an alternating-current unit through rotary converters, that also is done with considerable loss in transmission. So the Macalpine gear, where its applicability obtains, adds quite materially to plant efficiency.

Perhaps the most beneficial work done by the Machine Company, in the way of reducing operating cost, has been the very extended application of its exhaust steam turbine. This has particularly occurred in power plants used to operate industrial establishments. Frequent opportunities occur of obtaining increased power by adding to an existing reciprocating engine plant the exhaust turbine, employing to operate it the exhaust steam otherwise going to waste or inefficiently employed, and it is not uncommon to find returns of from 33 to 50 per cent. upon the exhaust turbine investment. It is, moreover, a very simple piece of apparatus, characteristically free from trouble, and by designing it so that it may operate either with exhaust or live steam, it takes nothing from the flexibility of plant operation, oftentimes greatly improving that feature.

The machine company has done enough if it has contributed its share to the great reduction in cost of power plant construction during the last eight or ten years. The prime mover unit itself has been reduced perhaps two-thirds from its cost of ten years ago. The larger units now made possible have brought up the size and reduced the cost of

boilers. Condensing apparatus has been made more compact and efficient and lower in cost, and turbine-driven auxiliaries generally employed. The net result has been a general reduction of power plant investment to something like 50 to 60 per cent. of the valuation that we were formerly accustomed to place upon such properties. Thereby the operating company has enjoyed a radical reduction in fixed charges, has been placed in better position to afford the introduction of improvements, and has witnessed at the same time a material reduction in operating expense incident to the more simple character of its generating apparatus. And the writer believes that the machine company's efforts in the past year, with its high-speed turbine development, and with its other new work above noted, have been fully as potential in this direction as any year's accomplishments in its history.

ROADS AND PAVEMENTS

TO WHAT EXTENT DO AUTOMOBILES DESTROY OUR ROADS?*

By Logan Waller Page, Director United States Office of Public Roads, Washington, D.C.

This question and its immediate sequel, "What shall we do to prevent this destruction?" are the summing up of the most serious problem with which road builders have now to wrestle, and with all the discussions as to "cause" and "remedy" which have taken place in recent years, we cannot yet feel that we are any more than fairly started on the way to a solution of the problems.

In considering the injurious effect of motor traffic on our roads, I shall confine myself to a consideration of what has always been considered our highest type of construction, the broken-stone road, as first specified by the eminent French engineer, Tresaguet, in 1775, and later improved upon by Telford and Macadam. The principles involved in their methods of road building really depended upon the wear of traffic for the preservation of their roads. They had to contend only with horse-drawn vehicles, and the dust which was constantly being worn from the stone acted as a filler in the road surface, and under the action of moisture formed a cementing medium between the stones. Therefore, in a well-constructed macadam road, where the selection of stone was suited to the volume and character of traffic, the fine dust resulting from wear was just sufficient to replace that carried away by wind and water; the action of water caused this remaining dust to re-cement, and the surface was thus automatically rebonded. Moreover, the road surface remained practically impervious to water and the foundation was protected.

The advent of the automobile has, however, completely changed conditions, and the seriousness of the problem becomes more impressive when we consider the rapid advance in the production of motor-propelled vehicles. It was estimated that on November 1st, 1908, there were in the United States about 150,000 automobiles. The output in 1908 was 55,000 cars, for 1909 about 80,000, and it is anticipated that the close of the current year will have seen a year's production approaching the 200,000 mark. And, whereas the early output went largely to the large centres of wealth, and were looked upon as a rich man's latest luxury, we now find the automobile in common use throughout the length and breadth of our country, not a luxury, but a necessary means of daily travel for the business man and the farmer, who is the better enabled to cover his often widely distributed property. It has, therefore, come about that the smallest community is face to face with the problem of meeting the new conditions brought about by these changes in the character of traffic passing over their local highways.

* Read before the Southern Appalachian Good Roads Association.

There has been much discussion from time to time as to the reasons for the destructive action of automobile traffic, but I think the series of experiments conducted by the Office of Public Roads has given some most interesting and conclusive results, which, although previously published, will bear repetition in the present instance. A 60-horse-power car, stripped for racing, and weighing with driver and mechanism about 2,800 pounds, was driven over a stretch of level, broken-stone road, first at five miles an hour, with increasing rates of five miles an hour until a speed of sixty miles was attained. The road was a section of government road, which had been resurfaced two years previous to the test, and was in good condition. Photographers were stationed at a point on the road designated for the proper speed, and photographs were taken of the effect produced during the passage of the car. It was evident from a consideration of these photographs that up to fifteen miles an hour little or no effect was produced on the road, and even at twenty miles an hour the observers concluded that no serious damage was done. From twenty miles an hour on, however, the effect was decidedly noticeable with each increase of speed, and the dust is often lifted from the road by the severe shearing stress of the driving wheels, which I have compared to the action of a circular saw going through a board. Once lifted from the road, this fine material is subjected to the effect of air currents generated by the car body, and subsequently by the wind. Thus, large quantities of the very material that is essential for bonding the road together are rapidly carried away, the wearing stones are soon left bare and loose, and subject to displacement, water finds its way into the body of the road, and a general deterioration rapidly sets in. It is, therefore evident that the most serious damage to our roads as a result of increased motor traffic is due to the shearing stress of the rear wheels on the road surface when the machine exceeds a speed of twenty miles an hour.

There is another source of injury. which is not so serious, for the reason that it is confined to rather sharp curves and easily overcome. This is the tangential stress or tendency of the car to skid in rapidly rounding a curve, thus shifting the crown of the road tangentially to the gutter. This difficulty may be obviated by raising the outer side of the road.

But, while the automobile is continually lifting the valuable binding material from our roads, and causing injury to crops, property values, and even the health of the neighboring communities, it is doing absolutely nothing toward replacing the dust so distributed. The principles of Macadam and his predecessors are set at naught, for whereas the iron-tired, horse-drawn vehicles of other days caused a continual replenishing of dust, the motor-driven car, with its pneumatic tire, is practically without any wearing effect on the road stone. As motor traffic increases, a point is reached where the type of road has to be changed, and this point varies with the volume of horse traffic and the volume and speed of motor traffic, a condition in part brought about by

a failure of the motor vehicle to produce sufficient wear on the road surface.

It is those who have the building and maintenance of our rural highways who are most seriously affected by this great problem. It is comparatively easy to control the speed of motor traffic through our larger towns and over the park systems of our cities, and it is admitted that at low rates of speed the motor vehicle is no more injurious to the road than ordinary traffic. But, in the open country, where we have the grinding action of the iron tire and heavy load followed by the high-speed automobile throwing up and distributing the products of wear, we are confronted with the necessity of providing a new and more durable form of road.

For several years past highway engineers and chemists have been uniting their efforts in attempts to solve this problem, and, generally speaking, have experimented along two lines, either to add some palliative to the surface of the road, in order to hold the dust, or else to construct the road with the use of some binding material that will hold the stone in place. Water was the original dust-layer, but its continual application is costly, especially on long stretches of open highway, where facilities are not always at hand for securing water. The addition of hygroscopic salts to the sprinkling water was then tried with the object of having the salt retain the water in the road surface, and in this respect calcium chloride has proven fairly successful, although even this very hygroscopic salt has a tendency to dry out unless the climate is quite humid. The lighter residual oils and tars have been used in holding down the dust with varying success, dependent on the quality of the material, its method of application and adaptability to the character of the road in question. And right here it may be said that, while I do not think a fully satisfactory solution of our great problem has been reached, it is an unquestionable fact that a large percentage of the failures to date has been due to the application of inferior materials, deficient in certain well-known necessary characteristics or to the use of good products in conditions to which they are not adapted. There has been a too general acceptance of the fact that any oil or tar is a good dust preventive or road-building material, and that whatever the eager salesman guarantees (?) must be good and fulfil all the claims he makes for it.

While results from surface treatment can only be regarded as temporary, lasting, perhaps, in the case of proper oils or tars, throughout a season, more permanent results have been secured through the application of some of the heavier bitumens during construction. These may be applied either by heating and mixing with the upper course of stone before spreading, known as the mixing method, or by pouring the hot bitumen into the upper course of stone after it has been shaped, known as the penetration or grouting method. The former is the better way, in that a more uniform distribution of the binder is secured, but the method involves considerable expense, as well as time, especially where a proper plant is not available and the mixing has to be done by hand.

By working along those lines we have certainly bettered conditions and produced a highway better fitted to resist the ravages of modern traffic, but there is much work ahead of us before we can say that we have wholly solved our problem. Automobile production is increasing with rapid strides, the distribution of cars is becoming daily more general, and, whereas almost the entire output of cars has until now been largely for passenger transportation, I believe the next ten years will witness a great development in freight transportation. In England large quantities of food are transported to the city of London in trains of cars drawn by traction engines, and these trains return to the farms with supplies. The value and economy of motor transportation for freight in cities has been demonstrated, and the economy of building roads over which it can travel in the country will become more and more evident to taxpayers in rural districts. And, while there is a tendency on the part of many severely to arraign the automobile for its destructive action on our public highways, they should not lose sight of the other phase of the subject, which is worthy of serious thought. The application of mechanical arts to our daily convenience and comfort must necessarily introduce new problems which require long and patient experimenting for their solution, but, when solved, are apt to produce a betterment of conditions that might otherwise not have been reached. So the motor vehicle, while tending to destroy our broken-stone roads, has had an improving influence, no only in the building of many miles of better highways, but in rendering most urgent the study of road improvement and preservation. The dust nuisance antedated the automobile by many years; if our experimental work leads to success, it will demonstrate the really beneficial effect to ourselves and posterity that motor traffic has had upon the development of the art of road building.

ENGINEERS' CLUB, TORONTO.

Address of Mr. C. M. Canniff, Retiring President.

One of the duties—it would appear—of a retiring president is to cudgel his brain and attempt that hardest of tasks: to say "Good-bye" more or less gracefully.

Although most likely it will be a sad case of the minus sign, certain thoughts possess me, born of the important step onward recently taken by our club. I think first of all, we should be extremely gratified at the most satisfactory report which your directors have been enabled to present this evening. There seems—be we as conservative as we please—nothing on the horizon to forecast anything but the brightest of futures.

It may surprise some of the members that as far back as 1887, I recollect discussing off and on with the late County Engineer, James McDougall, just such a social organization as now we can boast, and well I remember our glee, when, chiefly through Mr. Chipman's efforts, the first meeting took place at the old School of Practical Science in 1889. So you will see that getting where we are now has been a long drawn-out proceeding.

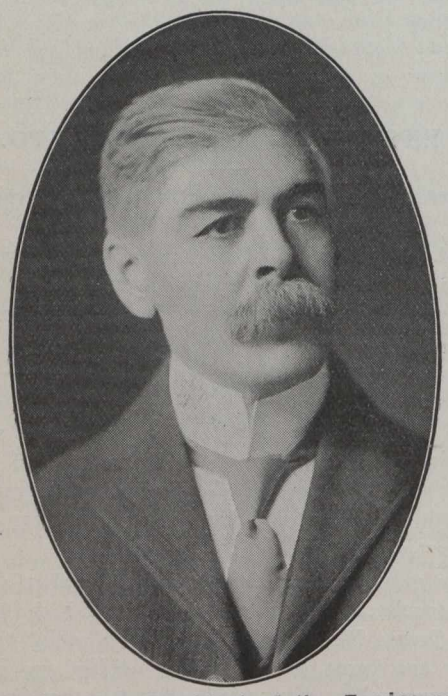
The abode we have acquired—in whatever manner and after whatever vicissitudes, time is too short to go into details—is not not very extensive nor exactly sumptuous, but the appointments can be viewed with pardonable pride, and that they are within our means redounds to our credit. We can re-echo Sir Wilfrid Laurier's sentiments upon the new navy: "It is small, but it is our own!"

A convience at first, the Engineers' Club is largely destined to become a necessity; and certain of us have loftier ambitions for a palatial structure belonging to us, and I think a standing committee—now that we have made a good start—should at once be appointed to that end. The second side of the bread takes less time to toast, we can always count on that. The stranger within our gates, as well as fellow-citizens, should be impelled to pause and enquire: "What building is that?" and as answer receive: "That, sir, is the local habitation of the engineers and technically trained men."

Publicity pays; it pays to advertise. The time is ripe. We should remove the muffler and let the noise of our fame go abroad throughout the land. The importance of our allied professions in the community could not but be emphasized for the enquirer and also the prominence of Toronto as a professional centre. And when, gentlemen, I use the word "publicity," let me hammer it home.

Somebody has said the engineers will never amount to tuppence until they can act as host. Is this nonsense, or perchance it is the ultimate crystallization of a whole bulk of shrewd, true, business reasoning? When Julius Caesar—you may remember—was lampooned by Cabullus, he invited him to supper and made him his friend everafter. Look to other men and play the game—play their game. Engineers—and although for brevity throughout these remarks I use the word "Engineers"—all the allied professions: architects, surveyors, etc., may take the lesson to themselves, I think, can no longer afford to be out of step with the others on our main streets.

Round about us, we now have suitable facilities for returning the civilities and courtesies of our brethren in other



C. M. Canniff, Past President of the Engineers' Club.

cities, for extending a social hand, one to another, or to the business man with whom we are transacting affairs, for properly entertaining visiting technical organizations.

In our paper-reading section, we hope to secure addresses on a higher and more interesting plane than formerly, whilst probably sufficient funds will now be available to defray the expenses of well-known out-of-town speakers, who we may desire to hear on subjects of particular moment. A large room, over 80 feet x 80 feet, immediately adjoining our present dining room, is available, when we can afford and seem to require it, and therein—leaving the dining room free for other uses—it is neither impossible nor unlikely that we might take the Canadian and Empire Clubs as exemplars, and arrange weekly luncheon addresses by eminent men on subjects of general technical interest, and so enhance the popularity of the club. I am convinced that we and the allied professions would decidedly benefit by the publicity. The press leads the people, and the big point is that the press would at last take us seriously. The ideas or arguments offered would be big enough and broad enough—valuable and imprejudiced—with the weight and force, to give them merit for the public press. Publicity pays—let me repeat it—publicity so loud and insistent as to wake the seven sleepers!

I do not know if I keep longer on this tack, but you will say I am lecturing you. But, as the poet has it:

Fear not the anger of the wise to raise,
Those best can bear reproof who merit praise.

Modern civilization, gentlemen, has been made possible only by the work of the engineer; our removal from mediaeval semi-barbarism is measured by the advances made in our profession. If, as a club, we are to attempt to do anything tending to the advancement of engineering, a part of that work surely consists in the manifestation of a lively interest in the public engineering and other technical problems of our own community, province, and country. Only the other day the city engineer of Toronto was peremptorily ordered by a popular lawyer-mayor to do impossible engineering connected with our water supply; not many miles from North Toronto—so the thistledown rumor sails along—is a canal under construction, which, when completed, will not hold water at all; two small items of scores that might well come within the purview of such a body of ours. I have no knowledge, of all the costly improvements proceeding in the city or about it, that any opinion whatsoever, has once been expressed upon the advisability of such expenditures from an economic or utilitarian point of view, or that any action ever has been taken whereby the club, as a body, has declared itself upon the expediency of such public works from an engineering standpoint. The Board of Trade does it, the Canadian Manufacturers, the Guild of Civic Art, etc., have been known to interest themselves from their own standpoint in similar matters, and thereby have compelled recognition as important factors in the city's life, but totally lacking has ever been any similar action by the Engineers' Club, as a body,, stamped as it would be, with the approval of an organization of men qualified to pass upon the question at issue, and carrying with it that dignity, which would command the moulding of public opinion. All the world loves a doer, the old saw should run. As we all admire a man who proves himself capable of achievement so do men take pride in their identification with a progressive organization. Thereby should we prosper.

Now, without being wishful to branch at all upon the point of the generally conceded rules of individual progressional etiquette or ethics, I submit that nothing prevents this suggestion metamorphosis from our old time placid ultra-conservatism, from our tongue-tied apathy, and if for nought else than that we may leave behind our life of mediocrity, where we have apparently hedged ourselves about with a triple wall of reticence and precaution.

The new regime should mean a change from archaic conditions, where all activity centred about a few and the main body of the club, was a clay-cold unleavened mass, giving little or no response, and evincing no enthusiasm.

May I ask, by the way, is it merely a coincidence that simultaneous with the assurance of an expended club, came to the fore, a suggestion with the result that a main committee representing the Engineers' Club, the two architectural bodies, the Board of Trade, the Canadian Manufacturers, the Builders' Exchange and various contractors, have even now nearing completion a proposed revision of the civic building by-laws for submission in due time to the Board of Control? A good start has already been made.

Then I need not remind you that the City Council and other local bodies have an unfortunate habit of summoning

to counsel professional gentlemen from outside rather than available local men, or an advisory board of several eminently well qualified for the services required. It is time we got over the cry-mercy stage and asserted ourselves. Is our club not going to prove influential enough in its new suit of clothes to ameliorate this condition? None of us would care to assume the sorry role of the selfish miller who begrudged every drop of water that went past his mill, but there should be a limit to the philanthropy of those who spend our taxes.

The club should take its place in the city's activities; it should be a power in the community, and exercise by practical up-to-date businesslike methods to the fullest extent the moral force—the moral force—behind the professional ability in the club.

Then, too, with a permanent secretary, all the machinery for an employment bureau is to hand. The tacking up with much trepidation, of a notice; "Wanted—Situation as draughtsman," to be seen by a random caller, will cease to be the disheartening proceeding it was to the technically trained sufferer from the ninety-nine plagues of an empty purse. Our club should prove a clearing-house for ideas and information on all matters affecting us. The enlarged technical library—one worthy the name—which we have begun to gather under Mr. Hare's capable direction—cannot but greatly conduce to our professional good.

The non-resident engineer, architect, surveyor, etc., upon coming to town will now know whether to wend to meet his kind, whilst the offered opportunities for a business trysting-place or for attending to correspondence, should win approval.

Not the least worthy result of the improved club lies in the likelihood of its being the incentive to getting out the prominent and older architects and soforth engineers there being a very human desire cherished by the man below the salt to meet and enjoy the benefit of acquaintance with the prosperous gentlemen "up the line."

For the graduated student it should prove the greatest boon, as he will find here, should he lack friends or influence, a short cut to congenial employment, besides being surrounded by the proper influences—getting the note from the tuning fork—as it were, for his further progress in his calling, and to indicate what is expected of him. It is worthy of mention perhaps, that to him also, together with grip and pass-word should come something of the rounded-off-corners condition, something, for instance, of the general self-confidence (not alone in public speaking though that is an important point too) lack.

And now in conclusion, gentlemen, if you please, we are living in the Twentieth Century. Like unto the Psalmist, we each can say with all reverence, "The lines are fallen unto me in pleasant places; yea, I have a goodly heritage." We are Canadians all, by birth or adoption, and Canada as a greater British statesman has said, is the Keystone of the Imperial arch—the mightiest expression of Colonial loyalty * * * for she was founded by exiles whose ideal was a United Empire. The long, lean years when Canada was a poor relation, when all England's frown was for her, and all her smiles were for the United States, is as a tale that is told and as a fire that is quenched. The Canada of bursting granaries and a present prosperity unparalled has been set on a hill. The world's great eye is focussed upon us. The vast unexploited riches of public domain, the strong tide of immigration—as rivers running to the sea, the influx of capital on an unprecedented scale, all these voice their own story that at last the Dominion is coming into its own, and henceforth is to go forward with the assured and mighty stride of a giant. Remember that this is the day of the young nation, no less than that of the young man. And the Twentieth Century belongs to Canada. Remember, also, deny it who will, brothers versed in cultural lore, brothers skilled in the statesman's craft or commercial cunning, that the century's thought by natural processes has begun with a strong preference for facts as against fancies and that the world folk of civilization are exalting substance over form; in other words, that the Twentieth Century belongs also to the engineer, to the scientifically trained worker.

Prophecies recently made by shrewd authorities place Toronto's population at a million, within 15 and 20 years respectively. Even now it boasts a greater postal revenue and customs returns than any other Canadian city. Back of us in New Ontario there are still sixteen million acres of virgin soil, of splendid agricultural value, 300,000,000 acres of pulpwood. Realize the record of Cobalt, the possibilities of South Lorraine, of Montreal River, Gowganda and Porcupine—and lo! the prospector not really started on his town yet. The province leaves the world in the production of nickel, and produces even now 12 per cent. of the world's silver—much of its mica and corundum—all this as sure as that the needle's eye bars the camel.

So Toronto is to be a veritable Queen City, if signs count at all. One hundred and ten years ago, the River Clyde was 18 inches deep where the women and children crossed the fords; to-day it takes to its bosom the giant warships of Britain. Is this a portent of the time when feasible improvements in canalization are to give twenty feet draught from Toronto harbor clear into the heart of England? What an array of potentialities!

Please look ahead and tell me what the greater Engineers' Club of Toronto, that we have succeeded in launching so auspiciously is going to be in ten, yes, five years.

May each and every one of us be here to see and to marvel, is my farewell wish!

THE ENGLISH TELEPHONE SITUATION.

(Continued from page 316.)

subscribers to the two systems operating within the London district have been practically indentical, and the two systems are intercommunicative.

As the termination of the National Company's licenses approached it became necessary for the Government to decide whether it would purchase the company's plant or undertake to set up an entirely new plant of its own to serve its future monopoly of telephone communication. All practical reasons pointed to the taking over of the company's plant as the best course, and in 1901 the post-office reached an agreement with the company for the purchase of its plant within the city of London at the expiration of its license. In 1905 another agreement was made between the Postmaster-General and the company providing for the purchase of the company's entire plant. By the terms of this agreement the post-office is to buy and the company is to sell on the 31st day of December, 1911, the entire plant of the company, which is in use under the sanction of the Postmaster-General for the carrying on of the company's licensed telephonic business. Control of the company's plant and of all income from its service is to pass to the post-office on December 31st, 1911, regardless of whether all details of purchase price have been then agreed upon or decided by arbitration. Provision is made by which the Government is allowed to pay three-fourths of the purchase price at its own option, or with the consent of the company, the whole purchase price, in annuities extending over a period of twenty years.

The agreement for the purchase of the company's plant contains certain provisions as to the method of reaching the valuation which call for expert advice, such as the Jackson firm will be called upon to give. The agreement defines the value of the plant as "the value on the 31st of December, 1911, (exclusive of any allowance for past future profits of the undertaking, or any compensation for compulsory sale or other consideration whatever), of such plant, land, buildings, stores and furniture, having regard to its suitability for the purposes of the Postmaster-General's telephonic services." The phrasing of the agreement on this point repeats the language of the decisions to the House of Lords upon the interpretation of the Tramway Act of 1870. This decision uses the term "then value;" and applied to the present undertaking the decision is to the effect that the price to be paid by the post-office is the sum which it would cost to replace the plant on the date of purchase diminished by the money expense of the depreciation of plant during its time of use.

The general problems, therefore, are before the Government in reaching a valuation of the National Company's plant. One of these problems is the present value of the various parts of the plant computed according to the rule thus stated. The other problem is the extent to which the valuation and the obligation to purchase may be affected by the fitness or unfitness of various parts of the plant to the conduct of telephone business under the purposes of the Postmaster-General. The decision of this point evidently hangs on various large matters of policy. Within the city of London, for instance, the company has many overhead conductors, and it is likely that the post-office would substitute underground cables in place of these. Such a policy would leave the overhead wire much reduced in value.. A large portion of the company's instrument equipment is naturally of the magneto type, which is being rapidly superceded in this country and has been to some extent in England.

An agreement on price is to be reached if possible between the Postmaster-General and the company. Failing such agreement, the matter will be arbitrated by the Railway Commission.

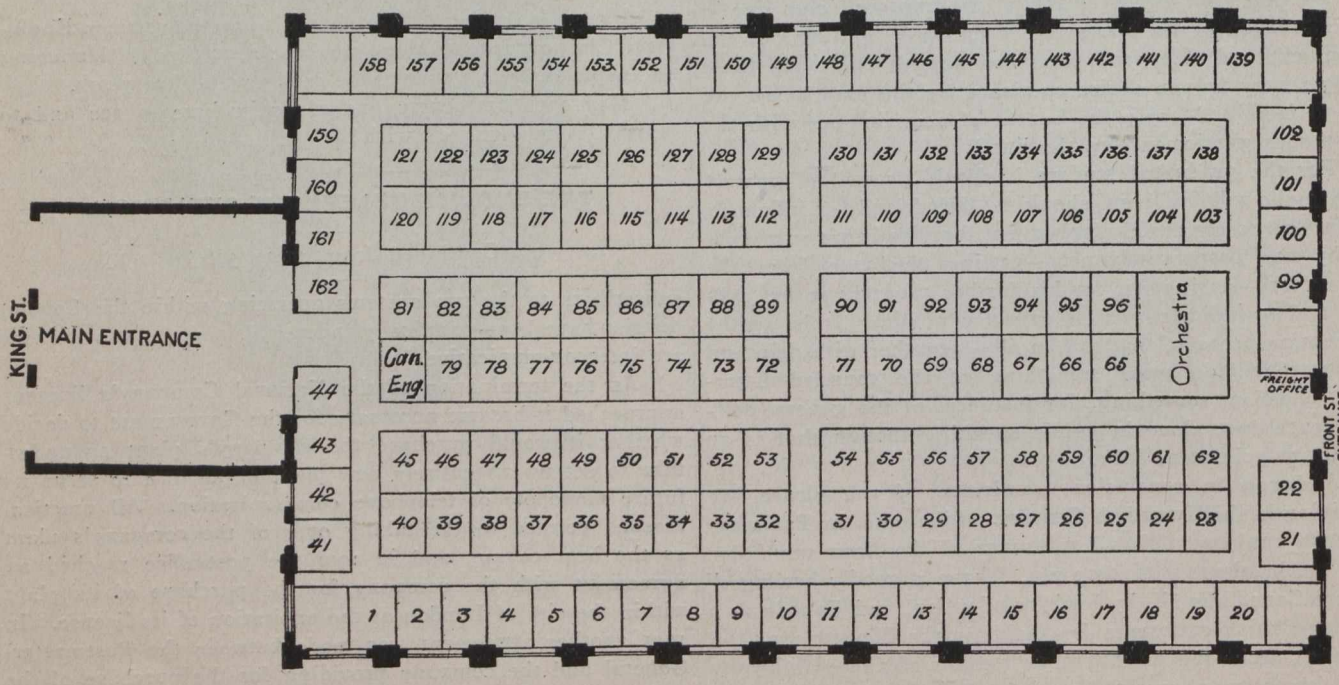
NEW INCORPORATIONS.

Oshawa, Ont.—Pedlar People, $500,000. M. H. Ludwig, A. W. Ballantyne, C. F. Ritchie.

London, Ont.—London Motor Sales Co., $40,000. C. Abbott, H. J. Sutherland, A. M. Heaman.

Toronto.—British and Colonial Land and Securities Co., $1,000,000. Col. Sir Henry Pellatt, Col. J. Mason, H. S. Strathy, J. M. Gibson. Jarvis Sanitary Filter Co., $40,000. H. S. Murton, T. D. Archibald, F. H. Russell. Ross Motor Car Co., $40,000. W. J. Ross, G. N. Shaver, R. B. Law. Chapman Brick Co., $40,000. C. Chapman, Misses C. L. Chapman, L. M. Chapman.

PLAN OF ST. LAWRENCE ARENA.



THE CANADIAN CEMENT SHOW, MARCH 6—12.

The accompanying cut indicates the layout of the St. Lawrence Arena where the 3rd annual exhibition conducted under the auspices of the Canadian Concrete and Cement Association will be held.

The "Canadian Engineer," anxious that their booth shall be located as conveniently as possible for the use of their friends have selected booth **No. 80,** and here files of the paper may be consulted and a representative will be present to assist visitors at the Show in any way that we can be of service to them.

If you purpose being a visitor or an exhibitor at this exhibition, and if we can now be of any use to you in making further arrangements for your trip to Toronto in March, we would be pleased if you would communicate with us.

The Book Department of the The Canadian Engineer will have at this booth a number of the best and latest books on concrete work, our purpose being to make it easy for the man interested to learn what is being published on Concrete and Reinforcements.

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., apartment block	Feb. 18.	Feb. 2.	269
Calgary, Alta., brick and stone building	Feb. 16.	Feb. 2.	269
Dauphin, Man., two bridges	Feb. 25.	Feb. 9.	54
Eglinton, Ont., electric light poles	Feb. 16.	Feb. 9.	70
Fort William, Ont., cedar poles	Mar. 2.	Feb. 9.	300
Montreal, Que., dredging plant	Feb. 22.	Feb. 9.	300
Monterrey, N. L., Mexico., gas plant	Mar. 1.	Feb. 2.	66
Mount Laurier, P.Q., water supply	Feb. 20.	Jan. 26.	65
Ottawa, Ont., wharf at Ste. Famille	Feb. 20.	Jan. 26.	235
Ottawa, Ont., marine boiler	Feb. 15.	Jan. 12.	66
Ottawa, Ont., departmental bldg.	Feb. 28.	Jan. 5.	131
Ottawa, Ont., schooner	Mar. 1.	Feb. 9.	300
Ottawa, Ont., motor trucks	Mar. 17.	Feb. 9.	300
Ottawa, Ont., public building at Listowel	Feb. 27.	Feb. 9.	300
Ottawa, Ont., public building at Tillsonburg	Feb. 28.	Feb. 9.	300
Pincher Creek, Alta., issue of debentures	Feb. 20.	Feb. 9.	54
Quebec, Que., railway	Mar. 2.	Feb. 9.	70
South Middleton, Ont., schoolhouse	Mar. 15.	Jan. 12.	163
Strathcona, Alta., engine, boilers and generator	Mar. 1.	Jan. 26.	65
St. Catharines, Ont., pipe and specials	Feb. 28.	Feb. 9.	70
Toronto, Ont., right to cut pulpwood	Apr. 10.	Jan. 19.	203
Toronto, Ont., wing in General Hospital	Feb. 18.	Feb. 9.	300
Victoria, B.C., supply of valves and pig-lead	Mar. 3.	Feb. 2.	269
Welland, Ont., Robertson Machinery Company	Feb. 21.	Feb. 9.	300
Winnipeg, Man., supply of asphalt	Mar. 1.	Jan. 26.	235
Winnipeg, Man., conduit system.	Feb. 22.	Feb. 9.	70
Winnipeg, Man., motor car	Mar. 3.	Feb. 9.	54

TENDERS.

Fredericton, N.B.—Tenders will be received until February 27th, 1911, for the construction of a sea protection wall at Mace's Bay, in the parish of Lepreaux, Charlotte County. John Morrissy, chief commissioner of public works, Fredericton.

Fredericton, N.B.—Tenders are called for up to March 6th prox. by the Department of Public Works, for building the concrete substructure and approaches of Tracy Station bridge over the N. W. Oromocto River, in Gladstone, Sunbury Co.

Montreal, Que.—Tenders will be received until February 20th, 1911, for fireproof construction of a double school, and two private residences for teachers. Alphonse Content, architect, 11 and 17 Place d'Armes Hill, Montreal.

Brockville, Ont.—Tenders will be received until February 21st, 1911, for the various trades required in connection with alterations and improvements to be made to the Old Fellows Block, corner of King and Apple Streets, Brockville, Ont. B. Dillon, architect.

Ottawa, Ont.—Tenders will be received until March 1st, 1911, for the construction of a public building at Mitchell, Ont. R. E. Desrochers, secretary, Department of Public Works, Ottawa.

Ottawa, Ont.—Tenders will be received until February 21st, 1911, for the following improvements to the armory property at Joliette, P.Q.: Cement sidewalk, roadway, runway for carts over sidewalk, levelling and seeding, ornamental iron fence and wood fence. Eugene Fiset, Col., Deputy Minister of Militia and Defence, Ottawa.

Ottawa, Ont.—Tenders will be received until the 15th day of February, 1911, for the construction of a magazine building and an explosive store building at London, Ont. Eugene Fiset, Col., Deputy Minister of Militia and Defence, Ottawa.

Ottawa, Ont.—Sealed tenders will be received until February 21st, 1911, for the construction of two ice piers at Annapolis Royal, Annapolis County, N.S. R. C. Desrochers, Department of Public Works, Ottawa.

Ottawa, Ont.—Tenders will be received until March 8th, 1911, for the construction of a wharf at Le Petit-Debarquement, County of Montmorency, Que. R. C. Desrochers, secretary, Department of Public Works, Ottawa.

Ottawa, Ont.—Tenders will be received until February 24th, 1911, for the supply of some 200,000 barrels of cement. L. K. Jones, Sec. Dept. of Railways and Canals, Ottawa. (Adv. in the Canadian Engineer.)

Brantford, Ont.—Tenders will be received until March 2nd, 1911, for the supply of sewer pipe. T. Harry Jones, city engineer, City Hall, Brantford. (Advertisement in the Canadian Engineer.)

Toronto, Ont.—Tenders will be received until February 18th, 1911, for the various trades required in the erection of the building for the Broadview branch at No. 275 Broadview Avenue. Burke, Horwood & White, architects, 28 Toronto Street.

Toronto, Ont.—Tenders are requested for the erection of a freight shed on Yonge Street dock. Plans and specifications can be obtained at office of the Niagara Navigation Company, Limited, Traders Bank Building, 9th floor.

Fort William, Ont.—Tenders will be received until February 20th, 1911, for the moving of the present Isolation Hospital, and placing it in position on new site of Northern Avenue. A. McNaughton, clerk, Fort William.

Winnipeg, Man.—Tenders will be received until February 17th, 1911, for the erection of the Sterling Bank Building, corner Portage Avenue and Smith Street, Winnipeg. James Chisholm & Son, architects.

Winnipeg, Man.—Tenders will be received until February 23rd, 1911, for the supply of labour and materials required in the erection of a public bath house to be located in Selkirk Park. M. Peterson, secretary, Board of Control Office, Winnipeg.

Winnipeg, Man.—Tenders will be received until February 20th, 1911, for the building of superstructure of substation 1, on King Street, near Notre Dame Avenue. M. Peterson, secretary, Board of Control, Winnipeg. (Advertisement in the Canadian Engineer.)

Elstow, Sask.—Tenders will be received until the 18th day of February, for the construction of approximately seventy-five miles of rural telephone line, including instruments. Harold Young, secretary-treasurer, Elstow, Sask.

Calgary, Alta.—Tenders will be received until February 24, 1911, for the purchase by the city of a pile hammer. W. D. Spence, city clerk, Calgary.

Calgary, Alta.—Tenders will be received until the 20th day of February, 1911, for the supply of 200, more or less, 5 light ornamental posts. A. G. Graves, city commissioner, Calgary.

Calgary, Alta.—Tenders will be received until February 20th, 1911, for the erection and completion of a residence for Lieut.-Col. James Walker, at East Calgary. Lang & Major, architects, Suite 11, Board of Trade Bldg., Calgary.

Calgary, Alta.—Tenders will be received until February 24th, 1911, for the purchase of the fire apparatus now stationed in the Crescent Heights fire hall, including the following: Two double 45-gallon tank chemical engines, equipped as follows: 200 ft. chemical hose, 2 nozzles, etc., etc. W. D. Spence, city clerk, Calgary.

Gleichen, Alta.—Tenders will be received until March 16th, 1911, for the following:

1. Drilling and casting an eigh-inch well.
2. Supplying about 60 tons of cast iron pipes and specials, or alternatively an equivalent quantity of steel pipes.
3. Supplying and erecting an elevated steel tank.
4. Supplying gate valves and fire hydrants.
5. Supplying about 3,400 feet of vitrified tile sewer pipe.
6. Supplying manhole castings.

B. S. Corey, secretary-treasurer, Gleichen, Alberta. (Advertisement in the Canadian Engineer.)

Vancouver, B.C.—Tenders will be received until February 22nd, 1911, for the supply of brass goods and galvanized iron pipe for the city of Vancouver. Wm. McQueen, city clerk, City Hall, Vancouver.

Victoria, B.C.—Tenders will be received until the 21st day of February for wing, Court House, Vancouver. F. G. Gamble, public works engineer, Department of Public Works, Victoria.

Victoria, B.C.—Tenders will be received until March 3rd, 1911, for the construction of approximately 400,000 square yards of pavement. Angus Smith, city engineer, Victoria. (Advertisement in the Canadian Engineer.)

CONTRACTS AWARDED.

Fredericton, N.B.—The contract for rebuilding the Shaw bridge in Charlotte County was awarded by Hon. John Morrissy, chief commissioner of public works, to Councillor W. R. Fawcett, of Southampton, York County. The contract price was in the vicinity of $700.

Ottawa, Ont.—The following contracts have been awarded:—

Elora, Ont.—Post office fittings. Conractors: The Office Specialty Manufacturing Co., Ltd., of Toronto, $775.

Leitche's Creek, Cape Breton County, N.S.—Wharf. Contractors: Robt. and Barth. Musgrave, of North Sydney, N.S., $5,582.

Quebec Customs House.—Restoration of, and addition to. Contractors: Joseph Gosselin, of Lévis, and Emile Dubé, of Fraserville, P.Q., $135,369.

Gravenhurst, Muskoka District, Ont.—Wharf. Contractor: D. G. Stewart, of Ottawa, $12,984.

Seel Tug Boat for British Columbia.—Contractors: The Vancouver Shipyard, Limited, of Vancouver, B.C., $6,850.

Mount Forest, Ont.—Public Building.—Contractor: Geo. A. Proctor, of Sarnia, Ont., $17,666.

Port Burwell, Ont.—Breakwater. Contractor: M. J. Hogan, of Westmount, Montreal, $157,500.

Lindsay, Ont.—Post Office Fittings.—Contractors: The Deisenroth Contracting Co., of Toronto, $1,727.

Toronto, Ont.—Post Station "B." fittings. Contractors: The Deisenroth Contracting Co., of Toronto, $1,132.

Frech River, Ont.—Dam. Contractor: J. F. Boyd, of Sault Ste. Marie, Ont., itemized prices involving approximate expenditure of $13,365.

Pembroke, Ont.—The list of tenders received for intake pipe and force main, are as follows:—

Name of Tenderer	Intake Pipe	Force Main
Geo. Crowe & Son, Trenton, Ont.	$ 9,812*	$ 5,989
Emil Michel, Pembroke, Ont.	....	4,300*
J. F. Connolly, Toronto, Ont.	12,400	5,300
R. Browder, Ottawa, Ont.	13,000	4,452
E. Behan, Pembroke, Ont.	13,650	6,765
Ruthd. Cumming, Toronto, Ont.	14,490	.....
Leslie Contracting Co., Toronto, Ont.	17,690	.....
Ferneyhough & Barnes, Pembroke, Ont.	.....	10,492

*Accepted. T. Aird Murray, Consulting Engineer.

Hamilton, Ont.—The different contracts have been awarded by the Board of Control as follows: The Gartshore-Thomson Company was given the contract for cast-iron pipe; the Reinforced Concrete Company, Jackson, Mich., for 78-inch concrete pipe, at $7.22 per ft.; the Hamilton Foundry Company for castings, at $1.95 per 100 lbs.; the Canada Cement Co., cement at $1.48 a barrel.

Winnipeg, Man.—J. D. McArthur has been awarded the contract for completing the connection of the Algoma Central Railway from the present end of steel to a point on the main line of the C.P.R. The work will involve an expenditure of $1,000,000.

Winnipeg, Man.—The Winnipeg Electric Railway Company has awarded the contract to the General Electric Company for the plant for the new power station to be erected this summer. It will be installed in four units of 3,000 kilowatts each.

Edmonton, Alta.—The contract for the supply and delivery of hollow terra cotta partition tile required in connection with the new parliament buildings has been awarded to The Alberta Clay Products Co. Ltd., Medicine Hat, Alta., and the contract for angles required in the same work, has been awarded to The Steel Company of Canada, Hamilton, Ont.

Red Deer, Alta.—Jackson & Goldie, bridge contractors, of Winnipeg, Man., have been awarded the contract for the concrete foundations of the high level bridge over the Red Deer River at Red Deer, Alta. It is 2,110 feet long, consisting of a steel tower viaduct. This bridge is being built by the Alberta Central Railway. J. Grant McGregor, chief engineer.

Vancouver, B. C.—The contract for steel in connection with the B. C. Telephone Company's new exchange building was let to Messrs. Ross & Howard.

Merritt, B.C.—Messrs. Macdonnell, Gzowski & Company have secured the contract for the second thirty-mile section of the Kettle Valley Railway.

RAILWAYS—STEAM AND ELECTRIC.

Montreal, Que.—Canadian Pacific Railway officials expect to make great headway with their big dam at Bassano this spring. With the approach of warm weather, work on the main dam and the big ditches will be pushed forward at top speed. Four hundred teams of mules are at present being shipped by the chief contracting firm, Janse, McDonnell & Co., from Panama, to be put on the job, and it is stated that when operations are in full swing in the summer no less than a thousand teams and double that number of men will be at work. The site of the main portion of the work is on the Bow River, three miles below Bassano. Here, last year, the C.P.R. let contracts totalling nearly six million dollars, for the work of damming the river at the Horseshoe Bend, digging a main canal and diverting the water into Crawling Valley, a deep, dry coulee bearing off from near the Bow in a northeasterly course almost to the valley of the distant Red Deer. Construction work was started last fall and one of the first operations was the building of a pile bridge spanning the Bow River at the Horseshoe Bend. This has now been completed, the tracks have been laid and the last preparations are being made for the building of the great 7,000-foot dam. A huge concrete spillway is also being built, a coffer dam lined with steam piping to keep out the frost having been sunk across the river. The main canal will be two and one-half miles long, from the dam at the river to the point south of Bassano, where it debauches into Crawling Valley. The valley will form a part of the system for half a mile, when a second large dam across it will divide the system into two main arteries, the one leading to the northward and ultimately reaching the Red Deer River, the other to the southeast, serving the territory between the C.P.R. main line and the Bow. The former will cross the railway about a mile east of Bassano. The main canal and the concrete dam will require about two years to complete, and it is estimated that the total cost of the work will be about $12,000,000.

Montreal, Que.—Before bigger cars can be put on Wellington and Ontario streets to deal with the increasing traffic, the subways will have to be enlarged. Petitions asking that the enlargement be made have been sent in by residents of the two districts to the Board of Control, and Mr. Janin, the chief city engineer, has been instructed to report upon the feasibility and cost of the work.

Montreal, Que.—Quebec shippers are giving attention to the proposed new line of the Canadian Pacific Railway from that city to Presque Isle, Maine. The route from Montreal to St. John will not be materially shortened by the building of such a line by the C.P.R., but it will mean a saving in the present Quebec St. John route of about 160 miles. At present traffic from Quebec goes to St. John via this city, but if the C.P.R. bill, which is at present before the legislature, goes through an almost direct connection between the Ancient Capital and St. John will be established.

Montreal, Que.—The Canadian Pacific Railway has under consideration at present the continuation of the double tracking of the line westward from Medicine Hat to Calgary. The matter has not been definitely settled, but it is expected that an appropriation for the work will be made soon. The reducing of a number of grades is also under consideration. This will involve an alteration in the course of the line in some places. It is stated unofficially that the revision of the survey necessary for this work has been completed as far as Gleichen. It is also unofficially stated that the line will maintain its present location as far west as Langdon, and from there deviate southward and parallel the present line about a mile distant as far as the approach to Strathmore. Leaving Strathmore it may again leave the present line, going north of Eagle Lake, the present track lying south of this body of water. Should the appropriation be granted the work will probably be started this spring.

Montreal, Que.—A C.P.R. branch line near Princeton, B.C., from Midway to Spence's Bridge, is at present under construction. Forty-five miles of track have been laid east of Spence's Bridge and ten miles west from Midway. The road will follow the Tulameen river west from Princeton. The construction of this road will open up a fine district of agricultural land. Large lumber limits are in the neigborhood and also several promising mining camps. At Steamboat Mountain, close to the line, is a gold camp, for which assay values, it is said, have been running all the way from $6 to $3,600 a ton.

Ottawa, Ont.—After some discussion, a bill to incorporate the Mather Bridge and Power Company, passed the Railway Committee recently. The proposal is to extend the time for building a bridge across the Niagara at Fort Erie, and to suspend water-wheels beneath for power developments. Considerable money has been spent on the Canadian side, but the Washington Government has refused permission for the bridge to be built until a canal has been completed on the American side of the river, which will be three years yet.

Ottawa, Ont.—Mr. Graham has given notice of a resolution empowering the government to lease the St. John Valley Railway when it is completed for a period of 99 years and to operate and maintain it as a part of the government railway system of Canada. The rental to be paid for the line will be forty per cent. of its gross earning. The government of Canada is authorized to enter into a contract with the railway and with the government of New Brunswick, which will pay a subsidy of $25,000 a mile for the line between Grand Falls and St. John, a distance of 220 miles. The road is to be up to the standard of the National Transcontinental in New Brunswick.

Toronto, Ont.—Construction is expected to commence in about three months on the Canadian Northern Ontario Railway east from Port Arthur to overcome the gap in the system in new Ontario of 500 miles between Sudbury and Port Arthur. This report was current in Canadian Northern Railway circles recently. Location of the line has been completed, and it is intended to conduct the laying of the steel from both terminals. It will take about three years to complete construction and have the line ready for traffic. The railway will open up the clay belt of New Ontario for settlement. The company will begin the placing of settlers on the six million acres granted by the province in this clay belt for the building of the road shortly after construction has been started, and settlers will be brought out from the British Isles and the land sold to them on liberal terms. The company will obtain most of its laborers for the work from Great Britain, and many of these, it is expected, will settle on the land when the line is finished.

Toronto, Ont.—Port Mann will be the site of the car shops of the Canadian Northern in British Columbia, and it is intended to make this a model town. Lines will extend from it to Vancouver and to the delta of the Fraser River. The company has completed the preliminary location and grading on the line through the Fraser valley, and the contractors are now awaiting the arrival of two shipments of steel on the coast to begin track-laying. The British Columbia section of the system extends through the Yellowhead Pass to Kamloops, and down the Fraser valley to the coast.

Kingston, Ont.—The last order the Kingston Locomotive Works has is to build ten locomotives for the Algoma Central Railway. The works are now well supplied with orders, which will take nine months to fill.

Winnipeg, Man.—Word was received here from Brandon recently to the effect that the Grand Trunk Pacific has arranged for the lease or purchase of the Brandon, Southeastern and Hudson Bay Railway, a Great Northern property, crossing the boundary at St. John's, N.D. The report says the Grand Trunk Pacific will extend this line to the bay.

Victoria, B.C.—Contractors M. Carlin and Grant Smith & Company have commenced active work on the Island section of the Canadian Northern Pacific Railway Company. A store and general depot, to form a base of supplies, and a branch camp is now in course of construction at Peddar Bay.

From Peddar Bay construction will be carried on in both directions ,while other camps will be established along the route. The contractors are willing to sub-let the contract for the second twenty miles of the railroad, but as there is three feet of snow on the route running from Sooke to Shawinigan Lake, construction will be impossible there for some time. Sixteen sub-contractors have been over the second twenty miles and are ready to tender. The sub-contractors will not only clear the right of way but also complete the construction work. As there are no formidable difficulties in the first forty miles it is confidently anticipated that rails will be laid over this portion by the end of the year. In this section the construction of only one bridge is necessary—that over Millstream, a distance of seventy-five feet. The adjustment of difficulties in the purchase of the right of way from 4.7 point to a distance of nine miles outside the city is proceding rapidly, and it is anticipated that the entire right of way will have been purchased within the next few weeks, and the contractors will be able to proceed with the work with all expedition.

SEWAGE AND WATER.

Victoria, B.C.—The agitation some time ago initiated for the carrying out of necessary sewer work to generally improve the sanitation and health conditions of Esquimalt district has broughte fruit in the creation by the Lieutenant-Governor-in-Council of the Esquimalt Sewerage District, under the Act of last year. The area of this includes all lands bounded on the east by the westerly boundary of Victoria City, on the north by the southerly boundary of the E. & N. Railway Company's right-of-way and the eastern boundary of Section 2 of the Esquimalt district, and on the west and south by Esquimalt harbor, the Straits of Fuca, and Victoria harbor. At a meeting of the property owners in the interested district held recently, a resolution was unanimouslv passed providing for the holding of a public meeting to consider sewerage matters for the district at the Lampson Street school on the evening of the 28th inst., when three or more sewerage commissioners will be elected. Mr. A. R. Wolfenden in the meantime is acting as secretary of the movement pro tem.

Saskatoon, Sask.—Engineer Clark, who has recently returned from the East, where, at the request of the city council, he inspected a number of sewage disposal and water filtration works, in view of similar projects being carried out in Saskatoon, has written two interesting reports, which are now under the consideration of the board of works. The reports are supplementary to those which have already been submitted to the council by Mr. Clark. In the report on the water question, Engineer C. Clark describes the sedimentation, filtration and sterilization processes of water filtration, and in concluding says: 1. In the application of

the priciples of filtration to the water of the South Saskatchewan River I beg to recommend the installation of mechanical filters for the following reasons: 1. Because of the amount of turbidity in the water slow sand filters would be too expensive to operate, because they would require cleaning too frequently. 2. Because of the smaller area required and therefore more easiy protected against extreme cold. 3. Because of the limited area of land available for filtration purposes . One acre equipped with mechanical filters will clarify 100 millions per day. 4. Because slow sand filters cost more to install. Mechanical filters have been installed and are being successfully operated at the following points, producing the quantities stated:

	Gals. per day.
Cincinnati, Ohio	112,000,000
New Orleans, La.	44,000,000
Hackensack, N.Y.	24,000,000
Louisville, Ky.	38,000,000
Columbus, Ohio	30,000,000
Harrisburg, Pa.	12,000,000
Youngstown, Ohio	10,000,000

LIGHT, HEAT AND POWER.

Fredericton, N.B.—Employees of the New Brunswick Telephone Company will, this week, complete improvements costing about $15,000, which have been made during the past few months by a corps of linemen. Cables have been installed throughout the city on the streets used to any extent for wires, while a conduit is now in use on Queen Street. A new submarine cable has been laid across the St. John River between this city and St. Marys, and the new and old poles in the city have just been straigtened.

Ingersoll, Ont.—The power and light commission has adopted power rates for hydro-electric, which is now as far as Clearville, and expected in a few days. The commission has decided not to interfere in the matter of meters. Flat rates for residences will be done away with and meters installed.

Hamilton, Ont.—The controllers recently decided to advertise for an independent electrical expert to make a complete report for Hamilton on the establishment of a house lighting, street lighting and power distribution plant to be operated by hydro power and also to value the local plant of the Cataract Power Company, which the city is willing to purchase if it can be had at a reasonable figure. The board of control to-day instructed the city engineer and the police to make all property owners who have enroached on the streets with steps, verandahs and buildings, move them back at once. Many people will be put to heavy expense, as in some cases stores have been built two or three feet over the line

Port Arthur, Ont.—At the recent annual meeting of the board of directors of the Kaministiquia Power Co., Ltd., it was decided that in view of the recent new contracts from large consumers of power in this city, the assurance that still further contracts would be effected in the immediate future, and the confidence of the directorate in the future development of this district; that the work of doubling up the capacity of the plant, be at once undertaken, same to be completed by September next.

CURRENT NEWS.

Halifax, N.S.—The preliminary plans for the mining and the Metallurgical Laboratory in connection with the Nova Scotia Technical College have been approved, and next summer will see the Laboratory all ready for operations.

Fredericton, N.B.—Mr. J. W. Shields, inspector of steel work for the provincial government, returned recently from Chipman where he was looking after bridge work for the public works department. The Chipman bridge is completed and is a splendid steel structure of three spans, one of which is 117 feet long, the draw span is 147 feet and the fixed span about 90 feet long. Work on the Florenceville bridge has been commenced.

St. John, N.B.—Following an extensive investigation on reforestation, an American lumber company, now operating in New Brunswick, plans immediate action in reforesting the more denuded parts of the province. Nurseries will be established at Salmon River and Matins Head, where trees will be grown from seed. The company has fifty thousand acres at Cookshire, Que., which will be seeded this spring. The work to be done this year, it is understood, is merely preparatory to extensive reforesting in New Brunswick and Maine.

Moncton, N.B.—There is quite a new construction proposed for additional rolling stock under consideration to be built in the I.C.R. new shops here at Moncton. Some fifteen vans and one stores car are actually being constructed in the I.C.R. shops here, six of the vans are already completed and in use and the stores car is well under way. Specifications have been prepared and orders given for the necessary stock to construct in the shops here during the coming season the following rolling stock:—3 colonists cars, 3 stock cars, 1 refrigerator, 38 platform cars, 1 gas tank car, 50 box cars of wood and 50 box cars with steel under and upper frames.

Quebec, Que.—Quebec will make a bid for a big shipbuilding plant and one which is prepared to undertake the construction of the largest warships. At a meeting of the finance committee held recently, one of the most important decisions reached was in connection with the request of Mr. Hugh Russell, who had enquired as to what privileges the city would be willing to grant to a company which would establish a shipbuilding plant in the port of Quebec. The company desires to establish yards here so as to be able to tender for the new ships of the Canadian navy. It was decided to offer an exemption from taxes for twenty years as well as a liberal bonus should the company locate here.

Montreal, Que.—A syndicate is being formed here for the purpose of constructing an elevated railway, 14 miles in length, extending along Craig and St. James from the western to the extreme eastern limits of the city. Another north and south section will run up St. Lawrence, Main Street or St. Denis, as the company and the city council may decide. At the present rate of increasing the passenger traffic and the city's population, it becomes more evident from day to day that the surface cars cannot handle the traffic. With a population of a million souls in less than ten years, something will have to be done to meet the difficulty, and as underground roads are almost impossible on account of the soil peculiar to Montreal, it looks as if the erection of an elevated road were the only alternative.

Montreal, Que.—The Canadian Government has completed surveys on the Hudson Bay Railway, and has placed contracts for two large steel bridges over the Nelson River. When completed, this line should have the greatest wheat tonnage in the world, with prospects of carrying upward of 100,000,000 bushels during the season of navigation through the Hudson Straits.

Montreal, Que.—The preliminary estimates for all permanent road and sidewalk making to be done in the city during the coming season were dealt with by the Controllers at a recent meeting. In all nine miles of paving will be laid during the summer, whilst a considerable amount of permanent sidewalks will be looked after. One million dollars will be expended in street work and the sum of $500,000 will be apportioned for sidewalks. The general plan outlined by the Controllers for this work, is that, in so far as possible, all existing unpaved gaps in the main streets of the city will be looked after first. Thus, on Mount Royal avenue, which is paved from Papineau to Sanguinet streets, the paving operations will be taken up and completed from Sanguinet to Park avenue, and from Papineau to the eastern limits of the old city. St. Antoine street will be paved from Craig to Guy streets, whilst several unpaved portions of Dorchester, Lagauchetiere and Notre Dame streets will be treated.

Montreal ,Que.—As a result of the adoption of the board's findings, the mayor and city clerk have been empowered to enter into a contract with the firm of Messrs. Herring, Fuller & Monahan, of New York, the experts who were engaged by the city some months ago to study the local water supply, and who will be called upon to draw up complete plans and specifications for the work to be done. These plans are to cover operations which will cover an expenditure of $1,250,000, and they are to be ready for the early part of the coming spring, so that the city will be in a position to call for tenders for the construction of the plant. The amount involved in the preparation of the plans is $31,425, this being fixed on a two and a half per cent. basis of the total cost of the work. In addition, the New York firm of experts are to receive $150 per month to cover

clerical services in connection with consultations, and $100 per day for every day that it may be found necessary for a member of the firm to visit the scene of operations in person in order to supervise the work of constructing the filter. All operations in connection will be carried out under the direction of George Janin, city engineer, who will work in collaboration with Messrs. Herring and Fuller, till such time as the plant is in full working order. The trial tests of the whole plant will be supervised by the New York firm, and it is estimated that it will take upwards of twenty months to install the initial units of the filter.

Brockville, Ont.—At the regular February meeting of the town council a by-law was passed abolishing the office of town engineer and providing that "all duties to be performed by the town engineer of the town of Brockville, under any by-law or statute now in force, shall hereafter be performed by some person to be specially appointed by by-law or resolution of the municipal council as occasion may arise."

Kingston, Ont.—The seventh annual "at home," of the marine engineers, members of Council No. 4, National Association of Marine Engineers, was held at the city hall recently. Close upon five hundred people were in attendance. The engineers' dance is always a big event in Kingston, and this year the engineers' maintained their good record for a fine affair.

Ottawa, Ont.—The tests of the water pressure recently by Mr. Norman Wilson, the inspector of the Fire Underwriters Association, were far from satisfactory, though the pressure showed an improvement over that when the previous tests were made a little over a week before. The pressure registered at the pump house was 96 pounds, an improvement of 13 pounds over the pressure when the previous test was made. The fire pressure should be 110. The tests were made with hose with 1¼-inch nozzles from hydrants on Metcalfe street at the corner of Wellington, Sparks and Queen streets. With two streams the pressure showed 29 pounds, with four it was 28; six streams reduced it to 26, eight streams to 25, and ten to 24 pounds. The tests showed that the fire engines are essential.

Ottawa, Ont.—After an investigation of the typhoid outbreak in Ottawa, Mr. Meadows, provincial sanitary inspector, has come to the conclusion that the cause of the outbreak was the drinking water, contaminated by sewerage near the city. The source of contamination being local, Hull and Aylmer are in no danger of a similar outbreak.

Ottawa, Ont.—The huge bulk of 59,659,776,000 cubic feet of water will be stored on the headwaters of the Ottawa River when the conservation dams now being constructed by the Dominion Government have been completed. Two of these works, at Kippewa and Temiskaming Lakes, will be finished during the present year, and one at Quinze Lake next winter. The waters controlled or retained by the dams will cover an area of 331 square miles, and the Ottawa River throughout its entire length to Montreal will, as a result, be given an even flow of water for power purposes throughout the year by the conservation of the spring floods. This high water will be let loose during the low-water periods of late fall and winter. This will obviate a recurrence of the power famine which has within the last few weeks crippled the big Chaudiere industries here.

Ottawa, Ont.—As the result of representations to the government on the part of the Archaeological Society of America, the Royal Society and like influential bodies, a new department has been established in connection with the Geological Survey of Canada, that of ethnology and archaeology. Dr. Charles Sapire, an eminent ethnologist, has been placed in charge, and is now engaged in an exhaustive examination of specimens appertaining to the life of the Nootha Indians of the west coast of Vancouver Island, a large collection of which interesting relics have been brought to the Survey here. Collection of specimens for the new department was only recently begun, but it will eventually become one of the important branches of the Survey.

Toronto, Ont.—Building permits issued between Jan. 24th to Feb. 7th by City Architect McCallum, amount to $181,600 and include 41 dwellings and three Dominion Bank branches.

Toronto, Ont.—That the question as to whether under existing conditions it can be operated as economically and at the same time give as efficient service will largely determine the feasibility of introduction of the Edison-Beach storage battery system of operating street cars to Toronto, is the opinion of Mr. C. H. Rust, city engineer, who returned recently from New York, where he, in company with Electrical Engineer Aitken, has been making investigations of the system in the interests of the city. Mr Rust says that the few storage battery cars being operated in New York seemed to be giving satisfaction.

Toronto, Ont.—Addressing the Canadian Club recently Dr. Haanel, director of mines for the Dominion Government, drew attention to the decreasing fuel supply of Canada and the results which would follow the cutting off of coal importations from the United States. He urged that the peat deposits of Canada, estimated at thirteen thousand square miles, be developed. This would furnish sufficient fuel for five million families for one hundred years.

Toronto, Ont.—The Toronto branch of the Canadian Manufacturers' Association has sent a letter to Sir Wilfrid Laurier advising him to enlarge the present Welland Canal between Lake Erie and Lake Ontario. The manufacturers claim that when the new Erie Canal, which is rapidly approaching completion, is ready for traffic, the Canadian grain route will be seriously handicapped, and may lose this regular traffic altogether. The executive hoped therefore that the government would make provision for the immediate construction of a new canal between Lake Erie and Lake Ontario, capable of accommodating any vessels engaged in traffic on the Great Lakes. If Canada was to get her share of the grain-carrying trade to which her natural facilities entitle her there must be a widening and deepening of the present channel between Lake Erie and Lake Ontario.

Guelph, Ont.—City Engineer Hutcheon has made a new proposition to the Board of Works regarding his remaining in Guelph. This proposition is to the effect that instead of his remaining away from Guelph four months of the year, that he will cut it in two, making his absence only two months, during which time he will provide the city with a competent engineer at his own expense.

Parry Sound, Ont.—A report is current that the controlling interest of the Canada Chemical Company has been purchased by the Standard Chemical Company, which has a number of plants throughout the country.

Welland, Ont.—It is reported that Welland is to have a blast furnace or smelting works, and the plant will be built this year. The cost, it is reported, will be $1,250,000, and the plant will be built by the Montreal Steel Co.—the O. I. & S. Co.'s new owners. The reported movement on foot to establish extensive lime works at Port Colborne is believed to be connected with this blast furnace proposition at Welland. It is believed that the extensive limestone deposits secured west of Port Colborne are to supply limestone for the smelting works to be located here.

Welland, Ont.—In order to permit of the construction the old steel bridge at Welland was cut in two and half shifted to each side so that the train traffic passes on either side uninterrupted while the work goes on where the old bridge stood. The bridge is built to swing from the side, leaving a 100-ft. clear channel and provision is made so that if the canal is enlarged there will be two clear channels of 100 feet each. The centre piers are 50 feet from the base of the rail to the bottom and 48 ft. square, built of solid concrete. The total cost will be about $300,000. Work is in progress 24 hours a day and 300 men are employed. The pay roll is from $11,000 to $12,000 per month. There have been a number of serious accidents to the men employed, but so far none have been fatal. Work was commenced early last summer and must be completed before the opening of navigation.

Winnipg, Man.—Samuel Hooper, provincial architect for Manitoba, is preparing plans for new government buildings, to cost over $3,000,000, according to estimates. The proposed buildings include new legislative buildings, a new agricultural college and a new asylum at Brandon, to replace that destroyed by fire about six weeks ago.

Calgary, Alta.—Berrington, Son & Watney, civil engineers of Wolverhampton, England, have written here stating that they intend opening a branch office in Calgary and that they will be working to a considerable extent as representatives of British capital that is invested in this city.

Vancouver, B.C.—That it will not be necessary to go deeper than from 70 to 120 feet to secure a splendid foundation for the piers for the projected new bridge across the second Narrows, is the statement of Mr. John Y. McNaught, manager of the Burrard Inlet Tunnel & Bridge Company, who also took occasion to correct the statements that have been published that a depth of 146 feet had been reached without getting any satisfactory foundation.

PERSONAL.

Mr. W. F. Tye, of Toronto, has been appointed engineer on the railway entrances to Ottawa, by the Ottawa city council upon recommendation of the board of control.

Mr. J. C. Sullivan, assistant engineer of the Canadian Pacific in Montreal, who, at the time of the death of the chief engineer of the company, the late J. E. Schwitzer, was under appointment to go to Winnipeg as assistant chief engineer, has left Montreal for the West, and will immediately assume his new duties there. Mr. Sullivan was named to go to Winnipeg when Mr. Schwitzer was made chief engineer and it has been decided that this plan shall be carried out.

SOCIETY NOTES.

At the annual meeting of the Canadian Forestry Association, at Ottawa, recently, Mr. George Y. Chown, registrar, Queen's University was elected president, and John Hendry, Vancouver, vice-president for the ensuing year. A total membership of 2,703 was reported, with a balance on hand of $1,033.67. The committee on forests' fire legislation presented a report saying it heartily concurred in the work done at the recent Quebec convention, and in addition suggested that a permanent head of fire protection work be appointed.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Copies of these orders may be secured from the Canadian Engineer for a small fee.

12811-12—January 23—Relieving T. H. & B. Railway from further protection of crossings at Ancaster Stone Road, between Lots 54 and 55, Concession 1, mileage 41, from Welland, and at third highway crossing west of Chippewa Bridge between Townships of Thorold & Pelham, at mile post 2 from Welland.

12813—January 28—Approving plans of station building of C.P.R. at Dorion, Lake Superior Division.

12814—November 14—Approving plans of new station of G.T.P. Branch Lnies Co., at Balcarres, Sask., on Regina Branch.

12815—January 28—Authorizing T. H. & B. Railway to construct spur in Township of South Grimsby, County of Lincoln, Ont.

12816—January 26—Authorizing C.P.R. to construct spur for Rat Portage Lumber Co., across First and Fir Sts., in Vancouver, B.C.

12817—January 24—Reporting agreement (amalgamation) between C.N.R. and Edmonton & Slave Lake Ry. Co., to Governor-in-Council for Sanction.

12818—January 26—Authorizing C.N.O.R. to construct railway across and divert public road in Lot 3, Concession 2, Township of Gloucester, County of Carleton, Ont.

12819—January 23—Approving agreement between Bell Telephone Co. and Central Ontario Railway for interchange business.

12820-21—January 27—Authorizing Hydro-Electric Commission to cross with its wires wire of C.P.R. at Carnegie & Harris Sts., Ingersoll, Ont., and at Lot 2, Concession 2, Township of Dereham.

12822—January 24—Authorizing C.P.R. to construct its Moose Jaw North-Westerly Branch across some 108 highways, and divert the same between mileage 9.59 and mileage 119.6.

12823—January 21—Authorizing T. H. B. Railway to construct spur in Township of South Grimsby, County of Lincoln, Ont.

12824—January 26—Approving revised location of C.N.R. through Township 28, and Ranges 4-6, west 4th mileage 196.64 to 210.21 from junction with QuAppelle, Long Lake & Sask. Ry. at Saskatoon.

12825—January 30—Authorizing C.N.O.R. to cross Dominion St., town of Trenton, Ont.

12826—January 30—Directing that C.N.R. before 30th April, 1911, reconstruct and put in good order the crossings between Sections 1 and 2, Township 11, Range 3, and in centre of section No. 11, construct suitable culverts and clean out existing ditch, etc. Application made by the rural municipality of St. Francois Xavier.

12827—January 30—Approving revised location of C.N.O.R. in the Parish of St. Andrews, County of Argenteuil, Que.

12828—January 30—Approving revised location of G.T.P. Branch Lines Co., Regina-Boundary Branch, mileage 88.32 to 100, and location mileage 100 to mileage 110.21, from Section 21, Township 7, Range 1, west 2nd Meridian, to the East Line of Section 28, Township 5, Range 7, west 2nd Meridian, District of Assiniboia, Saskatchewan.

12829—January 26—Authorzing C.P.R. to carry party of students of McGill University from Montreal, Que., to Rossland, Phoenix and Greenwood, B.C., at $40 return, or at $50 from Montreal to Vancouver, B.C., and return, including side trips to Rossland, Phoenix, and Greenwood; also authorizing rate of $2.75 from Sudbury to Sault Ste. Marie to carry such party if desired. Other parties desiring to travel for the same purpose to British Columbia or any other mining district to be granted equally favorable terms.

12830—January 30—Authorizing C.P.R. to maintain and operate its railway under two- structures being corner of Salt Block and an overhead conveyer owned by Western Canada Flour Mills Co., Ltd., in town of Goderich, Ont.

12831—January 20—Approving location of G.T.P. Branch Lines Co., Young-Prince Albert Branch from mileage 110.9 to the east boundary of First Avenue East, in the city of Prince Albert, Sask., all questions of street protection and street closing reserved for further consideration of the Board.

12832—January 30—Extending time until May 1st, 1911, for completion of certain work in town of Ingersoll by Lake Erie & Pacific Railway Co., required by Order 10805, dated June 6th, 1910.

12833—January 20—Authorizing Hydro-Electric Commission to cross with wires wire of Bell Telephone at Queen St., St. Mary's, Ont.

12834—January 30—Relieving Wabash Railway from further protection of Diltz Road Crossing, Township of Halton, County of Haldimand, Ont.

12835—January 30—Relieving C.P.R. from further protection of highway crossing one mile west of Vankleek Hill, Ont.

12836—January 25—Dismissing application of C.N.Q.R. to extend its yards in Hochelaga in Montreal, and right to cross Marlborough St., and to take extra lands, namely, Lots 106 and 107, on Stadacona St., and Lot 105, on Marlborough St.

12837—January 25—Dismissing application of city of Montreal to enjoin the C.N.Q.R. to remove a shanty at intersection of Valois Ave. and Ontario St., and to remove fence, etc.

12838—January 31—Authorizing C.P.R. to construct overhead bridge in lieu of subway where said railway crosses road allowances between Sections 11 and 12, Township 24, Range 1, west 5th, in city of Calgary. Approving of agreement between city and C.P.R.

12839—January 26—Adding Delaware & Hudson Railroad Co. to be a party to application of W. A. Stewart, of Nepierville, Que., and municipal council of St. Cyprien re inadequate train service furnished by Napierville Valley Railway Co.

12840—January 25—Approving C.N.Q. Railway's extension of yards between Moreau and Marlborough Sts., Montreal, Que., and refusing application for closing of Robillard St.

12841—January 31—Directing that C.N.R. carry out provisions of Order No. 12553, December 19th, 1910, within ten days from date of Order under penalty of $25 per day.

12842—January 24—Dismissing application of C.N.Q.R. for Order fixing terms, conditions, and method in which the dam and headrace, or other portions of water-power of Alexander Naud, Parish of Deschambault, Que., may be from time to time maintained, repaired and reconstructed.

12843—January 24—Authorizing C.N.Q.R. to use tracks on bridge over St. Charles River, near Quebec, including property owned in common by the Quebec Railway, Light & Power Co., and the Quebec & Lake St. John Ry. Co., for purpose of entering city of Quebec, C.N.Q.R. to pay $1,500 per annum by way of rental to Q. R. L. & P. Co. Applicant company to also pay arrears for use of said bridge, and be responsible for its share of maintenance and operation.

12844—January 25—Refusing application (without prejudice) of Mousseau & Gagne, of Montreal, to compel the G.T.R. to construct a highway crossing on a proposed road between St. Polycarpe and St. Clet, P.Q.

12845—January 25—Dismissing application of town of Notre Dame de Grace, Que., for an Order to alter Order No. 8208, dated September 14th, 1909.

12846—January 31—Authorizing C.P.R. to construct spur to premises of Burridge-Cooper Co., Ltd., in Regina, Sask., across Rose St.

12847—January 31—Extending time in which shelters to be erected by Order of the Board No. 12132, dated October 27th, 1910, at Reford, Sask., until June 1st, 1911. Company liable to penalty of $25 per day after June 1st, 1911.

12848—January 31—Authorizing Vancouver, Victoria, & Eastern Railway to construct spur to premises of Vancouver-Prince Rupert Meat Co.'s Works.

12849—January 30—Authorizing C.P.R. to operate three railway sidings upon and across Pardee Ave. and Liberty St., Toronto, to connect with siding of the G.T.R.

12850—January 31—Authorizing Hydro-Electric Commission to cross with wires track of G.T.R. at Main St., Norwich, Ont.

12851—January 30—Authorizing city of New Westminster, B.C., to lay water main under C.P.R. near Westminster Junction.

12852-53—January 25—Refusing application of Montreal, Park & Island and Montreal Terminal Railways, for approval of Standard Passenger Tariff of 3c. per mile with minimum fare of 5c. per mile, and specifying a maximum toll of 2½c. a mile on existing lines of railway.

12854—February 1—Granting permission for suspension of freight rates from Ontario, shown in the tariff of Joint and Proportional Rates, C.R.C., No. 188, issued by J. F. Tucker, of Chicago, until 1st of September next, and for the reinstatement until and including the 31st day of August next of the Joint and Proportional Rates between the same points shown in said J. F. Tuckers Tariff, C.R.C., No. 180, which tariff was superseded by C.R.C. No. 188 on 1st November, 1910.

12855—February 2—Relieving G.T.R. from further protection of crossing of Market St., at Paris Junction, Ont.

12856—February 1—Extending time until 1st March, 1911, for performance of work required by Order 12051, October 13th, 1910.

12857—February 1—Extending time until 15th April, 1911, for performance of work required by Order 12292, September 22nd, 1910.

12858—February 1—Authorizing C.P.R. to construct industrial spur to premises of Ogilvie Flour Mills Co., Ltd., and to cross Duncan Street in city of Fort William, Ont.

12859—February 1—Authorizing G.T.R. to reconstruct bridge No. 70, mile post 27.18, 2½ miles south of Madoc, Ontario.

12860—February 2—Authorizing C.N.O.R. to construct railway across Ontario St., (between Lots 18 and 19, Con. A), town of Cobourg, Ont.

12861—February 2—Authorizing T. H. & B. Railway to construct spur in Township of Pelham, County of Welland, Ontario.

12862—February 2—Authorizing C.N.O.R. to cross Darcy St., between Lots 14 and 15, Cobourg, Ont.

12863—February 2—Approving location of Alberta Central Railway, mileage 63 to 75, from Red Deer, Alta.

12864—February 1—Authorizing city of Medicine Hat to cross with its wires wires of C.P.R. at Esplanade St.

12865 to 12881 Inc.—February 1—Authorizing Hamilton, Cataract Power, Light & Traction Co. to cross with its wires wires of Bell Telephone Co. at following points:—G.T.R. public crossing, Lottridge St., Hamilton, G.T.R. public crossing, just east of 16-Mile Creek, 2 miles east of Jordan Station, at G.T.R. public crossing, 4 miles east of Jordan, Ont., at G.T.R. public crossing Wentworth St., Hamilton, at G.T.R. public crossing, Grimsby Park Station, Ont., at G.T.R. public crossing, 2 miles west of Beamsville, Ont., at G.T.R. private property, 3 miles east of Beamsville, Ont., at G.T.R. public crossing, Vineland Station at G.T.R. public crossing, Canning Factory Road, Grimsby, Ont., ¼ mile east of station, under

subway of G.T.R. public crossing, Elizabeth St., Grimsby, at G.T.R. public crossing Sherman Ave., Hamilton, Ont., at G.T.R. public crossing, Winona Station, Ont., at G.T.R. public crossing, 3 miles east of Jordan, Ont., at G.T.R., P. C. Gratham & Louth Town Line, 1⅜ miles west of St. Catharines, under D. P. & T. Co., on Line Road, 1 mile west of St. Catharines, at G.T.R. P. C. Pipe Line, Water Works, Hamilton, 4½ miles east of station.

12882—January 25 and 26—Dismissing application of Board of Trade, Halifax, N.S., re complaint that G.T.R. discriminates against the Port of Halifax in favor of other Atlantic ports in its differential rate of 1c. per 100 pounds.

12883—February 2—Dsmissing application of Township of Paipoonge, re C.N.O.R. to maintain suitable highway crossing where it crosses the side line between Lots 3 and 4, in Con. "B."

12884—February 2—Approving location of G.T.P. Branch Lines Co., Regina Boundary Branch from the east line of Sec. 28, Township 5, Range 7, west 2nd Meridian, to east line of Sec. 32, Township 3, Range 4, west 2nd Meridian, Saskatchewan, mileage 110.21 to 130.92.

12885—February 3—Authorizing C.N.O.R. to cross Sinclair Avenue (in Lot 20, Con. A.), town of Cobourg, Ontario.

12886—December 1—Rescinding Order No. 12443, and providing that plans be filed by 15th March, 1911, by town of Lachine, Parish of Lachine, and Montreal West, with suggestions as to elimination of crossings, etc., or protective appliances to be installed.

12887—February 3—Authorizing C.P.R. to contsruct spur to premises of Superior Fuel & Coal Co., Ltd., in Block 9, of Parish Lot 42, St. James, city of Winnipeg, Man.

12888—February 3—Authorizing C.P.R. to construct spur to premises of Mr. Abs. Eby, in part of Lot 89, village of Elmira, Ont.

12889—February 3—Authorizing Hamilton-Cataract Power, Light & Traction Co. to cross with wires wire of Bell Telpehone Co., at G.T.R. public crossing, 1 mile west of Jordan, Ont.

12890—February 6—Amending Order No. 12225, of November 9th, 1910, that sub-clause (c) of clause 8 be amended by adding the words, "except mail cranes, which shall be erected and maintained as directed in Order 5657, of November 20th, 1908," after the word "structure" in first line of said sub-clause.

12891-92—February —Authorizing Canadian Light & Power Co. to maintain wires across track of G.T.R. at Lachine Canal, north bank, 2,000 feet west of Cote St. Paul Bridge, and at Lachine Canal, north bank, 800 feet east of Dominion Works, Canada Car & Foundry Co.

12893—Dismissing application of Lachine, Jacques-Cartier & Maisonneuve Ry. Co. to cross C.P.R. at Jacques-Cartier Jct., Que.

12894-95-96—February 6—Authorizing G.T.P. Branch Lines Co. to cross with its Prince Albert Branch highways (3) in the District of East Saskatchewan, Saskatchewan.

12897—February 6—Authorizing G.T.P. Branch Lines Co. to cross highway in District of Saskatoon, Sask., north-west ¼ Section 5, Township 34, Range 27, west 2nd Meridian.

12898—February 6—Authorizing C.P.R. to construct proposed extension of its Langdon Branch to Langdon Station, and across road allowance at south-west ¼ Section 24, Township 23, Range 27, west 4th Meridian, Alberta.

12899—February 6—Authorizing city of St. Boniface, Man., to construct Marion St. across track of C.N.R. Co.

12900—January 3—Authorizing C.N.R. to cross tracks of C.P.R. near Jacques-Cartier Jct., mileage 49.3, south from Hawkesbury by overhead crossing, all expense to be borne by C.N.R.

12901—February 6—Re Order 4988 of July 8th, 1908, and circular letter No. 58, of December 23rd, 1910, railway companies subject to jurisdiction of Board to file tariffs of interswitching tolls not later than 1st March, 1911, in accordance with provisions of Order

MARKET CONDITIONS.

Halifax, N.S., February 13h, 1911.

Weather conditions at the opening of the New Year have not been such as would encourage a large volume of trade. The price situation is steady, and it is expected the values will continue firm. Imported pig-iron is very steady in price, and an increase in metal prices is expected.

Axes.—Ordinary chopping axes, single bit, $6.50 per dozen, double bit, $11. Special brands, prices on application to jobbers.

Bar Iron.—The market for bar iron is open, but the situation is firm, and prices range as high as $2.25 base.

Black Sheet Iron.—This commodity is in good demand. We quote 24-gauge, $2.40.

Cast Steel.—The market is steady at 10 to 15c., according to makers.

Cement.—Stocks are low and market is steady, $2 per bbl.

Coil Chain.—The jobbing prices of English proof chain in Halifax are as follows: 3-16 x 4, $7.15; 3-16 x 3, $6.25; ¼, $5.35; 5-16, $4.30; ⅜, $3.90; 7-16, $3.85; ½, $3.60; ⅝, $3.60; ¾, $3.50; ⅞, $3.50; 1, $3.50; 1⅛, $3.50.

Fencing Wire.—We quote: Plain, twisted and galvanized at $3.25 per 100 lbs.; barb at $2.75 per 100 lbs.; bright staples in 100-lb. kegs at $3, and in 50-lb lots, $3.25. Galvanized staples are 25c. extra.

Galvanized Sheet Iron.—The wholesale prices are as follows: 16 to 20-gauge, $3.45; 22 to 24, $3.80; 26, $4.30; 28, $4.55. These prices are for less than case lots.

Ingot Tin.—The tin market as usual is a fluctuating one, and the present price is about 38c. net cash.

Lead Pipe.—Quotations here are open, and the price quoted to-day is about $4.75 for ordinary jobbing quantities.

Linseed Oil.—Raw is fully worth $1.20, and boiled, $1.25 per gallon. Orders are small, stocks low, and the outlook firm.

Nails.—Nails are firm. Wire nails, $2.45, and cut nails, $2.60. Business in this line is reported fairly active.

Peavies.—There is a better enquiry than last year. Prices are unchanged at $11 to $13 per dozen, according to make, but we are advised that there will be an advance.

Pig Lead.—We quote $4.25 for English and $4 for Canadian. The outlook is for higher prices.

Pipe.—Wrought iron, 1-in., $5.25.

Roofing Paper.—The demand is good. Tarred paper, $1.70 per 100 lbs.; three-ply roofing 90c. per 100 lbs.; two-ply roofing, 65c.; sheathing paper, 30 cents per roll; tarred sheathing, 40 cents per roll.

Rope.—The price of cordage for next spring's supplies is unchanged. For large lots dealers should write jobbers for quotations. Small lots are as follows: Sisal, 9½c. base; lobster rope, 9¾c.; British manilla, 9½c.; base, best manilla, 10½c. base.

Sheet Lead.—The price of sheet lead is also very firm, 3 lbs. and heavier, $4.75 per cwt., in rolls, and $5.75 in smaller quantities.

Steel.—Tire, $2.50; spring, $2.70; machine, $3.25; toe caulk, $3.50; sleigh shoe steel, $2.50; the above are all base prices.

Tin Plates.—I. C. coke, $3.95 to $4.10; I. C. charcoal, $4.75; I. X. charcoal, $5.50.

Turpentine.—Prices now quoted are as high as $1 to $1.10 in bbls., and $1.05 to $1.15 in smaller quantities. The market is open.

White Lead.—For Canadian pure, in 50 and 25-lb. irons, $6.25 is being asked. Brandram's B.B. genuine in 25, 50, and 100-lb. irons, $7.35, and B.B. No. 1, $6.10. The trade expect prices to be much higher before long.

Zinc.—This commodity is very firm, $7.50 for casks and $8 for smaller quantities. Spelter is $2.75 per cwt.

Montreal, February 15th, 1911.

The decision of the Interstate Commerce Commission has been awaited with considerable interest on the other side of the border. It is believed that it will be handed down during the latter part of this month. The iron and steel trade in particular feels itself interested in the nature of the decision, but where the iron and steel trades are effected it follows that general business conditions will be influenced also, no doubt. Should the decision be favorable to the railways, the result will be more satisfactory to the iron and steel trades, as it no doubt would mean the purchasing of very large quantities of steel rails, structural steel, and various other iron and steel products which are used more especially, by railways for the building of cars, locomotives and other equipments. Whether the decision is favorable or otherwise, it is sure to have a good effect, for the simple reason that the railways will then know what to expect. It is the uncertainty rather than anything else which is inducing the companies to hold back orders—if such are being held back.

A large number of steel manufacturers hold to the opinion that the bookings in February will average somewhat above what they were in January. They do not anticipate a large increase in business until the Interstate Commerce Commission has rendered its opinion in the matter of freight rate increases.

The United States Steel Corporation is operating at about 55 per cent. of its blast furnace capacity at the present time. The increase is due to an exhaustion of pig-iron stocks and an increase in mill capacity.

At Pittsburg, an improvement in the iron and steel business all along the line is predicted by manufacturers who say the present year will show an increase of 15 per cent. to 20 per cent. over last year.

"The last week has witnessed a wonderful improvement in the amount of the business actually placed, and the outlook has changed," declared James A. Campbell, President of the Youngstown Sheet & Tube Co. "The manufacturers who were decidedly pessimistic a few months ago are confident that conditions will continue to improve. Buyers are now coming into the market more freely."

At Sharon, Pa., all departments of the Ohio works of the Carnegie Steel Co. are running, and the Grenville plant is working for the first time in several weeks. The South Sharon plant has started up again after a several days' shut down.

Chairman Gary's statement that Steel Corporation bookings were 30,000 tons daily, in January, to the 27th, against 22,000 tons, daily, in December, presages a gain of more than 200,000 tons in bookings for the month and as shipments average only a slight increase the recent forecast of from 100,000 to 200,000 tons' gain in unfilled orders for January 31st, is given additional support. This will be the first gain for a year.

Reports from England are most encouraging, although prices do not seem to have advanced to any great extent as yet. Demand is waking up somewhat, and shipmeots of pig-iron for export are being made.

The local trade continues dull though quite as active as merchants anticipated for this time of the year. Merchants are quite optimistic concerning the future, and all are looking forward to active business during the coming season. Prices are holding steady and no changes of importance have been reported during the week.

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 2¼ 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 nundred, $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 11 to 12c., covering all Canadian makes.

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

Dried Fruits.—Currants, Filiatras, 6¾ to 9½c.; dates, 5½c.; raisins, Valentias, 7¾ to 8¼c.; prunes, 8½ to 12c.

Eggs.—No. 1 eggs are 26c.; selects, 30c.; new laid, 50 to 60c.

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, 85 to 95c.

Rice and Tapioca.—Rice, grade B, in 100-lb. bags, 3¾ to 3½; Tapioca, medium pearl, 5¾ 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, February 15th, 1911.

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. Price at some yards $9.50, at others, $10.00 to $11.00 for common. 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., 70c. until further notice, per ton of 2,000 lbs., 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. In October and November competition forced prices of limestone up to 90c., the city and the province competing for several thousand tons. But the reservoir and the hydro-electric being both supplied, normal prices have been resumed. One quarry (Maloney's) will run all winter to supply stone for the Island.

Cement.—Car lots, $1.65 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. Nut coal is very scarce.

Copper Ingot.—The market has reached a firm basis, and holders are quite stiff at $13.50 per 100 lbs. There is a good demand.

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

Dynamite, per pound, 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, $8 to $12 per ton.

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.—A steady request at former prices:—Black, ¼-inch, $2.03; ⅜-inch, $2.25; ½-inch, $2.63; ¾-inch, $3.28; 1-inch, $4.70; 1¼-inch, $6.41; 1½-inch, $7.70; 2-inch, $10.26; 2½-inch, $16.39; 3-inch, $21.52; 3½-inch, 27.08; 4-inch, $30.78; 4½-inch, $35.75; 5-inch, $39.85; 6-inch, $51.70. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.43; 1-inch, $6.35; 1¼-inch, $8.66; 1½-inch, $10.40; 2-inch, $13.86, 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 22c. per 100 lbs. f.o.b. car without freight. Demand is moderate.

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, $30 to $40; hemlock is in demand and held quite firmly, we quote $17.50 to $18; spruce flooring in car lots, $22 to $24; shingles, British Columbia, are steady, we quote $3.10; lath, No. 1, $4.60; white pine, 48-inch, No. 2, $3.75; for 32-inch, $1.85 is asked.

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

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; retail, $2.15 per barrel of 300 lbs.

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

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, $1.05 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 73 per cent. off list at factory. Demand normal.

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, $2.50; 12-gauge, $2.55; 14 gauge, $2.35; 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.

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.—The market is cornered, stocks are light and prices are advanced to 45c. to 46c.

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.—Butter is firmly held since last issue, dairy prints are 21 to 23c., creamery prints, 27 to 28c. per lb.

Canned Goods.—Peas, $1.35 to $1.75; tomatoes, 3s, $1.35 to $1.40; pumpkins, 3s, 97½c.; corn, 95c. to 97½c.; 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, 12¾c. to 13c.; twins, 13c. to 13¼c.

Coffee.—Rio, Green, 15 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, 7¼ to 8c.; Vostizzas, 9 to 10c.; uncleaned currants, 7 to 7¼c.

Eggs.—Strictly new-laid, 30c.; storage, 23c. dozen.

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 per ton; shorts, $23 to $24 per ton.

Lard.—Tierces, ¼c. up abroad, and we quote 13c. here; tubs, 13¼c.; pails, 13½c.

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, $1.70.

Smoked and Dry Salt Meats.—Long clear bacon, 12 to 12¼c. per lb., tons and cases; hams, large, 14 to 15c.; small 16 to 16½c.; rolls, 12 to 13c.; breakfast bacon, 17 to 18c.; backs (plain), 19 to 20c.; backs (peameal), 19 to 20c.; shoulder hams, 14c.; green meats out of pickle, 1c. less than smoked.

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

Sugar.—Granulated, $4.45 per 100 lbs., in barrels; Acadia, $4.35; yellow, $4.05.

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; cabbages bring from $1.25 to $1.50 per barrel; Canadian, $1.50 per bag; carrots, 60c. per bag; beets, 80c. per bag; turnips, 40c. per bag. Fall apples sell at $4 per barrel, for ordinary, but first-class scarce at $5.

TORONTO HORSE MARKET.

The local horse market is a little slack, but this is the usual feature of the January trade. Farm workers, especially mares, which cannot be bought below $250, have the call.

Desirable drafters, 1,700 lbs. and over, are going at $225 to $325, lighter drafters $175 to $225, and chunks, 1,350 to 1,500 lbs., at $150 to $200.

Winnipeg, February 13th, 1911.

Markets in Winnipeg continue quiet, and on enquiry prices remain unchanged, great preparation is still going on in anticipation of the building season when it opens up in the spring.

The local iron and steel plants are busy with work for the coming season.

The plant of the Dominion Bridge Company in Winnipeg which has been greatly increased since they opened up in the West is one of these. The Winnipeg plant of this firm was established in 1906 with a small shop of 4,000 tons' capacity, in 1910 this was extended, and the present capacity of the plant is 15,000 tons. In 1906 all drafting and engineering work was done in Montreal and Toronto, while since the extension of last year all this work is now done in the local works, and it is the intention of the company to have this plant practically a separate one to handle all Western work. The local plant is equipped with all modern machinery, and except in size is as well equipped as the head works at Montreal.

Mr. G. E. Bell, late of the Montreal office, has just been appointed manager at Winnipeg, taking the place of Mr. E. E. Sheppard, who has gone into architectural work.

Anvils.—Per pound, 10 to 12½c.; Buckworth anvils, 80 lbs., and up, 10¼c.; 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., 4¾c.

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, $20; 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, $11.25; 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; ⅝ x 6, 7 and 8, $4.25; ⅝ x 8, 9, 10, and 12, $4.05; 25c. extra on other sizes.

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 100 lbs.

Timber.—Rough, 8 x 8 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

(Continued on pages 69 and 70.)

VICTORIA, B.C.
PAVEMENTS

SEALED TENDERS
marked
ASPHALT PAVEMENTS

will be received by the purchasing agent up to

4 p.m., March 3rd, 1911

or the construction of approximat ly

400,000 Square Yards

of Pavement. Specifications, form of tender, etc., may be obtained at the City Engineer's Office.

ANGUS SMITH, City Engineer
W. W. NORTHCOTT, Purchasing Agent

Victoria, B.C., February 14, 1911

DEPARTMENT OF RAILWAYS AND CANALS.

DOMINION CANALS.

Notice to Dealers in Cement.

SEALED TENDERS, endorsed "Tender for Cement." will be received by the undersigned, up to 16 o'clock on Friday, the 24th February, 1911, for the supply of some 200,000 barrels of cement, more or less, required for the construction and maintenance of the various canals of the Dominion and to be delivered in such quantities, at such places and at such times as may be directed.

Dealers in cement may tender for the total quantity required, or for such portions thereof as may suit their convenience.

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

The Department does not bind itself to accept the lowest or any tender.

By order,
L. K. JONES,
Secretary.

Department of Railways and Canals,
Ottawa, 8th February, 1911.

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

Copies of the Canadian Engineer of the issues of January 5th and 12th, are wanted. By forwarding the same to the main office your subscription will extend over an additional month.

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 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 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.

Fairchild, Webster & Jackson

Civil and Mechanical Engineers and Surveyors

DUNNVILLE, ONT.,
Feb. 7th, 1911.

INFORMATION DEPARTMENT,
CANADIAN ENGINEER,
62 CHURCH ST., TORONTO.

Dear sirs,

I just wish to place on record my appreciation of the Information Department of The Canadian Engineer in enabling me to gain my present position. This position is just the sort that I came to Canada eleven months ago to seek.

Yours faithfully,

A. M. JACKSON.

This engineer gained a partnership in a good firm of consulting engineers through The Canadian Engineer's Information Department. Scores of men have been placed in good positions through this department. This service is free to both employee and employer. Just write "Send me a Blank." Fill out the Blank and The Canadian Engineer gives you results.

POSITIONS WANTED

ENGINEER with nine years' experience in British municipal work, water supply, sewage disposal, and engineering contract work, seeks employment in Canada, office or works. Commence May next or earlier. Particulars filed with Canadian Engineer. Address 156, Canadian Engineer.

A PRACTICAL Portland cement maker, 30 years' experience, able to superintend erection of works; rotary process, and supply plans, etc.; also patentee, wishes to associate with capitalists to erect new works, or will take management of existing mills. Highest references and testimonials Address "Cement," care of Canadian Engineer, Toronto.

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.

EXPERIENCED CIVIL ENGINEER, M.I.C.E., London, with fifteen years of colonial practice; up in all the most modern methods of construction and organization of large works; is open to engagement. Address, Experience, c/o Canadian Engineer.

POSITIONS VACANT

WANTED for a town in British Columbia a road-way foreman or inspector. In applying, state fully experience, I. D., Box 408, Canadian Engineer.

APPLICATIONS will be received by undersigned for the position of Commissioner of Works for Town of North Bay. Applicants will state salary, experience and references. M. W. Flannery, Town Clerk, North Bay.

WANTED—Two foremen for structural steel erection work to commence March 1st. Reply I. D., Box 409, Canadian Engineer.

WANTED.

Transit, must be in good condition; give full description, with lowest cash price. Box 158, Canadian Engineer.

FOR SALE

FOR SALE—Set of books on stationary engineering; also a set on telegraph engineering, including a complete electrical experimenting outfit. Address Box 146, Canadian Engineer.

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.

When writing to Advertisers mention The Canadian Engineer—you will confer a favor on both Advertiser and Publisher.

Index to Advertisements

Tenders Called For

TOWN OF GLEICHEN, ALBERTA.

Waterworks and Sewers.

Tenders are invited and will be received by the undersigned, not later than 16th March, 1911, for the following:—

1. Drilling and Casing an eight-inch Well.
2. Supplying about 60 Tons of Cast Iron Pipes and Specials, or alternatively an equivalent quantity of Steel Pipes.
3. Supplying and erecting an Elevated Steel Tank.
4. Supplying Gate Valves and Fire Hydrants.
5. Supplying about 3,400 feet of Vitrified Tile Sewer Pipe.
6. Supplying Manhole Castings.

Specifications, Forms of Tender and full particulars may be obtained from The John Galt Engineering Company, Consulting Engineers, Winnipeg and Calgary.

The Corporation of the Town of Gleichen do not bind themselves to accept the lowest, or any tender.

B. S. COREY,
Secretary-treasurer.

Gleichen, Alberta, 15th February, 1911.

CITY OF WINNIPEG ELECTRICAL DISTRIBUTION SYSTEM.

TENDERS FOR CONDUIT.

Sealed tenders on prescribed forms addressed to the Chairman of the Board of Control, Winnipeg, Canada, and marked on the envelope, "Tender for Conduit System, 1911," will be received at the office of the undersigned up to 11 a.m., on Wednesday, February 22nd, 1911, for the following items:—

Specification No. 63, Conduit, 1911.
Specification No. 64, Construction of Conduit Runs, 1911.

Copies of the specifications, of certain plans, and of the Form of Tender may be obtained from the Power Engineers, Smith, Kerry & Chace, Carnegie Library, Winnipeg, where the plans of the routes may be examined.

Each tender must be accompanied by certified cheque for five per cent. (5 per cent.) of the amount of the tender.

The city reserves the right to reject any or all tenders, or to accept any tender which shall appear advantageous to its interests.

M. PETERSON, Secretary.
Board of Control Office, Winnipeg, February 2nd, 1911.

CITY OF BRANTFORD.

Tenders for Sewer Pipe.

Sealed tenders addressed to Ald. Chas. Hartman, Chairman of the Board of Works, in care of the City Clerk, Brantford, Ont., will be received till 12 o'clock noon, on

THURSDAY, MARCH 2nd, 1911,

for the supply of Sewer Pipe, required by the City of Brantford during 1911.

Specifications may be seen and instructions to bidders and forms of tender obtained on application to the City Engineer.

Each tender must be accompanied by a marked cheque, payable to the order of the City Treasurer for the amount called for in the form of tender.

The lowest or any tender not necessarily accepted.

T. HARRY JONES,
City Engineer.

City Hall, Brantford,
February 14th, 1911.

(Continued on pages 66 and 70.)

Tenders Called For

TENDERS WANTED.

THE QUEBEC & SAGUENAY RAILWAY.

Tenders will be received up to March 2nd, 1911, at 5 o'clock p.m. by the undersigned, for the construction of about 56 miles of the above railway, from Cap Tourmente to Murray Bay Wharf, divided up into sections of ten miles.

A certified check amounting to $20,000, for each ten mile section tendered for must accompany each tender.

Forms of tender may be obtained and specifications and plans examined at the office of J. F. Guay, Civil Engineer, Morin Building, Quebec; also at office of The Canadian Engineer, 62 Church Street, Toronto.

The right is reserved by the company to reject any or all tenders.

(Sgd.) J. F. GUAY.

ST. CATHARINES WATER WORKS.

TENDERS.

Sealed tenders addressed to "The Chairman, Water Works Commission," endorsed "Tender for Pipe and Specials," gate valves, pig-lead, will be received up to noon on Tuesday, February 28th, 1911, for the cast iron pipe and special castings, 12-in. to 36-in.; gate valves, 4-in. to 36-in., and pig-lead required.

Specifications, forms of tender and full particulars may be obtained at the office of the Commission, City Building.

The Commission does not bind itself to accept the lowest or any tender.

ALEX. MILNE,
Superintendent.

St. Catharines, Ont., February 2nd, 1911.

CITY OF STRATHCONA, ALBERTA.

Tenders for Engine, Boilers and Generator.

Tenders addressed to David Ewing, Chief Engineer, Power House, Strathcona, Alberta, for above machinery, will be received until noon, Wednesday, March 1st, 1911. Specifications may be obtained upon application to the undersigned.

A. J. McLEAN,
City Engineer.

CITY OF WINNIPEG.

ELECTRICAL DISTRIBUTION SYSTEM.

Tender for Superstructure Sub-station No. 1.

Sealed tenders on prescribed form, addressed to the Chairman of the Board of Control, Winnipeg, Canada, and marked on the envelope "Tender for Superstructure Sub-station No. 1," will be received at the office of the undersigned up till 11 a.m., on Monday, February 20th, 1911, for the building of superstructure of this station on King Street, near Notre Dame Avenue, according to specification No. 57, copy of which, along with plans of building and form of tender, may be obtained by bona fide tenderers at the office of Smith, Kerry & Chace, Power Engineers, Carnegie Library, Winnipeg.

Each tender must be accompanied by certified cheque for five per cent. (5%) of the amount of tender.

The City reserves the right to reject any or all tenders, or to accept any bid which appears advantageous to its interests.

M. PETERSON,
Secretary.

Board of Control Office,
Winnipeg, February 6th, 1911.

NOTICE TO CONTRACTORS.

FOR CAST IRON PIPE.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, up to noon on.

Tuesday, February 28th, 1911,

for the supply of 20-inch CAST IRON PIPE.

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.

Tenderers shall submit with their tender the names of two personal sureties (to be 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-laws, must be strictly complied with, or the tenders will not be entertained.

The lowest or any tender not necessarily accepted.

C. R. CEARY (Mayor),
Chairman Board of Control.

City Hall, Toronto,
February 9th, 1911.

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

PATENT ATTORNEYS

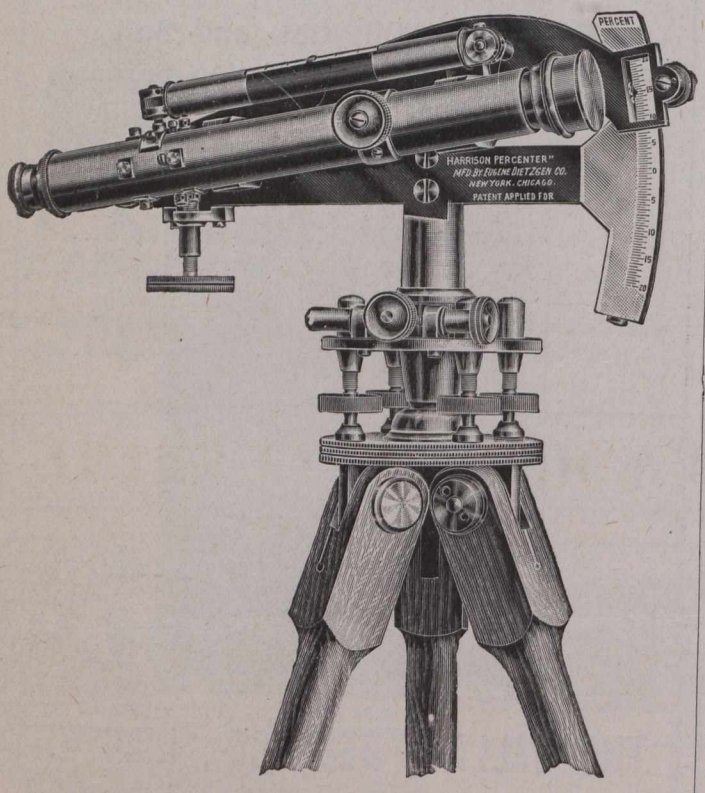
AMONG THE MANUFACTURERS

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

PERCENTER LEVEL.

Of the large exhibit which the Eugene Dietzgen Company, of Toronto, had at Winnipeg, the percenter level was the most interesting. This level has been designed to afford a ready means of determining, quickly and accurately, and with but one operation, the grade per cent. being taken between any two points, without measuring the distance between the same, and without any calculation or reference to tables.

In using the percenter level, it is necessary only to send a rodman to the point of which the grade is to be determined, and in one observation, taking but a moment's time, the grade can be found by a direct reading on the graduated arc of the instrument.



The instrument is practical and thoroughly reliable, and will be found especialy serviceable for use by railroad engineers and road builders on preliminary work. For the rapid determination of grades, cuts and fills, setting of stakes, irrigation work, etc., it is unequalled. It can also be used in place of the regular Dumpy level.

The weight of the instrument with tripod is only eight pounds, while the magnifying power is 22 diameters, and altogether is something new in engineers' field instruments.

SHELBY COUNTY COURT HOUSE.

That sidewalk lights are practical indoors as well as out is demonstrated by the construction of the new court house of Shelby county in Memphis, Tenn., where the "Raydiant" sidewalk light, manufactured by the Berger Manufacturing Company, of Canton, O., are in use.

The lights were installed largely in the courts of the huge building, which is one of the handsomest and most magnificent in the South. The cost of the building was $1,500,000. The architects for the court house were Hale & Rogers, of New York. Perfect light is essential in a county hall of justice, and it was only after a thorough test and demonstration of the light-giving qualities of the "Raydiant" system that the lights were contracted for.

NEW INCORPORATIONS.

Prince Albert, Sask.—Northern Brick Co., $50,000.

Harris, Sask.—Magnet Lumber and Implement Co., $15,000.

Gravenhurst, Ont.—Gravenhurst Hardware Co., $20,000. R. Wade, J. Scott, Orillia.

Brantford, Ont.—Pratt & Letchworth Co., $350,000. O. P. Letchworth, R. L. Fryer, C. W. Sherman.

Sault Ste. Marie, Ont.—Lethbridge Brick Co., $20,000. W. W. Lethbridge, C. B. Sexsmith, D. P. McPhail.

Sussex, N.B.—McQuin Lumber Co., $20,000. R. C. McQuin, W. C. McQuin, S. McQuin, of Penobsquis.

Madoc, Ont.—Canadian Talc and Silica Co., $100,000. C. J. Jones, F, E. Bray, H. B. Hungerford, Chicago.

Keewatin, Ont.—Lake of the Woods Boat Building Co., $40,000. H. T. Cossey, H. A. C. Machin, F. J. Ap' John.

London, Ont.—George N. Kernohan Lumber Co., $40,000. G. N. Kernohan, J. M. McEvoy, London; A. F. Hale, Pembroke.

St. John, N.B.—A. R. Williams Machinery Co., of St. John, $99,000. A. R. Williams, T. A. Hollinrake, Toronto; M. W. Doherty, St. John.

Hamilton, Ont.—Robert Hyslop Co., $50,000. R. Hyslop, W. T. Hyslop, A. J. Hyslop. Industrial Development Co., $100,000. W. Lees, L. F. Stephens, H. S. Lees.

Winnipeg, Man.—W. P. Jamieson & Co., $100,000. W. P. Jamieson, F. W. Stoneham, O. H. Clark. Lear Plumbing and Heating Co., $5,000. R. H. Lear, W. Benton, W. Gibb.

Montreal.—Mutual Profit Realty Co., of Canada, $100,000. A. A. Welsh, W. Roderick, Gananoque; G. B. MacCallum, Kingston. Guilbault, Desparois & Garneau, $100,000. W. G. Mitchell, R. Chenevert, F. Callaghan. Industrial Land Syndicate, $75,000. W. H. Cox, F. E. McKenna, R. H. Teare.

British Columbia.—Andersons, $200,000. Arrowhead Oil, Coal and Gas Co., $250,000. Butterfield, Mackie & Co., $50,000. C. H. Wallace Co., $10,000. Dreadnought Armour Safe Co., $150,000. Green City Vancouver Gold Copper Mines, $1,500,000. Vancouver Island Auto Co., $50,000. Victoria-Vancouver Lime and Brick Co., $100,000.

Toronto.—Independent Tire Company, of Toronto, $40,000. C. H. Stringer, O. W. B. Yearsley, C. W. Watson. Central Business Properties, $40,000. A. B. Ormsby, T. A. Rowan, N. Sommerville. General Holding and Development Co., $25,000. G. M. Clark, R. W. Hart, M. Gordon. Lake Shore Land Company, $100,000. M. E. Robins, N. Sinclair, S. Watson. English Canadian Investments, $40,000. R. B. Law, C. S. Buck, G. C. Campbell.