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REINFORCED CONCRETE BRIDGES BUILT OVER CURRENT RIVER, IN THE CITY OF PORT ARTHUR, ONTARIO.

BY L. M. JONES.*

The city of Port Arthur is beautifully situated on a hilly slope rising from the waters of Thunder Bay, Lake Superior. Almost through the centre of the city winds a little stream known as McVicar's Creek, while towards the northerly end of the city Current River finds its way to the lake. The banks of these two streams, as well as the surroundings, abound in the beauty of Nature, and present a pleasing view to any who have spent some time in the neighborhood.

The spanning of these streams with traffic bridges, both for vehicles and electric railways, has given the city engineer's department an opportunity of designing bridges to suit the required conditions in each case.

In General.—The bridges to be herein described were completed in the year 1911, and are constructed within the city park system, the one spanning Current River, the other carrying traffic over the penstocks immediately north of the river. These bridges are on the line of Cumberland Street (the main street of the city) and upon which the lines of the Port Arthur and Fort William Electric Street Railway are constructed. The chief object of constructing the bridges at this time was to give street car facilities to the employees of the Western Dry Dock and Shipbuilding Company's plant, which is located north of the river and near the lake shore.

Before commencing work there was considerable discussion as to where the bridges should be located, the Board of Park Commissioners being anxious to have the bridges built alongside the Canadian Pacific Railway Co.'s bridge, owing to the fact that they were of the opinion that the extension of the street railway would tend to divide the park into two portions. While this was somewhat true, the difficulties of construction, and the ultimate appearance of the bridges being considered, it was decided to build the bridge on the line of Cumberland Street.

The foundations at the location decided upon were solid rock, and as the work was done at the season of the year when the water was low, no difficulty was experienced in getting in the footings. For this location the type of construction selected was the reinforced girder and slab type, supported with concrete posts resting on the footings, with retaining walls to support the embankments. As there is a dam about 1,000 feet up stream from this location, it was decided that the placing of the posts in the river-bed would be

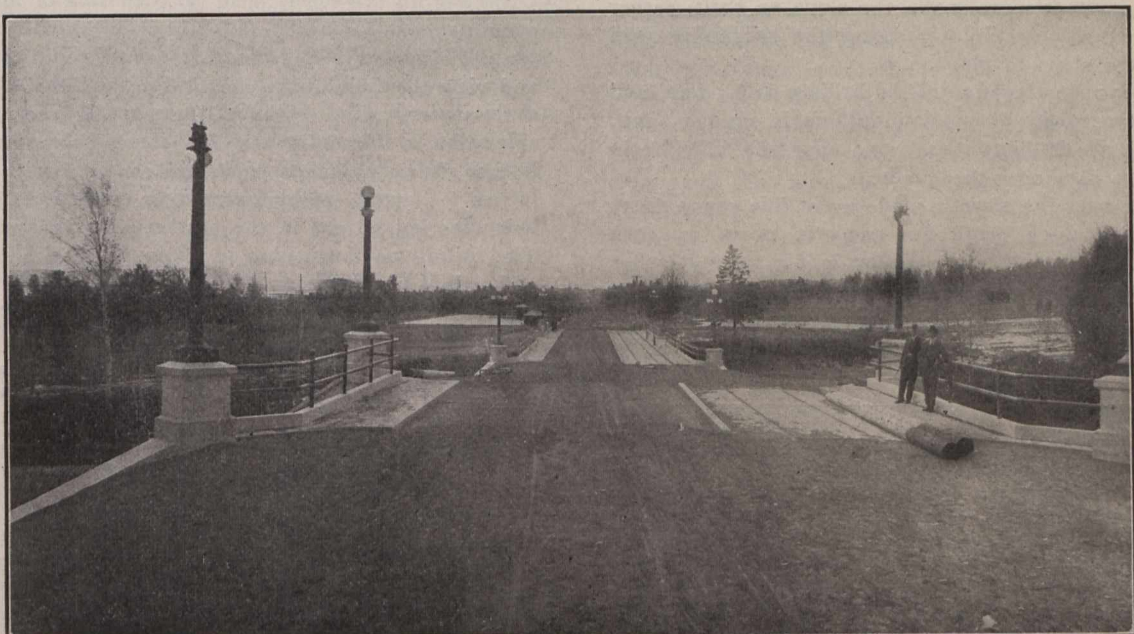


Fig. 1.—View Showing Deck of Both Bridges, with Swimming Pool in Distance.

* City Engineer of Port Arthur, Ont.

all right, as there would be no ice, driftwood, or such like to contend with. In Fig. No. 2 will be seen a general elevation of the two bridges, with roadway connecting same. It will be noticed that there is a difference between the elevations of the roadways of the bridges. The reason for this is, that it was thought best not to set the roadway elevation of the longer bridge to suit the requirements of the bridge over the penstocks, as this would necessitate a long embankment of considerable height to approach the bridge from the southerly end, and, as stated before, objections were raised to having this roadway divide the park into two portions. Also, if the bridges were kept at the same level it would make the slopes of the earth embankment extend too far into the swimming pool, shown in Figure 1, on the left-hand side. It is the intention to make the slope as built, rather flat, and sod it, so that children using the swimming pool can also use the slope to play on.

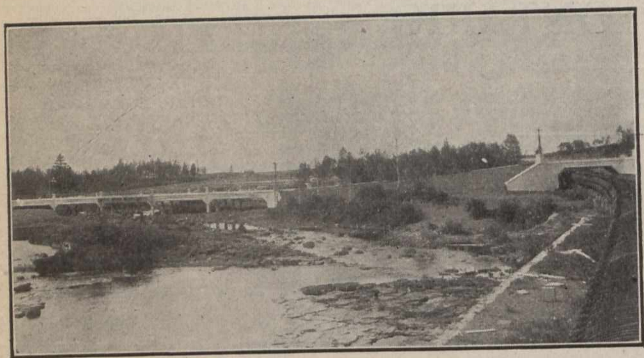


Fig. 2.—View Showing General Elevation of Bridges.

The difference in elevation of the bridges is 6.5 feet, and the grade of the roadway connecting them is six per cent., but as the distance is short there is no apparent difficulty in operating street cars over the grade.

The bridge over the river is made up of five spans, forty feet in the clear, there being five concrete posts in each bent, ten feet on centres, these posts being twenty inches square with champered corners and reinforced with four one-inch cup bars, held together with 3/16 in. hooping at intervals of one foot. The two outside beams were 16 in. by 36 in., and the three inside longitudinal beams being each 24 in. by 36 in., while the transverse beams over each bent were made 20 in. by 36 in. The minimum depth of the slab is nine inches, the roadway portion being sufficiently deep at the centre to form a suitable crown for the proper drainage of water, while the street railway portion was crowned to suit the depth of rail. The deck of the bridge is provided with two sidewalks, one being five feet wide, and the other six feet wide, a driveway 18 ft. 8 in. between the curbs, and a street railway reserve suitable for single track.

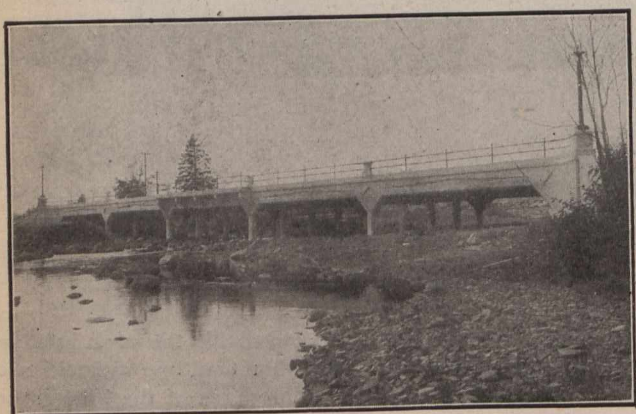


Fig. 3.—Showing Exterior Features of Design.

It might be well to explain here that owing to lack of funds, and the small amount of traffic in sight at the present time, we were unable to construct double tracks, unless the roadway width was sacrificed, which was not thought advisable. The vehicle roadway is paved with three-inch creosoted wood blocks laid in the usual manner, with expansion joints at each curb, and at every twenty feet at right angles to the line of the roadway. The portion in the track allowance was finished with 2 to 1 cement mortar troweled to a smooth finish with proper slopes to the rain water outlets.

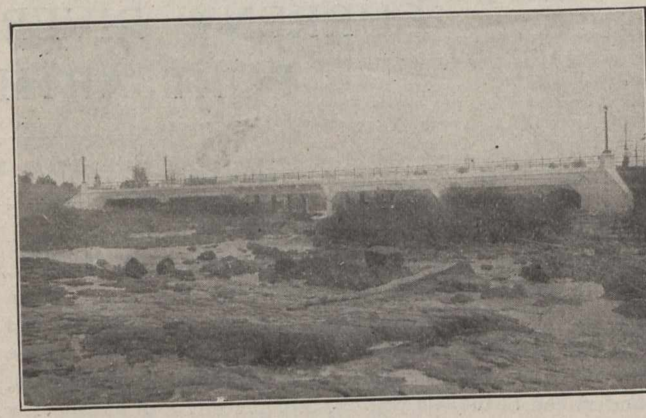


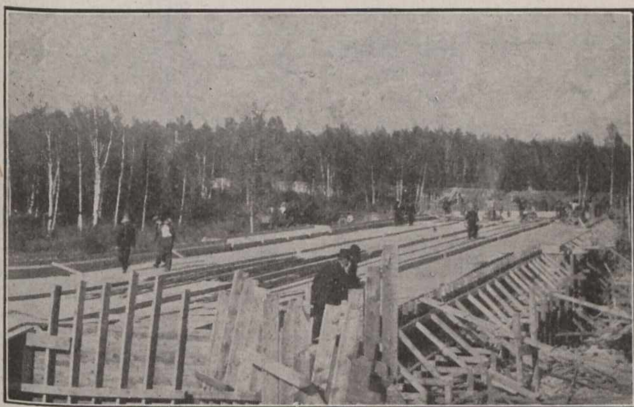
Fig. 4.—View Looking Downstream.

Overhanging the centre span on each side of the bridge was constructed a balcony 3 ft. 3 in. wide by the length of the span. These were built so that people could stand on them and view the falls above the bridge, and the scenery on the down-stream side, without interrupting the traffic on the sidewalks. The supports for these balconies were cantilevered from the main beam and covered with a slab four inches in depth. Besides providing space for sight-seers the balconies helped out in the aesthetic features of the design. The railing on the bridge is 2½-in. pipe with plain fittings, and a ball ornament on each post. Over each bent is constructed a concrete post, as part of the railing, while pedestals of larger proportions are placed at the ends of the railing to support the lamp standards. Where the pipe rails enter the concrete posts and pedestals they enter a pipe of large diameter set in the concrete, and in this way free ends are provided for expansion. The lamp standards are the "Luxolabra" type with five lamps on each, all lamps being 40 watt tungstens. The railing and lamp standards were all painted a deep green, and the effect is very good.

Fig. 5.—Bridge Over Penstocks.

In designing the architectural features of the bridge the aim was to make all lines straight in preference to any curved lines, and thus reduce the cost of formwork. Also, the idea being to make all surfaces as sharp and clean cut as possible.

The general features of the bridge over the penstock are similar to those of the longer bridge, the span being twenty-six feet in width. On the cross section of the bridge submitted herewith the details of the beams and slabs are fully shown. After the embankment connecting the two bridges has fully settled to a solid condition, it is the intention to connect the curbs, sidewalks, and railings on each bridge, and to finish the roadway in a permanent manner.



Cumberland Street Bridges; View of Form Work in Place.

The rails for the street cars were bedded and surrounded with concrete, being held together with tie rods at intervals of four feet. So far, and under traffic conditions, this has proved satisfactory, there being no signs of chipping or cracking of the concrete; in fact, this can be said of the entire work.

Design.—In figuring for the design of the bridges, the calculations were based on the following data:—

Live load, a thirty-ton street car, and an additional live load of one hundred pounds per square foot, with an amount for impact figured at fifty per cent. of the live load.

Ratio of modulus of elasticity of steel to that of concrete, 15.

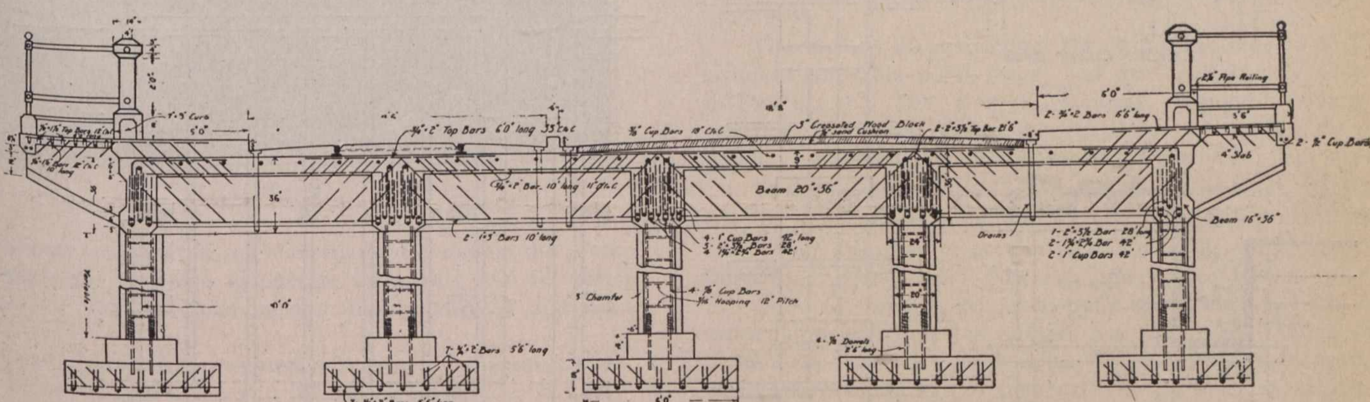
Allowable working stress of steel in tension, 16,000 pounds per square inch.

Society of Civil Engineers. The sand used was ordinary bank sand, sharp and coarse grained, with a very small percentage of loam. The broken stone called for in the specifications was crushed trap rock, of a size that would pass a one-inch ring. Shortly after the work was commenced the demand for crushed rock was so great that it was impossible for the contractor to secure any, so it was decided to use the lake shore gravel.

This gravel is found on the lake shore, about ninety miles from Port Arthur, and is admirably suited for work of this kind. In size the gravel ranges from the size of a pea up to that which will pass through a one-inch ring, the stones being of various shapes, mostly angular. As the surfaces of the stones are pitted, the cement mortar has a far better chance to bond with them than it has with ordinary gravel, and as the stone is of a granite nature the strength of the concrete was not feared by using this gravel. The proportions for the reinforced concrete were as follows: Columns, 1; 1½; 3. Slab, 1; 1½; 3. Beams, 1; 2, and 4, and for the mass concrete in wing walls and abutments, 1; 3; 5; with "plums" placed in the ordinary method. All the concrete was mixed with a "Ransome" concrete mixer. In order to obtain a good surface on the exposed faces of the bridge, the concrete mixture was of a sloppy nature, great care being taken to have the concrete well spaded and worked next to the forms. The results are very good, as may be seen in the accompanying views of the bridge.

Tenders were called for the work on July 10th, 1910, and the contract awarded to Messrs. Seaman and Penniman, of Fort William, on August 2nd. Owing to delays in securing materials the work was slow in progressing, so that it was late in the fall before the concrete work for both bridges was completed. All the forms were left on the bridge through the winter, and early in the spring of 1911 the wood blocks were laid, railing set up, and the bridges properly finished. The contractors are deserving of great praise for the work they did, their methods of working, and the diligent manner in which they attended to all the details of the form work, etc., had a good deal to do with the successful carrying out of the designs.

Construction.—The reinforcing steel used in the construction of the bridges was the "Kahn System of Reinforcing," and was furnished by the Trussed Concrete Steel Co., of Walkerville, Ontario. In order that contractors could tender on the same basis, as regards the reinforcing steel,



Reinforced Concrete Girder Bridge over Current River, Port Arthur. Section at Centre Span, Showing Balcony.

Allowable working stress for concrete:—

(1). The extreme fibre, 750 pounds per square inch.

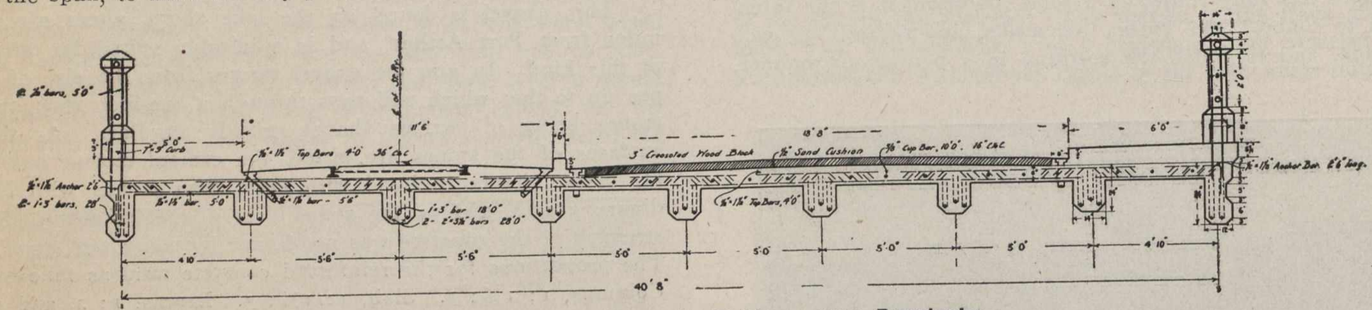
(2). Direct compression, 600 pounds per square inch.

(3). Shear, 50 pounds per square inch.

Concrete.—The cement used in the concrete was Lehigh brand, Portland cement, which, when tested, had to meet the requirements of the cement specifications of the Canadian

the city purchased it direct and delivered it f.o.b. the site of works.

After the footings were set in place, the form work was commenced on the columns, girders, and abutments. The steel in the columns was then set in place, and the abutments and columns were poured to the level of the under side of girders. The forming was then constructed for the entire work on both bridges, according to the details shown in the plans presented herewith. Great care was exercised in getting the forms well braced and finished, so that all exposed surfaces would appear smooth and uniform after the removal of the forms. In this, the efforts were very successful, and good results were obtained. The forms for the long span girders were given a camber of ¾ inch at the centre of the span, to allow for any possible settlement when forms sidewalks, roadway, and track portions was completed. Upon the completion of the whole work on the bridges, and after the forms were removed, the surfaces of concrete exposed to view were well brushed with steel brooms, and a coat of waterproofing, known as "Dry Wall" was applied. The results of the application are apparently all right, as far as can be seen at present, but it was feared at the time it was applied that the material would peel off.

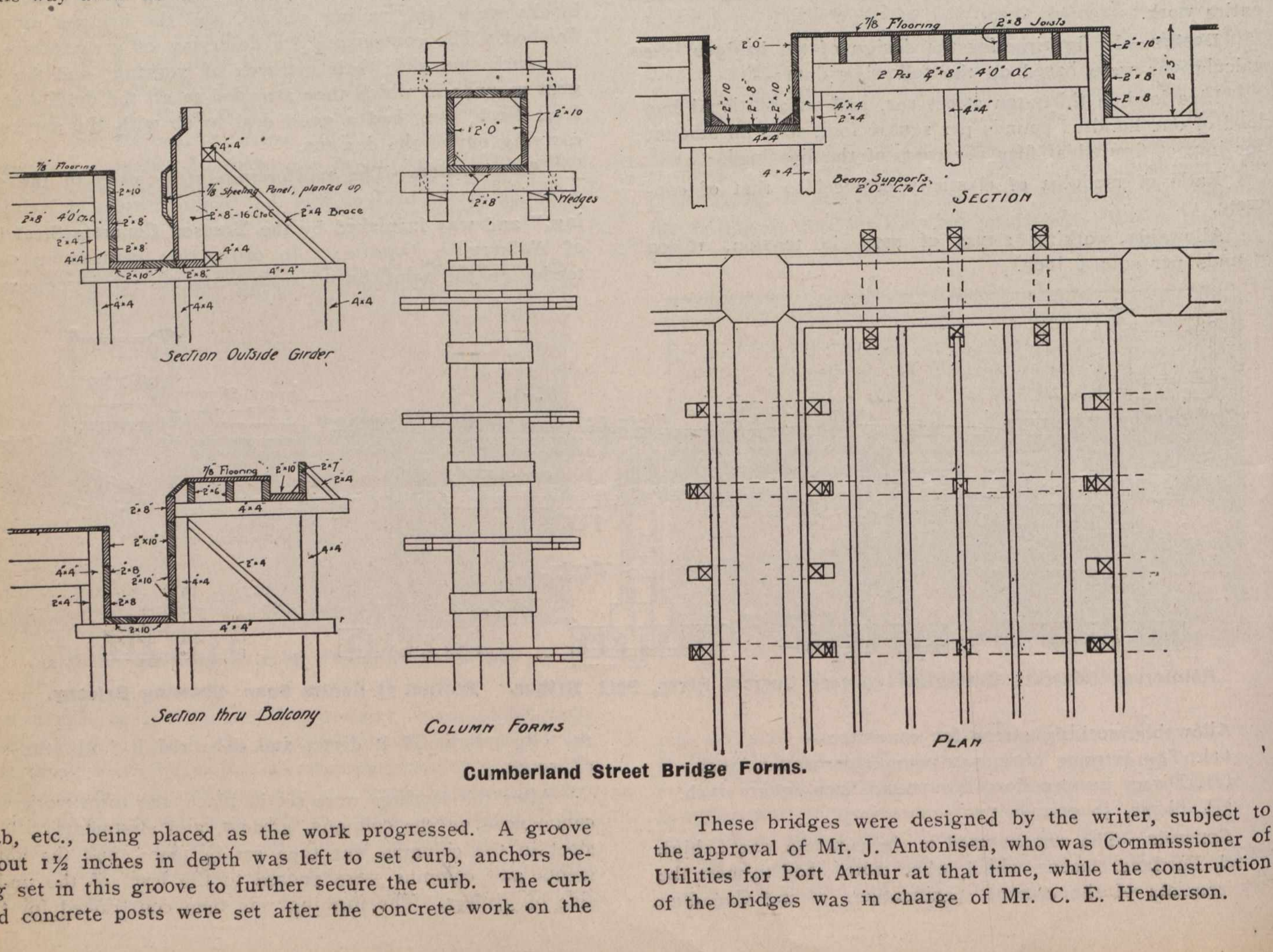


Cross-Section of Concrete Bridges over Penstocks.

were loaded with concrete. After the work of setting forms was completed, the steel was placed in the girders, being firmly supported with wire, fastened to a 2-in. by 4-in. placed across the opening of girder forms at intervals of 3'-0. The pouring of concrete was then commenced and carried on day and night until the completion of each bridge. As stated before, the concrete was of a rather sloppy nature, and besides reasons previously stated, this was necessary as owing to the amount of steel in the beams, it was difficult to thoroughly embed it with anything but a concrete of this kind. The concrete work was commenced at one end of the bridge and finished up to the top of the slab, and continued in this way until the other end was reached, the steel in the

The cost of the bridges is as follows:—

Bridges, proper constructed in place	$17,589.98
Reinforcing steel	3,800.00
Freight and hauling steel	628.46
Lamps, including duty, wiring, etc.	585.85
Dry rock excavation	50.00
Boulder excavation	280.00
Dry earth excavation	153.40
Wet earth excavation	377.60
Rip-rap	198.20
Earth embankment	2,493.25
Sundries	223.94
Total	$26,380.68



Cumberland Street Bridge Forms.

slab, etc., being placed as the work progressed. A groove about 1½ inches in depth was left to set curb, anchors being set in this groove to further secure the curb. The curb and concrete posts were set after the concrete work on the

These bridges were designed by the writer, subject to the approval of Mr. J. Antonisen, who was Commissioner of Utilities for Port Arthur at that time, while the construction of the bridges was in charge of Mr. C. E. Henderson.

SIGNALING AND INTERLOCKING.*

The author of this paper directed the attention of his audience to the signaling and interlocking systems of the new passenger terminal of the Chicago and North Western Railway Company.

When this structure had assumed a condition wherein the signaling system demanded a rigid comparison with pre-existing types, the three-position upper quadrant semaphore signal was adopted.

By the adoption of this type of signaling and the use of all three positions on the dwarf signals in the Lake Street or terminal plant, the company were able, with one signal, to give information of proceed, stop, and as to position of the signal ahead. This was deemed necessary for enginemen and trainmen in the safe handling of trains at reasonable speed, and results have shown the absolute safety and reliability of the practice. At Lake Street use was made of the third position on the last signals governing trains inbound into the depot to indicate that the track under the train shed is clear.

The dwarf signals (Fig. 1) are motor driven and, except at the Lake Street plant, all dwarf signals are used in two positions only, viz., horizontal and diagonal.

Inasmuch as the signaling and interlocking of a large terminal is installed as much for the acceleration of traffic as for its protection, the means of receiving and giving information and of communication is one of the important features, and was, therefore, given a great deal of attention, and in the solution of the problem almost everything was considered. The telegraph was dismissed from consideration almost immediately, as it restricted too closely the source of supply for levermen to operate the plants and for tower directors. The various means finally adopted and used were:—

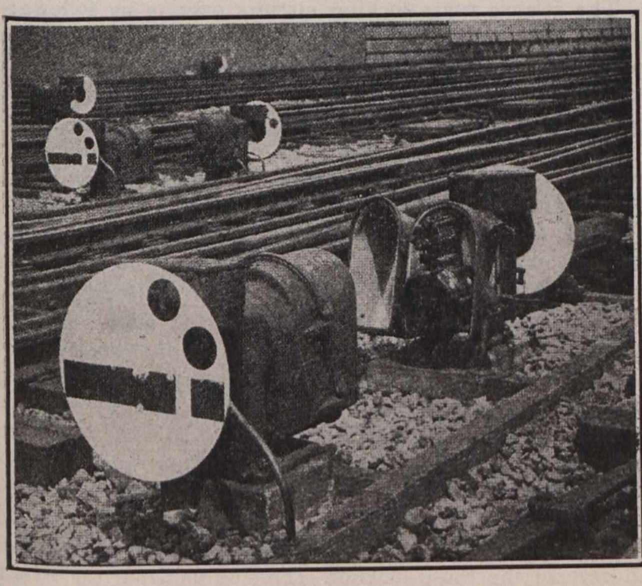


Fig. 1.

Conductors-towermen-gatemen's system of annunciators.

Telautographs.

Various forms of automatic train annunciators and indicators.

Illuminated track diagram.

Lights over levers.

Telephones.

Intercommunicating system.

* Abstracted from a paper read before the Western Society of Engineers, by J. A. Peabody.

In operating the system for through trains, the conductor pushes his butten one minute before time for his train to leave. This lights the top light on the tower director's table and the first light of the gatemen's indicators, reminding the tower director and gateman that it is nearly time for the train to leave. The tower director, if he can handle the train on time, immediately pushes his button, which action puts out the top light and lights the second one on his table, puts out the first and lights the second one at the gate, and lights the top light of the conductors' indicators. When it is time for the train to leave, the gateman closes his gates, and after waiting for the last passenger who went through the gate to get on the train or at least giving him sufficient time to do so, he pushes his button. This puts out the second light at the gate, puts out the top light and lights the lower one of the conductors' lights, and puts out the second and lights the third of the tower directors' lights, thus advising the conductor and tower director that the train may leave. The conductor then, and not until then, gives the engineman the signal to proceed, which he does, provided the proper interlocking signal indicates that he may. The restoring of the first interlocking signal to the stop position automatically restores the system to its normal condition ready for the next move.

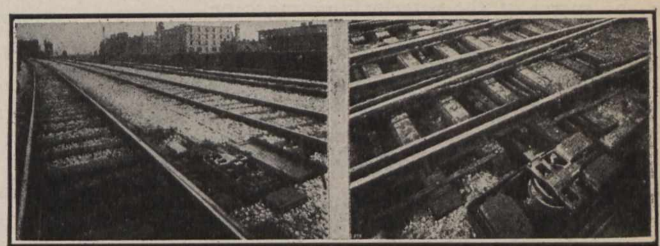


Fig. 2a. Single Switch. Fig. 2b. Double Slip Switch.

For giving information from one tower to another of a train move and something as to its character, a push button scheme was developed which has been named the "Intercommunicating System."

The indication on these boards is made by small telephone lamps arranged in horizontal rows and columns. The columns represent the track numbers, and the rows the various classification of trains. The boards were made to suit local conditions and are entirely of standard telephone apparatus.

The method of connecting the switch movements to the switches, movable point frogs, and derails is clearly shown in Fig. 2 a. b. The General Railway Signal Company's standard No. 4 movement was used for everything except derails, for which their standard No. 2 movement was used.

No detector bars were employed on the switches, derails, etc., of the Lake and Clinton Street plants, detector circuits only being relied on to protect against the throwing of these functions under trains. In the other three plants, where the speed of trains is on an average much higher, both detector bars and detector circuits are employed. When detector bars were not used with the No. 2 movement, a spring was applied on each movement to take its place in insuring that vibration would not operate the movement sufficiently to unlock the derails if the control circuit were broken.

The track circuits used as detector circuits were made as long as possible consistent with operating conditions, in order to cut down as much as possible the total number of track circuits required and also in a measure provide against slow-acting relays.

Continuous rail insulated joints were used. The switch rods are insulated and the switch tie plates cut so as to leave a space of not less than two inches between the ends, as experience, covering a period of several years, demonstrated that the strength of a continuous plate between two rails is not required; also, the cut plate is much cheaper both in first cost and maintenance and can be inspected for insulation without difficulty.

The operating switchboard, the circuits of which are shown in Fig. 3, contain the main protection used for the interlocking apparatus.

The power wires from the main power switchboard pass through this board to the interlocking machine. The ammeter is inserted in the positive wire. By means of this ammeter the leverman may watch the current used to operate the switches and signals, and can tell whether they are working properly.

At Lake and Clinton Streets, several ammeters are placed on the turret of the interlocking machine.

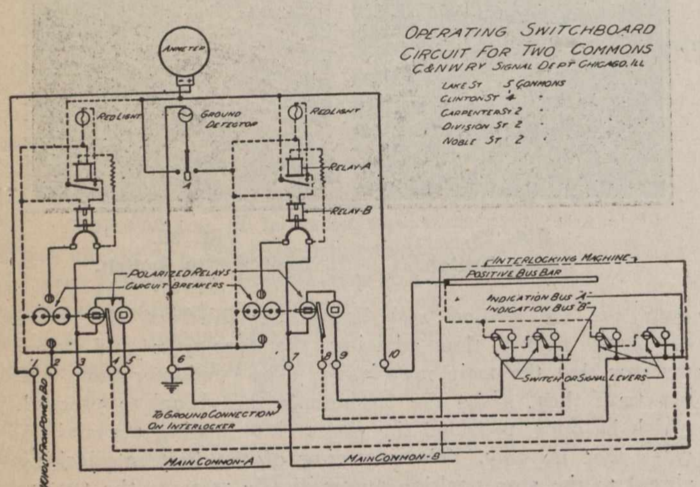


Fig. 3.—Circuits-Operating Board.

The track circuits for the interlocking plants are fed by means of loops from 20-volt storage batteries located in the towers. Two positive and two negative wires are run from the low voltage distributing board to the junction boxes in the section of the plant to be fed. The wires of the same polarity are joined at the end, thus forming loops so that current from the switchboard has two paths to any point on the loop. The loop wires can break at any place, and every point would still receive current.

On the switchboard, ammeter jacks are placed for each wire and again for the main feed wires after the loop wires have joined. A regulating rheostat is inserted in the positive lead capable of cutting the battery down to about 12 volts, at which point it is generally maintained. The track sections are fed from various points on the loop through resistance units placed on each side. These are in most cases 37.5 ohms, although on some sections the resistance has been reduced on one side to meet local conditions. These resistances are of the enclosed fuse type mounted on the terminal boards of junction boxes and manholes. During wet weather, when the leakage between rails increases, the rheostat may be used to allow more current to flow to compensate for this leakage. The purpose of the ammeter jacks is to determine when a break occurs in any of the loop wires. As long as the circuits are perfect the readings are the same, while if there is a break the readings on the No. 1 and 3 wires will be different from the readings on the No. 2 and 4 wires respectively.

In calculating the size of the wire for the loops, one side of each loop was considered cut off at the switchboard and every track circuit occupied except the one nearest the cut-off end.

The voltage required on this last track circuit must be enough to pick up its relay. The voltage on the switchboard being 12, the current used by each shunted track circuit being known, the size of wire is easily worked out. The practical limit to the number of track circuits that could be fed from a loop was found to be 20. Relays of 12 ohms are used on all circuits fed from the track circuit loops. A 12-ohm resistance unit is located in series with the relay to obtain a quick drop-away of the armature, the time being reduced 50% by the insertion of this resistance. This is very desirable on account of the detector locking.

Where the track sections are adjacent to the towers the track relays are located in the tower, but where they are too far away for efficient operation, repeater relays are placed in the tower and controlled by the track relays which are placed adjacent to the track sections.

For the train-shed track circuits two 110 volt to 20 volt direct current to direct current motor generator sets were installed in a relay room under the station platform. These feed direct to the tracks, no storage battery being used, and the sets are run successively in six hour periods.

These motor generator sets are run off the depot lighting system, and by using them instead of a rheostat, the lighting circuits and track circuits are kept separated, and any grounds which may occur on one will have no effect on the other.

At tthe signal bridges at which power-houses are located, the track circuits are each fed from a single cell of 120 ampere hour capacity storage battery with an 8-ohm resistance in series. Relays of 4 ohms are used where the track circuit is fed from these individual cells.

The release route locking circuits operate as follows:—A train entering a route locks up all switches, derails, and movable point frogs in the route, and when the train leaves each track section, all switches, derails, and movable point frogs in that section are released so that they may be moved.

This result is accomplished as follows: The circuits are divided into two general classes—the stick relay circuits and the lock circuits. The stick relay circuits are composed of the stick relay pick-up and the stick relay stick-up wires. The lock circuits are composed of the battery feed wire and the lock wire. The direction in which the locking takes effect is determined by the position of the stick relay, the relay being up when the train is going in one direction and down when going in the other. The relay is picked up by a contact on the sigal governing in the direction requiring the relay up, and is then held up by back contacts on the track relays in the route. The signal in the opposite direction does not pick the stick relay up and consequently it remains down. It will be readily seen that restoring one signal to normal position and clearing the opposing signal will reverse the route locking. This is valuable for switch-engine moves and also for those trains which are too long to completely enter the station and clear the last switch circuits of the interlocking plant.

The levers are controlled by electric locks located on top of the lever, the circuit being held normally open by a contact operated by the lever latch. A white light is in multiple with the lock and latch contact, showing at all times whether the lock can be energized or not. Each lock is controlled directly by the track relay of the section in which the switch is located, thus providing absolute detector locking, making it impossible to operate a switch lever, and therefore the switch, when the section in which that switch is located is occupied. The lock wire receives battery from a back contact of the stick relay while battery is fed to the other end of the route over the battery feed wire, when the stick relay is energized, through the front point of the relay. Thus it will be seen that when a train is going in the direction that the stick relay is energized, battery is fed behind the train as it proceeds. When the train is proceeding in the opposite direction, the stick relay being de-energized the current is also fed from behind the train. The switches and derails by this means are always locked ahead of and under the train while those which are behind the train are unlocked. In case it becomes necessary to change a switch or derail ahead of a train which has come to a stop, current may be supplied to all locks in the route except those under the train by means of a push button so located in the tower that it requires one man to operate it while the leverman is operating the lever, thus bringing two men into operation.

On account of the number of circuits, requiring a great mass of wires, it was necessary to do the work mechanically, i.e., furnish detailed plans showing exactly how each piece of work was to be done, the workmen being required to follow these plans without any knowledge of the circuits involved.

Terminal board plans were made for every junction box and manhole, showing the wires to be spliced through, the wires to go to terminals, the location of terminals and resistance units.

In the same way, plans were made of terminal boards for junction boxes on signal bridges and for those located in the towers.

Plans of the conduits were made, showing location and size of each. Tables were furnished showing the number and size of wires in each duct, the total length of each wire, and the number of feet to be left out at each end. The number of each wire and its destination was also shown.

Plans were then furnished of the back of the relay racks, the combination board, interlocking machine proper, the release buttons, etc., showing the details for connecting the wires and using the tag numbers described above to identify them.

The circuit sheets were written instead of drawn, and by description or number gave each connection to be made and each cable or conduit through which a wire ran. This work of the drafting room saved an immense amount of work in the field.

The motor-generator set provided for charging the storage batteries is located at the signal bridges.

The batteries being in duplicate, each set of battery has a charging switch so arranged that the load is never deprived of battery. The switch is constructed so that either set of battery may be discharged with the other on open circuit or being charged. In accomplishing this result and to avoid short-circuiting the battery a resistance is inserted in the circuit in the intermediate positions. All charging switches on the switchboard are arranged in series so that any number may be cut in at the same time. The voltage of the generator is adjusted for the number of cells being charged. Terminals are provided for connecting in a portable voltmeter ammeter.

To provide for the possibility of the alternating current failing or a fuse opening in the motor end, a three-phase 220-volt relay is used, operated in parallel with the motor controlling the charging circuit. Whenever the power fails or a motor fuse opens up, this relay opens the charging circuit preventing discharge of the battery. If the power returns, after failing, the relay picks up again and restores the charging circuit. As it picks up before the motor has reached full speed, the battery current runs the generator end as a motor and aids in bringing the set up to speed without excessive overloading.

THE DESIGN OF TALL CHIMNEYS.*

(Continued from last week).

Centre of Wind Pressure.—Let h = height from bed joint to centre of gravity of diametral plane, which will be the centre of wind pressure, H = whole height of portion, D = lower diameter, and d = upper diameter, then—

$$h = H \times \frac{D + 2d}{3(D + d)}, \text{ and } p = \frac{W(\frac{1}{2}D - l)}{hH\frac{1}{2}(D + d)}$$

For rapid proof we may apply this to the square pier,

$$\text{thus, } p = \frac{270(\frac{1}{2} \times 3 - 1)}{15 \times 3 \times 30} = 0.1 \text{ cwt.} = 11.2 \text{ lb. as before.}$$

When Tension is Permissible.—When tension is permissible on the inner edge the wind pressure may be increased, so that the resultant is forced nearer to the overturning edge. The maximum pressure will, under these circumstances, be $K\left(\frac{W}{A}\ 4 - 6\frac{l}{D}\right)$ and the minimum, or tension, $k = \frac{W}{A}\ 6\frac{l}{D} - 2$

Air and Combustion.—There are now some interesting points to note with regard to the use of the chimney. With air at 60 deg. Fahr., 30-in. bar., about 13 cu. ft., weigh 1 lb., and 12 lb. of air (156 cu. ft.) are required to combine with the constituents of 1 lb. of coal for perfect combustion, but to allow for working conditions it is necessary to provide 24 lb. (312 cu. ft.), which is equal to 700,000 cu. ft. of air per ton of coal. Putting it in another way, the air and smoke together, at a temperature of, say, 300 deg. Fahr.,

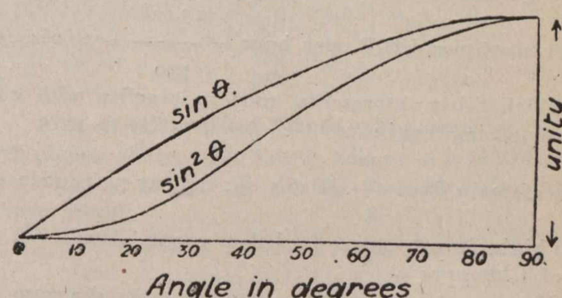


Fig. 5.

equal about 2,000 cu. ft. per cubic foot of water evaporated. The maximum economical draught for boilers is that arising from, or equivalent to, the pressure due to ½-in. head of water, causing a consumption of about 36 lb. coal per hour per square foot of fire grate area. The temperature of combustion in the furnace is about 2,400 deg. Fahr. The temperature of the gases is generally ascertained by hanging strips of metal foil in the flues on an iron wire, and noting which are melted by the heat—viz., copper 2,000 deg., aluminum 1,800 deg., zinc 750 deg., lead 630 deg., tin 440 deg. A 3-in. cast-iron pipe is sometimes built in the base of the chimney for the purpose of introducing these test pieces or a pyrometer, or for testing the suction. The temperature may be as low as 300 deg. Fahr., with any Cornish or Lancashire boilers, or as high as 1,000 deg. Fahr. with water tube boilers. At 600 deg. Fahr., which is about the usual temperature of the escaping gases, the volume of air entering the furnace is doubled on exit.

Chimney Draught.—The force of the draught in a chimney stack is the deficiency of weight of the column of rarefied air in the chimney compared with a similar column of the external air. The velocity in feet per second is, roughly, two and a half times the square root of the height in feet. As regards smoke prevention, there are several patents on the market, but a good stoker is the best smoke preventer.

Horse Power of Chimney.—The horse power of a chimney is sometimes spoken of. For a round chimney the following rules have been given:—

(1) $H.P. = 3\frac{1}{3}\ (\text{area sq. ft.} - 0.6\ \sqrt{\text{area}}) \times \sqrt{\text{height ft.}}$

(2) $H.P. = 2\frac{1}{2} \times \text{diam. ft.}^2 \times \sqrt{\text{height ft.}}$

(3) $H.P. = \dfrac{\text{diam. in.}^2 \times \sqrt{\text{height ft.}}}{70}$

(4) $H.P. = \dfrac{\text{diam. in.}^3}{300}$

but one would have supposed there were enough variations of horse power without introducing another.

APPENDIX.

Design for Chimney.—In order to emphasize the author's description, he now proposes to design a circular chimney for four Lancashire boilers, each having two furnaces, 2 ft. 9 in. wide × 6 ft. long, burning 12 lb. coal per square foot of firegrate per hour, and evaporating 9½ lb. water per pound of coal. The boilers themselves are 7 ft. 6 in. diameter × 30 ft. long, with Galloway tubes, and supply steam to an engine of 750 I.H.P.

Total firegrate area $= 4 \times 2 \times 2.75 \times 6 = 132$ sq. ft.

Consumption of coal per hour $132 \times 12 = 1{,}584$ lb.

Consumption per week of fifty-six hours $\dfrac{1{,}584 \times 56}{2{,}240} =$ 39.6, say 40 tons.

Water evaporated per hour $= 1{,}584 \times 9.5 = 15{,}048$ lb. $= 1{,}504.8$ gallons.

Water used per I.H.P. per hour $= \dfrac{15{,}048}{750} = 20.064$, say 20 lb., which fairly represents modern practice with compound condensing engines.

Area of main flue $\dfrac{132}{8} = 16.5$ sq. ft., say 3 ft. wide × 5 ft. 6 in. high, invert, say 4 ft. below ground level.

Height of Chimney:—

(a) From coal consumption, scaling from diagram, 40 tons per week = 140 ft. high.

(b) From length of flues, chimney being 28 ft. from further boiler. Three times length of boiler + twice length of main flue $= 3 \times 30 + 2 \times 28 = 146$, but there is something inviting about round numbers, so that 140 ft. may be decided upon as the height above ground level, or 150 ft. in all.

Sectional Area of Chimney:—

(a) From coal consumption $= \dfrac{1{,}584}{112} = 14.14$ sq. ft.

(b) From firegrate area $= \dfrac{132}{10} = 13.2$ sq. ft.

(c) From indicated horse power (I.H.P.) of engine $= \dfrac{750 \times 2\frac{1}{2}}{144} = 13.02$ sq. ft.

(d) From coal consumption and height $= \dfrac{1{,}584}{12\sqrt{150}} =$ 10.8 sq. ft.

(e) From firegrate area and height $= \dfrac{132}{1.5\sqrt{150}} = 7.18$ sq. ft.

An allowance of 14 sq. ft. should therefore be ample without any further allowance for friction. Reference to a table of areas shows that 4 ft. 3 in. diameter = 14.18 sq. ft. area, which may be decided upon as suitable.

Height of firebrick lining, $\dfrac{150}{5} + 10 = 40$ ft.

SKETCH SECTION.

Data.—Main flue 5 ft. 6 in. by 3 ft., invert 4 ft. below ground level. Chimney 140 ft. high, 4 ft. 3 in. least internal diameter. Lining 40 ft. high, 20 ft. of 9-in. thick and 20 ft. of 4½-in. vertical. Batter not less than 2½ in. in 10 ft.

Least permissible outside diameter at ground line $\dfrac{140}{12} = 11$ ft. 8 in. Thickness of shaft, say, 20 ft. of 1 brick, 20 ft. of 1½ brick, 20 ft. 2 brick, 20 ft. of 2½ brick, 20 ft. of 3 brick, 20 ft. of 3½ brick, 20 ft. of 4 brick, remainder of 4½ brick. Projection of cap 9 in.

The diameter at ground line requires to be 2/3′ 4½″+2/1½″+2/9″ 4′ 3″=12′ 9″. The diameter at top requires to be 2/9″+4′ 3″=5′ 9″, which fortunately gives the round number of 7 ft. for taper, or 3′ 6″ batter on each side = 42 in. in 140 ft. $= \dfrac{42}{14}$ ins. in 10 ft. = 3 in. in 10 ft., or each 20-ft length increases 1 ft. in diameter.

If the upper half of the firebrick lining stands central on the lower half, the clearance at top of former will be found thus: $\dfrac{36}{10} \times 3 = 10.8$ in. batter, $10.8 \times 2 = 21.6$, say 1′ 9½″ taper, reduced outside diameter 12′ 9″—1′ 9½″ = 10′ 11½″. Inside diameter of shell = 10′ 11½″—2/2′ 7½″=5′ 8½″. Outside diameter lining =4′ 7½″+2/4½″=5′ 4½″. Clearance=½ (5′ 8½″—5′ 4½″=2 in. at top of firebrick lining to be covered by oversailing course projecting, say, 4 in., and with clearance above top of not less than $\dfrac{40}{5} \times \frac{1}{8}$ = 1 in. to allow for expansion.

The clearance outside lower length of firebrick lining at junction with upper length will be $\dfrac{16}{10} \times 3 = 4.8$ in. batter, $4.8 \times 2 = 9.6$ in., say 9½-in. taper, reduced outside diameter 12′ 9″—9½″=11′ 11½″, inside diameter of shell=11′ 11½″—2/3′ 0″=5′ 11½″. Outside diameter of lining =4′ 3″+2/9″ =5′ 9″. Clearance=½ (5′ 11½″—5′ 9″) = 1¼ in., which will be satisfactory, but before the design is proceeded with further the stability should be calculated.

Calculation of Stability.—The first step in calculating the stability is to determine the weight of each portion between the various set-offs. Suppose the material to be picked stock bricks laid in lias mortar, the weight may be taken at 112 lb. per cubic foot.

Weight of Each Length.—

$$\text{Top length} = \pi h t \left(\frac{D + d + \sqrt{Dd}}{3} - t \right) \times 112 = 3.1416 \times$$

$$20 \times 0.75 \left(\frac{6.75 + 5.75 + \sqrt{6.75 \times 5.75}}{3} - 0.75 \right) \times 112 = 47.124 \times$$

$5.493 \times 112 = 28991.5$ lb.

2nd length	=	48371.68 lb.	
3rd	"	=	71147.44 lb.
4th	"	=	97148.08 lb.
5th	"	=	126509.60 lb.
6th	"	=	159230.40 lb.
7th	"	=	195096.16 lb.

Weight Above Each Set-Off.—The weights will be required in totals above each set-off; they may therefore be collected as follows:—

1st set-off	....		=	28991.50
2nd "	28991.50	+ 48371.68	=	77363.18
3rd "	77363.18	+ 71147.44	=	148510.62
4th "	148510.62	+ 97148.08	=	245658.70
5th "	245658.70	+ 126509.60	=	372168.30
6th "	372168.30	+ 159230.40	=	531398.70
7th "	531398.70	+ 195096.16	=	726494.86

Areas of Bed Joints.—The next step is to find the sectional area at the lower end of each portion—i.e., the bearing surface at each set-off—viz., $A = \frac{\pi}{4}(D^2 - d^2)$, d being now inside diameter.

1st set-off	.7854	$(6.75^2 - 5.25^2)$	= 12.74
2nd "	.7854	$(7.75^2 - 5.50^2)$	= 12.74
3rd "	.7854	$(8.75^2 - 5.75^2)$	= 34.16
4th "	.7854	$(9.75^2 - 6.00^2)$	= 46.34
5th "	.7854	$(10.75^2 - 6.25^2)$	= 60.08
6th "	.7854	$(11.75^2 - 6.50^2)$	= 75.20
7th "	.7854	$(12.75^2 - 6.75^2)$	= 91.84

Mean Pressure.—The mean pressure due to the direct load will also be required at each set-off—viz., $m = \frac{W}{A}$,

$$\text{1st set-off } \frac{289991.5}{12.74 \times 2{,}240} = 1.01 \text{ tons per sq. ft.}$$

2nd "	....	= 1.45	"	"
3rd "	....	= 1.91	"	"
4th "	....	= 2.34	"	"
5th "	....	= 2.79	"	"
6th "	....	= 3.16	"	"
7th "	....	= 3.53	"	"

Moduli of Section.—The modulus of section corresponding to each of these sectional areas—viz., $Z = \frac{\pi}{32}\left(\frac{D^4 - d^4}{D}\right)$, d being inside diameter, will be—

$$\text{1st set-off } 0.1012\left(\frac{6.75^4 - 5.25^4}{6.75}\right) = 19.65$$

2nd "	....	= 35.10
3rd "	....	= 55.20
4th "	....	= 80.42
5th "	....	= 111.43
6th "	....	= 148.91
7th "	....	= 185.28

Height of Centre of Wind Pressure.—The height of centre of wind pressure—i.e., centre of gravity of diametral plane—above each set-off—viz., $h = H \times \frac{D + 2d}{3(D + d)}$, d being top diameter, will be—

$$\text{Above 1st set-off } 20 \times \frac{6.75 + 2 \times 5.75}{3(6.75 + 5.75)} = 9.73$$

$$\text{" 2nd " } 40 \times \frac{7.75 + 2 \times 5.75}{3(7.75 + 5.74)} = 19.00$$

" 3rd "	....	= 28.00
" 4th "	....	= 36.50
" 5th "	....	= 45.40
" 6th "	....	= 53.64
" 7th "	....	= 61.74

Width at Centre of Pressure Above Each Set-Off.—This will be given by the formula $w = D - \frac{h}{H}(D - d)$, where h = height of c.g. of diametral plane above set-off, H = whole height above ditto, D = diameter at set-off, d = diameter at top.

$$\text{1st set-off } 6.75 - \frac{9.73}{20}(6.75 - 5.75) = 6.75 - 1 \times .487 = 6.26$$

2nd "	....	= 6.80
3rd "	....	= 7.36
4th "	....	= 7.92
5th "	....	= 8.48
6th "	....	= 9.07
7th "	....	= 9.67

Wind Pressures.—The wind pressure on each portion, according to the formula from which the table is constructed, will be $\log p = 1.125 + 0.32 \log (h + g) - 0.12 \log w$, where g is height of set-off in question above ground line, and h centre of pressure as in last paragraph.

Above 1st set-off, $\log p = 1.125 + 0.32 \log (129.73) - 0.12 \log (6.26)$

$= 1.125 + 0.32 (2.1130404) - 0.12 (.796574)$

$= 1.125 + .6761729 - .095588$

$= 1.7055840$

$\therefore p = 50.76$

Above 2nd set-off	"	= 48.89
" 3rd "	"	= 47.10
" 4th "	"	= 45.22
" 5th "	"	= 42.83
" 6th "	"	= 40.50
" 7th "	"	= 38.00

Area of Diametrical Planes.—The areas of the diametrical planes above each set-off will be $d = \frac{1}{2}(D + d)H$, where D = diameter at set-off, d = top diameter, H = whole height above set-off.

1st set-off	$= \frac{1}{2}(6.75 + 5.75)20$	= 125	sq. ft.
2nd "	$= \frac{1}{2}(7.75 + 5.75)40$	= 270	"
3rd "	$= \frac{1}{2}(8.75 + 5.75)60$	= 435	"
4th "	$= \frac{1}{2}(9.75 + 5.75)80$	= 620	"
5th "	$= \frac{1}{2}(10.75 + 5.75)100$	= 825	"
6th "	$= \frac{1}{2}(11.75 + 5.75)120$	= 1,050	"
7th "	$= \frac{1}{2}(12.75 + 5.75)140$	= 1,295	"

Bending Moment Due to Wind Pressure.—The bending moment due to wind pressure above each set-off, taking coefficient for circular chimney as $\frac{\pi}{4}$, will be $\frac{\pi}{4} p a h$.

$$\text{1st set-off } \frac{.7854}{} \times 50.76 \times 125 \times 9.73 = 18.52 \text{ ft.-tons.}$$

$$\text{2nd " } \frac{.7854}{} \times 48.89 \times 270 \times 19.00 = 75.24 \text{ ft.-tons.}$$

3rd "	= 172.10	ft.-tons.
4th "	= 307.48	"
5th "	= 481.25	"
6th "	= 683.80	"
7th "	= 911.46	"

Stress Due to Bending Moment.—The stress due to bending moment only will be $\frac{M}{Z}$, thus:—

1st set-off $\frac{18.52}{19.65} = 0.94$ tons per square foot.

2nd " $\frac{75.24}{35.10} = 2.14$ " "

3rd " $\frac{172.10}{55.20} = 3.11$ " "

4th " $\frac{307.48}{80.42} = 3.82$ " "

5th " $\frac{481.25}{111.43} = 4.31$ " "

6th " $\frac{683.80}{148.91} = 4.60$ " "

7th " $\frac{911.46}{185.28} = 4.91$ " "

Maximum Pressures.—The maximum compression on the leeward edge of chimney at each set-off under the full theoretical wind pressure may now be obtained by the formula $K = m + \frac{M}{Z}$ and the tension on the inner edge $k = m - \frac{M}{Z}$

					Tons per sq. ft.
1st set-off	1.01 + 0.94	=	1.95	comp.,	0.07 comp.
2nd "	1.45 + 2.14	=	3.59	"	0.79 tens.
3rd "	1.91 + 3.11	=	5.02	"	1.20 "
4th "	2.34 + 3.82	=	6.16	"	1.48 "
5th "	2.79 + 4.31	=	7.10	"	1.52 "
6th "	3.16 + 4.60	=	7.76	"	1.44 "
7th "	3.53 + 4.91	=	8.44	"	1.38 "

The safe load on the material according to the limits laid down being 8 tons per square foot, the result shows a trifle over, but not sufficient to necessitate any alteration in the design.

Cap and Base.—No account has been taken of the weight of cap nor of the extra surface it exposes to the wind, but the effect of these will be so slight that the stability will not be affected thereby. The part immediately above ground will usually be in the form of a square pedestal externally, with cornice, plinth and base; this will add considerable sectional area at the lowest set-off, reducing the maximum pressure, but increasing the whole load on foundations.

No Tension on Inner Edge.—If tension is not to be permitted on the inner edge then we must find the maximum wind pressure permissible by the formula $l = \frac{3D^2 - d^2}{8d}$ (d being inside diameter) and $p = \frac{W(\frac{1}{2}D - d)}{hH\frac{1}{2}(D+d)}$ (d being top diameter).

$$\text{Then } l = \frac{3 \times 12.75^2 - 6.75}{8 \times 12.75} = 4.33456 \text{ and}$$

$$p = \frac{726494.86(\frac{1}{2} \times 12.75 - 4.33456)}{61.74 \times 140(12.75+5.75)} = 18.54 \text{ lb. per square}$$

foot as the mean effective pressure over the whole area, but being cylindrical, the equivalent normal pressure on a plane surface would be $\frac{18.54}{0.7854} = 23.6$ lb. per square foot, or, according to Rankine's coefficient, $\frac{18.54}{0.5} = 37$ lb. per sq. ft.

Summary.—It will thus be seen that, unless extraordinary means are taken to secure stability beyond the allowances that have been made in the design, a wind pressure

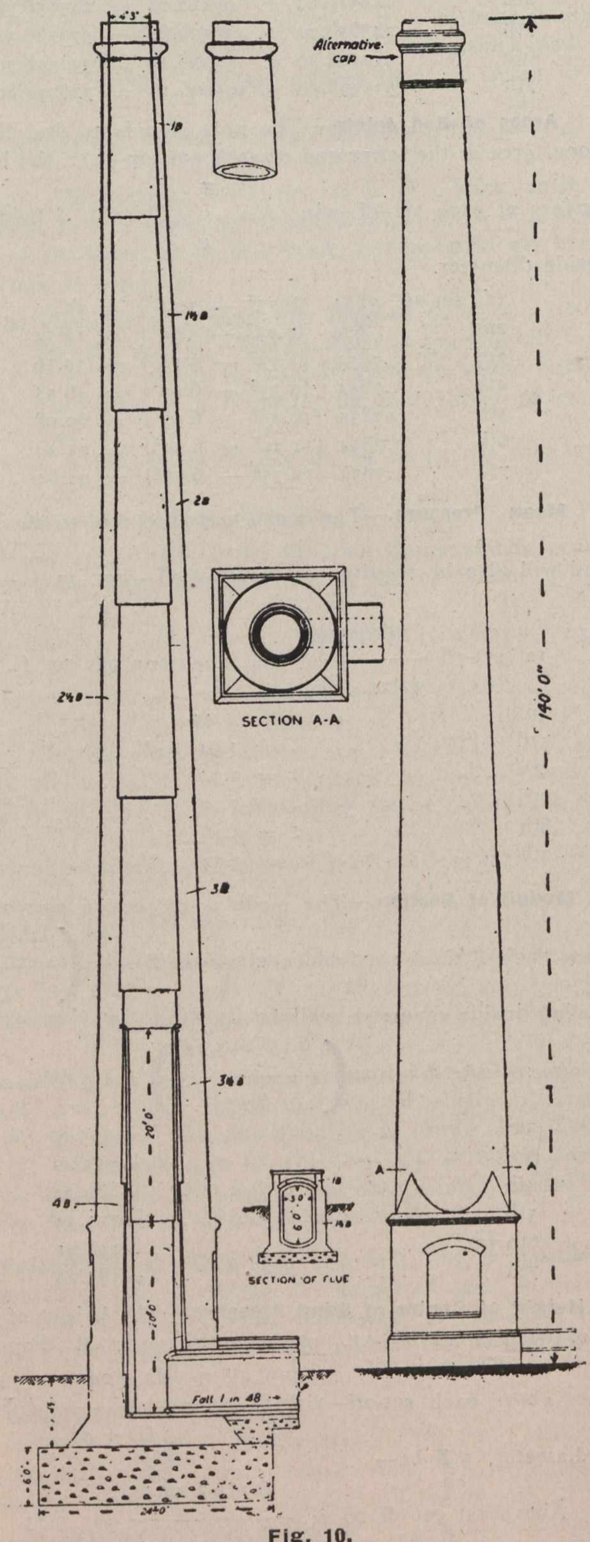


Fig. 10.
Design Accompanying Prof. Henry Adams' Paper on "Tall Chimneys."

varying from 38 lb. to 50.76 lb. per square foot will cause a maximum compression of 8.44 tons per square foot and a maximum tension of 1.52 tons per square foot, both being within the safe limits of the material, but that if no tension is to be allowed on the inner edge the wind pressure must not exceed an average of 23.6 lb. per square foot, or 37 lb.

(according to the coefficient taken), against a normal plane surface.

Prof. Unwin says (in "Bridges and Roofs," p 119): "We are in this country visited annually by gales, singularly constant in their maximum force, amounting to from 20 lb. to 25 lb. per square foot, on a surface perpendicular to their direction. More rarely cyclonic storms sweep over the country, during which still higher pressures are registered. A pressure of 30 lb. was registered during the Royal Charter storm; one of 33½ lb. was observed at Greenwich in the storm preceding the fall of the station roof at Manchester. Higher pressures still, up to as much as 55 lb., have been recorded at various times, but the accuracy of these observations is more doubtful. We shall probably allow margin enough for the worst contingency if the maximum pressure of the wind is assumed at 40 lb. per. square foot of a surface perpendicular to its direction.

Concrete Base.—The size of the concrete base will depend to some extent upon the nature of the soil, but it must be wide enough to avoid any risk of tilting under maximum wind pressure. This may be calculated as follows, assuming the concrete base to be 24 ft. square and 6 ft. deep—

Weight of shaft	....	726,495. lb.
" plinth, say	....	83,628 "
" footings,	say.	163,632 "
" concrete,	say.	414,720 "
		1,388,475 " = say, 620 tons.

Then $m + \frac{M}{Z} = \frac{620}{24 \times 24} + \frac{911.46}{\frac{1}{6} \times 24^3} \doteq 1.472$ tons per square foot maximum compression, and 0.681 tons per square foot minimum compression on the earth below the concrete.

Protection from Lightning.—The lightning conductor should consist of a coronal or copper band round the top of chimney, with copper needles, 6 in. long, fixed at intervals of 3 ft. or 4 ft., the points being platinized, gilded, or nickled, to prevent corrosion. The main conductor should be not less than 1 in. × ¼ in., securely attached to the coronal by a clean metal-to-metal connection, and be carried down side of shaft without insulation, but held by projecting holdfasts and clips every 4 ft. to 6 ft. The lower end should be carried down 2 ft. under the ground and 10 ft. away from the base, riveted and soldered to a sheet of copper 4½ sq. ft., area, 1/16 to ⅛ in. thick, and embedded in moist earth or coke-breeze. A tube well, as adopted by Mr. Killingworth Hedges, forms the best earth terminal when there is any doubt about the moisture round the copper being permanent.

Completion of Design.—The design may now be completed as shown.

Cost of Chimney.—The cost of building a tall brick chimney shaft is approximately 1s. 3d. to 1s. 6d. per cubic foot of the solid materials, labor alone being 4d. to 6d. per cubic foot, but much, of course, depends upon locality, quality of materials, and cost of labor.

Classification of Wind Force.—The classification by different writers of the force of the wind varies considerably. The following is a fair average:—

Description.	Velocity in miles per hour.	Approximate corresponding pressure lb. per sq. ft.
Barely perceptible wind ..	2½	1/32
Light breeze	5	⅛
Pleasant breeze	7½	¼
Good breeze	10	½
Strong breeze	15	1⅛
High wind	20	2
Half gale	30	4½
Strong gale	40	8
Whole gale	50	12½
Great storm	60	18
Hurricane	80	32
Violent hurricane	100	50

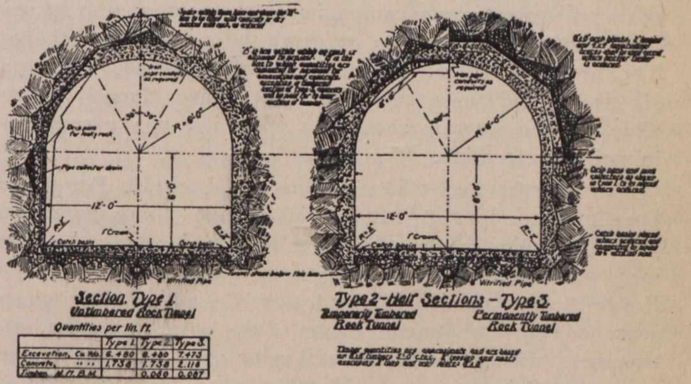
By Smeaton's formula $p = \frac{V^2 \text{ miles per hour}}{200}$

Alphons Custodis Chimneys.—The Alphons Custodis Chimney Construction Company have built a large number of tall chimneys in America and England, their specialty being radial perforated bricks, which appear to have every advantage but that of weight. Weight being one of the elements of stability, its reduction can only be compensated for by increase of one or more of the other elements, such as batter of shaft, diameter at base, or the tensile and compressive strength of bricks and jointing material. This company claim that the strength of their brickwork enables them to design very economical and efficient chimneys, but one would like to learn a little more about the wind pressure they are capable of resisting.

Improving an Old Chimney.—A chimney not powerful enough for its work may be improved by lengthening, or by the application of a moderate forced draught, such as the Meldrum system of steam jets in a closed ashpit. This system can also be made powerful enough to do the whole work with only a short iron shaft, but iron or steel shafts are very perishable, and brickwork is worth the extra cost, particularly as a tall chimney discharges the foul gases of combustion at a better height for dilution by the atmosphere. The importance of the latter point will be understood from the fact that the boilers described above would discharge about 40,000 cu. ft. of carbonic acid gas per hour into the atmosphere.

UNDERGROUND STREET CONSTRUCTION.

A proposed underground highway for foot traffic, to be built in the upper section of New York, will affect a populated area of half a square mile or more, and will bring about a saving of a quarter to a third of a mile walk to a large number of citizens who are required to use the subway frequently. This tunnel is to overcome the circuitous routes to Dyckman or 181st streets.



Typical Cross Sections—Tunnel Street, New York City.

The tunnel will open off from Broadway at grade a few feet from Fairview Avenue. The general level of the floor will be reached by going down two short flights of steps. The "street" will run 904.40 feet straight away down a 1.09 per cent. grade to a point 35.18 feet west of the subway station and then turn practically at right angles ending in front of the elevator by which the Interboro Company conveys its passengers to and from the street, 153 feet above.

The tunnel will be twelve feet wide and twelve feet high in the clear, the sides running up six feet straight to the arched roof, which will have a radius of six feet.

The entire construction will be of concrete reinforced with steel in the walls and roof, and permanently shored with timbers where necessary. With the exception of 173 feet at the street end of the tunnel, the entire excavation will be through solid rock, which fact of course greatly increases the cost of construction.

The contract for the construction of Tunnel Street has been awarded to Roswell D. Williams, 21 Park Row, Manhattan, at an aggregate bid of $72,260. An itemized schedule of the prices follows: 5,900 cu. yds. of rock excavation at $6.75 per yd., 2,300 cu. yds. of earth excavation at $1.20 per yd., 1,200 cu. yds. of refilling at 30 cts. per yd., 2,200 cu. yds. of concrete at $7.78 per yd., 750 cu. yds. of excess concrete at $6 per yd., 200 cu. yds. of dry packing at $2 per yd., 30,000 ft. (B.M.) of timber at $30 per M., 1,000 lin. ft. of galvanized wrought iron pipes at 50 cts. per ft., 800 lin. ft. of 6-in. pipe drain at $1 per ft., 360 sq. ft. of concrete (steps, landing, sidewalk, etc.) at 40 cts. per ft., 10 catch basins at $20 each, 33 sq. yds. of surfacing at 15 cts. per yd., 11,000 lbs. of steel beams and girders at 5 cts. per lb., 5,000 lbs. of steel rods and bars at 4 cts. per lb., 11,000 sq. ft. of floor finish at 10 cts. per ft., electric system (for lighting) complete $1,150.

The construction of the tunnel is expected to have an appreciable influence on the development of that section of Manhattan which it affects.

The difficult and devious approaches to the subway stations have hitherto constituted an indubitable and serious deterrent to the popularity as a residental section of a large area in that neighborhood. With its electric lights, adequate drainage and ventilating provision and equable temperature, the underground street will do much to relieve the discomfort of the transit situation.

PRESERVATION OF POWER TRANSMISSION POLES.*

By W. R. Wheaton.

The increasing cost of power transmission poles in recent years and the high maintenance charges have turned the attention of power companies to some process to increase the life of the poles and to cut down the maintenance charges. The first cost of the poles has nearly doubled in the past six years, and these two factors have been largely responsible for the interest shown by operating power companies in pole preservation.

In March, 1908, the San Joaquin Light & Power Corporation set a line of Western yellow pine (Pinus ponderosa) poles. The line is about 30 miles long and contains approximatel 6000 poles. These poles were cut in the Sierras above Fresno at an elevation of about 4,000 ft., and were thoroughly seasoned before treatment. Some of the poles received a brush treatment with carbolineum and with creosote, and the rest were treated in an open tank with creosote, zinc chloride and crude oil. The butt only was treated. Western yellow pine is very susceptible to a preservative treatment. Some of the butts were thoroughly penetrated with creosote and with zinc chloride, the average penetration (at the ground line) being 3 in. The penetration with crude oil averaged about 1½ in. The crude oil used was a heavy oil of asphaltum base supplied from the Kern River fields. In order to get a comparative life of the wood treated and untreated, stubs of untreated timber were set along the line about a mile apart. The writer inspected this line in June, 1910, at which time it had been set for twenty-seven months. The untreated stubs set along the line were completely rotten. Of the poles brush-treated with carbolineum and creosote the conditions were about the same, a large percentage of each showing signs of decay; 27 per cent. of the poles that had a brush treatment with creosote showed signs of decay, and 29 per cent. of the poles that has treatment with carbolineum showed decay, while 45 per cent. of the poles treated with crude oil were slightly attacked by decay. Of the poles treated with zinc chloride, 28 per cent. showed attack by decay. The poles treated with creosote in the open tank (over 50 per cent. of the entire line were treated in this way) were all perfectly sound and showed absolutely no signs of decay.

In August, 1911, two of the poles in this line which had received a brush coating of creosote fell over, owing to decay at the butt. During August and September, 1911, the line was gone over and all of the poles which had had a brush treatment of creosote or carbolineum were so badly decayed that they were strapped to a creosoted cedar stub.

The above results speak for themselves. The value of the experiment is apparent and is enhanced by the fact that the timber used will entirely decay, without treatment, in a year.

The San Joaquin Light & Power Corporation is now treating Western red cedar poles at the butts only by the open-tank process. There is no necessity for treating the top, since the top is not subject to decay. With this process the outer ring of sap wood on the cedar poles is filled with creosote, and if the timber is thoroughly seasoned before treatment there is little difficulty in accomplishing this. The penetration varies from ½ in. to 1 in. with an absorption of from 7 lb. to 9 lb. per cubic foot. As for the efficiency of the treatment, treated and untreated cedar poles have been set for four years. The creosoted poles are still perfectly sound, while the poles set untreated have decayed through the sap wood and into the heart.

The question has been asked why zinc chloride, copper sulphate or some preservative other than creosote has not been used to cut down the treatment charges. It was found that several poles treated with chloride of zinc were, after the installation of irrigation systems, in the middle of irrigated fields. The zinc was washed out of them, and the poles had to be replaced after a service of two years. The saving in the cost of treatment by the use of a metallic salt would not mean a saving in the end if many such replacements took place. A 50-ft. creosoted pole placed in the line means an investment of about $25. The use of chloride of zinc would cut this cost to about $24.25, and the saving is too small to be considered against the possibility of the loss of the preservative by leeching out after one or two years.

* Abstract of a paper read at the annual meeting of the Wood Preservers' Association, Chicago. Ill., Jan. 16-18, 1912.

SALT IN ONTARIO.

The occurrence of salt in that part of Ontario which lies entirely in the southwestern peninsula bordering Lake Huron, the St. Clair River, Lake St. Clair, and the Detroit River, according to such exploratory boring as has been done, indicates that there are a number of separate relatively small basins. The beds range from mere seams to formations 200 feet or more in thickness. The supply of salt in Ontario is practically inexhaustible. The bulk of the salt manufactured is used in Ontario. The quantity of salt produced in 1910 was 84,071 tons, valued at $414,978, as compared with 77,490 tons, valued at $389,573, in 1909.

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

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CONTENTS OF THIS ISSUE.

THE C. N. R. IN MONTREAL.

Some very interesting problems are suggested in the undertakings of the C.N.R., which will be commenced in Montreal next spring. The construction of the three-mile tunnel under Mount Royal will, of course, occupy first place among these. It would now appear that shafts from the surface of the ground may be sunk down to the tunnel at different points throughout its length, and that elevators may there be installed for the purpose of making connections for passengers. One of these shafts will probably be located half a mile or so from the north portal of the tunnel to accommodate residents in that vicinity. It is just possible that a shaft may also be sunk near the site of the look-out, so that sightseers may have access to the mountain through the C.N.R. tunnel and elevator.

At the south portal of the tunnel the line will emerge into daylight at the same level as the present Windsor Depot of the C.P.R., and will then reach across to the harbor. The tracks will be elevated all the way. Near the harbor a freight yard will be provided, the yard being elevated. It is figured that this will possess many advantages over the customary freight yard.

It is suggested that the tunnel should be connected with the subway system, which, it is believed, the requirements for rapid transit will necessitate before long, in such a manner that passengers will be enabled to transfer from one system to the other without coming to the surface.

GOOD ROADS.

On Thursday last a deputation, representative of all parts of Canada, waited upon the members of the Dominion Government to bring up the subject of "Good Roads." The delegation, which numbered about four hundred, urged that there should be aid given by the Federal Government for good roads construction. The inception of the Good Roads policy, the Act for which is now before the House, has been long demanded, and it is certain that this representative gathering will have great effect in securing prompt action. While the question of Good Roads is primarily one for the local municipalities, the counties and the provinces to handle, there is no doubt the Dominion Government can do a great deal to aid the movement. In all probability this aid will be in the form of grants to the Provincial Government for the construction of roads. It is outside their jurisdiction, however, to provide for maintenance.

Aside from the question of grants of money for purposes of constructing roads, the Federal Government must take up the question of the establishment of a Bureau of Highways. If there is to be an extensive system developed throughout the country, there must be developed and trained experienced road superintendents to take charge of the work. Definite standards and uniform methods must be laid down if there are to be adequate results for the expenditure in this connection. Therefore, it would seem that the most urgent matter for the Dominion Government to take up, ranking in importance above the question of grants for construction, is the establishment of a Department of Roads along the lines of the Office of Public Roads of the United States. This Department, however, in our opinion, should not form or be associated with the Department of Agriculture. In the United States such is the case, and at the Convention of Road Builders, recently held in Rochester, the suggestion was made that instruction for highway engineers should be given in the agricultural colleges. This is a mistake, as the logical place for the giving of such instruction is in the Engineering Faculties of our universities. These faculties have the necessary testing laboratories, and by the addition to their teaching staff of trained highway engineers, adequate instruction in the science of road-making can be given. The problems of road construction properly come under the engineer's work, and, therefore, can be better solved by him.

With a strong Department of Roads valuable data with reference to the wear of different types of roads, the compiling of specifications, etc., can be collected and made available for use throughout the Dominion. There is little question that such a Department is urgently required at the present time.

ENGINEERING STANDARDS COMMITTEE.

The question of an Engineering Standards Committee for Canada has been brought up and discussed a number of times, and it is a matter which must be finally settled at an early date if the engineering profession and the manufacturers are to secure the advantages of standardization of the different materials of construction. The seventh report on the work accomplished by the Engineering Standards Committee of Great Britain has recently been published; this is a document which records the progress in connection with standardization. The personnel of the committee and some idea of their work was published in the January 18th issue of *The Canadian Engineer*. It is interesting to note the progress made during the past year. The report states that the recommendations of the committee for sizes and for tests of materials continue to find their way gradually but surely into a very general use. The use of British Standard tramway rails is continued, the British Standard sections rolled during the year ending March, 1911, amounting to nearly 70 per cent. of the total tonnage produced.

The report states that a proposal has been submitted to the committee for the re-designing of the Standard Sections of tramway rails, so that they may have a uniform width of head throughout the series. The reason for this suggestion is that in the country lighter rails than those employed in the towns could then be laid, while still preserving the same width of head. At present the widths of the tires of cars intended for travelling over the heavier and broader sections are rather wide for the lighter and narrower sections. This subject is receiving the careful attention of the sub-committee concerned, but, having regard to the very extensive use of the existing standard sections, no alteration should be made unless it is clearly advantageous, and is backed by some evidence of a general desire for a change. Among other matters which have been dealt with by the committee, and in respect of which specifications or drawings will be issued shortly, are cast-iron pipes for house drainage, water, gas, and sewerage purposes.

Progress is being made with the standardization of vitrified ware pipes, and in this matter full acknowledgment is made of the assistance which is being afforded by the Institution of Municipal and County Engineers. That body has tabulated the data obtained from its members, and a report has been presented to the committee. A meeting was held to discuss the lines upon which standardization should proceed, and the manufacturing members have beeen aked to consult together and carry out tests with a view of formulating proposals which will be considered in conjunction with those received on the engineering side from the Institution of Municipal and County Engineers.

NEW PSYCHROMETRIC FORMULAE FOR USE IN AIR CONDITIONING.

A specialized engineering field has recently developed, technically known as air conditioning, or the artificial regulation of atmospheric moisture, the application of which to many varied industries has been shown to be of great economic importance.

The following information is abstracted from a paper by Willis H. Carrier, in the November Journal of the American Society of Mechanical Engineers:—

In the blast-furnace work it has increased the net profit in the production of pig iron from 50 to 70 cents per ton, and in textile mills it has increased the output from 5 to 15 per cent., at the same time greatly improving its quality and the hygienic conditions surrounding the operatives. The question of humidity is equally important in many other industries, such as lithographing, the manufacture of confectionery, bread, high explosives and photographic films, and the drying and preparing of delicate hygroscopic materials, such as macaroni and tobacco.

It is believed that its proper application in coal mines would prevent explosions to a great extent.

Accepted data used in psychrometric calculations are based largely on empirical formulae which are incorrect and also limited in their range. The author has therefore developed the following rational expressions, based on the established principles and laws governing atmospheric moisture, the latest results obtained by investigators of the properties of steam and water vapor, and data obtained from his own experiments.

Grains of moisture per pound of pure air at saturation =

$$G = 5284Ds\ (t + 459.64) \div (P - e) \qquad (1)$$

in which

t = Temperature of saturation, deg. F. ($t + 459.64$ = absolute temperature).

Ds = Density of saturated water vapor at temperature t, lb. per cu. ft. = reciprocal of specific volume of steam (as per values in Marks & Davis steam tables).

P = 29.92 = assumed standard of barometric pressure, in. of mercury.

e = vapor pressure of saturated water vapor, in. of mercury.

Also,

$$e = e^1 - [(P - e^1)\ (t - t^1)] \div (2800 - 1.3t^1) \qquad (2)$$

in which

e = vapor pressure at dry-bulb temperature t.

e^1 = vapor pressure at wet-bulb temperature t^1.

This equation should be used where the true wet-bulb temperature is ascertained by using an aspiration psychrometer. When a sling psychrometer is used, an average correction of 1.6 per cent. must be made for radiation error, making formula read:

$$e = e^1 - [(P - e^1)\ (t - t^1)] \div (2755 - 1.28t^1) \qquad (3)$$

Formulae (2) and (3) will give values of e with an error of less than 0.5 per cent., assuming Swann's value of the mean specific test of the air between t and t^1 to be correct.

Per cent. of relative humidity = $R = e \div e_2$, in which e is taken from (2) and e_2 = vapor pressure corresponding to saturation at the dry-bulb temperature t.

Let W = grains of moisture per cu. ft. at any vapor pressure e, and W_2 = grains per cu. ft. at e_2; then $W = RW_2$; also, $W = W_1\ (460+t^1) \div (460+t)$, in which W_1 = grains per cu. ft. corresponding to the dew point at vapor pressure e.

POWER PRODUCTION IN ISOLATED PLANTS AND COSTS.

In a paper presented to the American Institute of Electrical Engineers, Mr. P. R. Moses gives some interesting figures on the cost of making electricity. The following is abstracted from his paper:—

If heating is a negligible matter, as it is in tropical countries and in many manufacturing and industrial establishments, the choice of a prime mover is governed by the balance between investment and efficiency.

The high efficiency modern producer gas engine and the oil engine by their simplicity and reliability offer many advantages over the high pressure steam plant, and where steam is not used for other purposes to an extent proportional to the power requirements, the tendency is rightly, I think, toward this type of plant.

Two producer gas engine plants recently installed have given results fully equal to the guarantees, and a kilowatt-hour can be and is regularly produced at the switchboard under regular operating conditions for about two pounds of No. 1 buckwheat anthracite or pea coal, and this in plants of a few hundred kilowatts capacity.

One of these plants, of 175 kw. capacity, of which the load curve is given, is making current for 1.14 cents per kilowatt hour, including fixed charge on a power house, etc., for a duplicate equipment. These are the owners' figures and include all charges.

The other plant, a 600-kw. plant, divided into three units is using 1.75 pounds of pea coal per kw.-hr. under regular working conditions, including all fuel used for banking.

As the cost of the gas producer plant is no higher than that of a high efficiency steam plant, the relative merits under the conditions outlined hardly need elaboration.

On the other hand, in another plant, belonging to the same company for which the gas engine plant was installed, the steam engine offered the correct solution for at least part of the plant, because the electricity was practically a by-product of the concentration and evaporation of the sugar solution.

In many instances a combined steam engine and producer gas or oil engine plant offers the best solution, the steam plant being installed to such extent that its exhaust may be fully utilized.

With such equipment, with the exhaust gases from the gas engine used to heat reed water from the boilers, an almost ideal operating condition exists for at least part of the year.

I have investigated a number of isolated plants, operated by oil engines, and find particularly in the small plants that they are giving remarkable service. Almost universal testimony is to the absence of trouble and the reliability of the small sets. With the large units the heavy parts and the unfamiliarity of the operators have given some trouble, but in general the results are satisfactory.

The necessity for steam boilers and the space conditions in city buildings usually preclude any type of plant but steam unless the building is planned from the inception for the gas engine or oil egine equipment. As the engineer is frequently not called in until the general plan is adopted and as space beyond a certain amount is often extremely precious, the usual isolated plant in city buildings in the East is a steam plant.

Costs of Making Electricity.—Some kilowatt-hour costs in buildings follow: These costs are derived by deducting from the total operating cost of the building with an electric plant, the cost of operating without an electric plant. This latter cost is either actual or estimated, depending upon whether street service had been used prior to the installation of the private plant or not. In each instance the fact is stated. I do not go into particulars of each plant because there have been many such figures printed. They are, however, as closely correct as I can make them and are taken from the regularly monthly plant reports.

Where the costs are given for different seasons, the variation is due, of course, to the high cost of supplying heat and engineers services, etc., during the winter and the relatively low cost of these services during the summer.

The kilowatt-hour costs do not include fixed charges unless otherwise stated.

My reason for excluding fixed charges is that each case presents a different condition. Money may be worth 25 per cent. to one man and 3 per cent. to another. With the cost of making electricity before him, each man can then decide if this cost is sufficiently less than the central station charge to warrant investment.

Kilowatt-Hour Costs.

Loft building.—100 by 100 ft. (30 by 30 m.) 12 stories and basement.

Month.	Kw.-hr.	Total cost.	Basic cost.	Mfg. cost.	Mfg. cost per kw.-hr.
April	15080	756.81	300	456.81	$0.03
January	18450	936.26	470	466.26	$0.0252
October......	17810	884.76	300	484.76	$0.0328
July	12060	680.26	200	480.26	$0.04

Cost of plant $12,000. Fixed charges per kw.-hr. approximately ¾c.

Loft building.—185 by 200 ft. (56 by 61 m.) 12 stories and two basements.

Month	Kw.-hr.	Tl. cost	Basic cost	Mfg. cost	Mfg. cost per kw.-hr.
April	36930	1830.25	750	1080.25	$0.029
January ...	41950	1841.82	950	891.82	$0.0212
October ...	39480	1643.07	750	893.07	$0.0226
July	31800	1543.04	650	893.04	$0.0281

Fixed charges: ½ cent per kw.-hr. Plant cost, $20,000.

Apartment house: (free light); 36 apartments, high class refrigeration; best service.

Month	Kw.-hr.	Tl. cost	Basic cost	Mfg. cost	Mfg. cost per kw.-hr.
April ...	17450	1359.86	1016.85	343.01	$0.0197
January...	21620	1360.84	1052.29	308.55	$0.0142
October..	13500	1208.67	900.75	307.92	$0.0228
July	9350	1074.03	709.82	364.21	$0.0389

Apartment house: (Electricity sold to tenants; 87 apartments; high class refrigeration; best service; large quantity public lighting.)

Month	Kw.-hr.	Tl. cost	Basic cost	Mfg. cost	Mfg. cost per kw.-hr.
April					
January.	18154	2224.59	1749.18	475.29	$0.0261
October..	14885	1920.56	1507.34	413.22	$0.0278
July ...	11254	1731.54	1226.66	504.88	$0.045

These items are all higher than usual because last year the plant was completely overhauled, new plates installed in storage battery, new condenser for refrigerating plant, new hot water tank etc., all of which is charged off during ten months from date of expenditure.

Office building: 100 by 100 ft. (30 by 30 m.) 12 stories; tungsten lighting; four elevators.

Month	Kw.-hr.	Tl. cost	Basic cost	Mfg. cost	Mfg. cost per kw.-hr.
April	14600	738.15	365.62	372.53	$0.026
January ..	18310	714.39	458.40	255.99	$0.0142
October ..	15060	669.69	355.03	314.66	$0.021
July	11590	693.17	250.00	443.17	$0.04

Office building: 140 by 70 ft. (42.6 by 21 m.) 10 stories.

Total kw.-hr. 340,000 of which 88,817 were used mainly for driving an electric pump for operating two high-speed plunger elevators. 255,788 kw.-hrs. for lighting.

Total cost per year	$8,070
Basic cost (estimated)	3,200
Cost of electricity	4,870
Manufacturing costs per kw.-hr.	1.43 cts.

Manufacturing Plants.

Locomotive Works—oil engines.

	Cents
Total cost per kw.-hr. on 225 h.p. set (including 0.233 cent. for fixed charges)	0.74
5,300 hours a year at full load	
Shop time 6,500 hours.	
With load factor another year after panic, of only 24 per cent. cost per kw.-hr. was increased to	2

Malleable Foundry: Producer Gas Plant.

	Cents
Total cost per kilowatt hour including fixed charges approximately	1.71

Hardware: (Steam plant condensing.) These figures include interest and depreciation and are given through courtesy of Mr. T. Hoops, jr., Superintendent of Wilcox Crittenden & Co., Middletown, Connecticut.

1908.

Month	Kilowatts	Cost
May	23,970	0.01986
June	27,760	0.01733
July	29,600	0.01602
August	27,530	0.01736
September	27,830	0.01601
October	26,180	0.02095
November	22,360	0.02289
December	24,960	0.02164

Silk Mill Producer Gas Plant. (New York City); 150 by 100 ft. (45.7 by 30 m.) 4 to 5 stories high.

In week's run of 56 hours	4208 kw.-hr.
	Cents
2.6 pounds of pea coal per kw.-hr. approximate cost, including fixed charges	2¼

Department Store: 2,500,000 kilowatt hours.

Cost per kilowatt hour 1.34

Hotel: (based on figures given by chief engineer).

Cost of operation with plant	$33,285.71
Cost of operation without plant	
Cost exclusive of electricity purchased	25,779.71
Cost of making electricity	7,407.00
Cost per kw.-hr.......between 6/10 and 7/10 cents.	

Hotel: 300 rooms; 12 stories; 240,000 kw.-hr.

Total operating cost	$12,800
Basic cost (based on operation before plant was was installed)	8600
	$4,200
Cost per kw.-hr.	1.75 cents

Table of Cost per Kilowatt Capacity.

(Based on personal experience in New York and vicinity.)

	Per kw. of plant capacity.
Boilers (erected and set in masonry).	
Horizontal-tubular	$14— $18
Water-tube	10— 20
Steam engines:	
High-speed, simple direct-connected	20— 25
Medium-speed, compound non-condensing direct connected	28— 35
Low-speed, compound condensing, belted.	20— 25
Low-speed, simple, belted	25— 30
Gas engines	50— 60
Oil engines	75— 85
Gas producers	15— 20
Dynamos:	
Direct-connected to high speed engine	13— 16
Belt-connected to engine	12— 15
Direct-connected to corliss engine	16— 20
Switchboard	5— 10
Foundations	5— 10
Steamfitting—including auxiliary apparatus—such as feed heater, grease separator, exhaust head, tanks, covering, etc.	20— 30

The figures of installation cost have been published by me before and I use them in estimating and find them to be closely correct for New York City.

I hope that these figures, together with the other data presented will be of use and will also serve as a basis for discussion and presentation of other facts and figures.

WATER SUPPLY OF REGINA.

Some time ago the municipal council engaged the services of Mr. R. O. Wynne-Roberts to report on the domestic water supplies available in and around the city of Regina.

Mr. Wynne-Roberts' report has been submitted to the council and shows that seven million gallons of water are available daily for Regina, providing the waterworks system is materially extended at a cost of $1,106,045.

By 1918 the 7,000,000-gallon daily supply would be insufficient for the demand, if the growth of the city continues at its present rate.. By that time Regina will have to look to the Saskatchewan River, or Long Lake for a supply.

The report gives details on all available sources within a radius of fifteen miles of the city, as well as details of the foregoing expenditure which is as follows:—

At Boggy Creek: New pump well, $7,271; manhole, No. 1, $16,406; manhole, No. 1, $6,880; manhole, No. 2, $2,750; pump well to steam pump well and Zimmerman Br., $47,889; laterals, pipe lines, $2,000; two meters, at pump well, $2,000; one meter, at power house, $1,000; sinking wells and pump at Boggy Creek, $2,000; making a total of $88,206. The works outlined, in conjunction with those already in use, are contemplated to give a daily supply of 3,000,000 gallons.

Outlining a comprehensive Eastern Regina water scheme, it is pointed out that it has for its object the connection of several water-sheds into one trunk main, which would be conducive to economy. The works are designed so that they may be carried out in sections, as the council deems necessary.

It is proposed to lay a collection main in the ravine lying east of Rastadt to open out the springs and convey the water in vitrified pipes to main springs draining the water into the collecting mains. At a point where the collecting mains will terminate it is proposed to install a gasoline engine and pump with pump house and residences for men. The water will be collected in a suitable well and pumped through a steel main about eight and one-half miles in length, along road allowances, and there discharged into a circular reinforced concrete reservoir. Although the supply is dependent to a large extent on wells and underground water-sheds, certain sprinks will play an important factor if this report is adopted and carried out.

The estimates of the cost of the proposed works are placed under four heads, as follows:—

Silver Stream Section.—Pipe lines, $274,740; 400 h.p. engines and 7,000,000-gallon pumps, $20,000; pump well, $20,000; engine house, $2,000; cottages, $4,000; meters, water level recorders, $8,000; contingencies, $32,874; making a total of $361,614.

Slough Creek Section.—Pipe lines, $163,056; meters, $6,000; contingencies, $16,950; making a total of $185,961.

Hicksvale Creek Section.—Pipe lines, $270,400; two 1,000,000-gallon reservoirs, $35,000; meters, $6,000; turbine pumps and station, $6,000; cottage, $2,000; contingencies, $31,940; making a total of $351, 340.

Rastadt Springs Section.—Pipe lines, $179,300; engine, pump and building, $6,000; cottage, $2,000; meter, $1,000; contingencies, $18,830; making a total of $207,130.

It is proposed to deliver the water to the city through a steel main to be laid from Silver Stream along Dewdney Street and connect to the city water mains at a convenient point. It is proposed that the city water pressure should be maintained at about 65 pounds per square inch—that is about 150 feet head, which will be sufficient to provide an ample supply to the highest building in the city. The system would be capable of supplying water under a greater pressure when necessary

It is estimated that the combined scheme and watersheds described will probably yield a total supply of about 7,000,000 gallons per day. It is pointed out that it would be advisable to install self-recording meters on the various sections.

THE ST. JOHN VALLEY RAILROAD.

The contract for the construction of the above mentioned railway, when completed, will be a great impetus to commerce in the Maritime Provinces, particularly New Brunswick. The route, as described in the contract, is, briefly, from a point on the National Continental Railway at or near Grand Falls, via Centerville and Lakeside, to Woodstock, thence by the River St. John to Fredericton and Gagetown, thence crossing the St. John River at or near the Mistake, thence crossing the Kennabacasis River at or near Perry's Point, and thence to the city of St. John, the whole representing 208 miles. It is provided that the divisions from Fredericton to Woodstock and Woodstock to Centerville shall be completed on or before November 1st, 1913, and the whole road is to be completed on or before November 1st, 1915. The Provincial Government guarantees the bonds of the company to the extent of $25,000 per mile.

The road now under contract is one link in a chain of railroad development. Logically connected with the St. John Valley is the proposed line known as the St. John and Quebec Railroad, which it is planned to cross the State of Maine from a point of connection with the Aroostook Valley Road at Washburn to the western boundary of the State, from which point a line is chartered by the Dominion Government to run to the St. Lawrence River, fifty miles.

When these two sections of road are completed, the distance by rail from Quebec to St. John will be 370 miles, and a very important saving will be effected in transportation in these portions of the Dominion. Mr. Ross Thompson is the chief engineer, and Mr. S. B. Wass the assistant chief engineer of the company.

FORESTRY OPERATIONS ON THE PENNSYLVANIA RAILROAD.

An important work of interest to railway officials and others is the conservative management of the Pennsylvania Railroad timbered lands. The logging operations which have been conducted by the company's foresters during the last three years cover a total area of about 1,200 acres and form only one of the means which are being used by this railroad to solve the problem of procuring ties and other timbers. It has been in use for three years, during which time 2,600,000 board feet of lumber and 15,000 ties were procured from woodlands managed by the foresters. The tracts on which they are applying the principles of silviculture include small areas along the right-of-way which have no value to the company except from the timber which is growing on them, and the more extensive areas of land which are the catchment basins for the mountain reservoirs which supply water for locomotive and shop use.

Logging operations as carried on by the foresters have in view the best utilization of the standing timber and the conservation of the supply for future operations. Although the aim is to leave each tract logged in more productive condition than before, each case presents its own peculiar conditions, and must be considered as a separate problem. On many unmanaged timber tracts frequent fires have added to the injury caused by partial cuttings. In extreme cases the result of such fires and cuttings is that there are no young trees which are worth leaving and the mature trees are badly damaged. Under such extreme conditions the area, as a rule, would be cut clean and a complete planting made. The other extreme condition evists when the area has been free from fires and cuttings and the growth is so well graded in age that it is possible to cut out matured trees and still leave sufficient young growth to stock the area. The most prevalent condition, however, lies between these two extremes, and the methods adopted under such conditions are well illustrated by the work done on the Brush Mountain tract near Altoona, Pa., according to the Railway Age Gazette. This tract includes about 700 acres in the drainage basin of the reservoirs which store the water for use in case of fire at the Altoona shops. Forest growth conserves and purifies the ground water supply, and in order properly to care for the timberlands in drainage areas the officers responsible for the water supply were glad to avail themselves of the services of the company's foresters. The tract under management lies in a basin-shaped valley known locally as the "Kettle." The slopes are steep, with a range of about 400 ft. in elevation. The forest on most of the area was second growth in blocks of even age from six to eighty years old, resulting from fires and partial cuttings. There were also some virgin trees which had been left because they were not merchantable. Three types of timber are distinguishable. The bottom land bears hemlock, white pine, black birch, red maple, white ash, cucumber tree, tulip, basswood and black ash. As this low ground is continually moist, fires have never been able to run over it, and on that account the reproduction is good. The slopes, which include most of the area, have white oak, red oak, scarlet oak, black oak, chestnut, beech, black birch, white pine, pitch pine, black gum and pignut hickory. Fires have repeatedly run over these areas, with the result that there is very little ground cover and reproduction is mostly of sprout origin. The ridges are dry and the scattered timber was stunted and of poor quality. The principal species are chestnut oak, black oak and pitch pine. The reproduceion is so poor as to be hardly worth considering. Many trees on the tract had been seriously damaged by fire and wind, and many were dead or dying, so that much of the lumber was fast decreasing in value.

On account of the mutilated condition of this forest a very heavy improvement cutting was necessary. The intention was to remove everything that could possibly be removed without interfering with the water conserving value of the property or reducing the productive capacity of the land, and ultimately to secure a stand which would produce timber usable by the railway. To these ends there were removed in the cutting all mature, damaged and dead trees of all species; all trees of merchantable size, except where needed for reproduction; and every tree of the following species: gum, scarlet oak, birch, sassafras, ironwood, dogwood and witch hazel. The foresters of the company personally marked all trees for removal. In this marking a short-handled axe is used to blaze the trunk breast high and just below stump height. To identify the mark, a sharp blow is struck in the bare spot with the keystone brand of the head of the

Locust Grove, Planted in 1902.

axe. In the process of marking, many barren spots were found which had been so badly burned that there could be little or no natural reproduction of desirable species. On these areas it was decided to plant three-year-old Scotch pine seedlings where the soil is not too rocky and to sow white pine where there is not sufficient soil for the Scotch pine. A contract was let to an experienced woodsman for all logging on the tract, the contractor agreeing to deliver the manufactured timber on cars at Altoona. This contract also covered taking tanbark and the other by-products, except charcoal, which was covered under a separate contract. The tanbark was taken first, the work beginning early in the spring. Only hemlock and chestnut oaks were usable as tanbark, and the trees which were cut for their bark were allowed to remain where they fell until the beginning of the logging. For getting out the sawed timber, a portable sawmill having a capacity of about 5,000 board feet a day was used by the contractor. The foresters in charge of the work at first designated to the contractor what form of timber should be made from logs of a given species and size, but as the contractor had had considerable experience in this work and was intelligently interested in this conservative logging, the matter was left largely to his judgment with frequent checks by the foresters. The contractor was so well satisfied with the results of the marking that he has since sought to employ the company's foresters to mark trees on his own land. In general, ties were made from white oak and chestnut oak trees of a diameter which would just make one tie, as it was more profitable to saw logs large enough to make two ties into bridge timbers, crossing planks or smaller sticks. The contractor was required to avoid injury to young trees throughout the work by so felling trees as not to strike any trees not intended for removal, by not cutting saplings of desirable species for use in logging operations, and by not locating roads through young growth. All stumps were cut low, the rule being that the stump of a sound tree should not exceed in height half the diameter of the tree at stump height. The surface of the stumps was left smooth and in good condition so that desirable sprouts would be more readily produced. Branch wood and refuse was cut so as to lie close to the ground and thus rot more readily. Since cordwood was not readily saleable in the vicinity, it was necessary to make charcoal from the unmerchantable timber.

Both the contractor for the logging and the one for making the charcoal agreed to exercise every possible care in preventing fires and in fighting them when once started. This is the most important provision that can be made in managing timber land. During dry weather a man was kept patrolling the tract continually, and in case of an alarm of fire the contractor was required to set every man in his force to fighting the fire.

Up to the present time about 1,200,000 board feet of lumber, 5,000 cords of charcoal woods, 90 cords of paper wood, 130 cords of tanbark and 189,000 lath have been made from this tract. Of this amount the following was taken by the Pennsylvania Railroad:

Lumber—		
Oak	110,000	board ft.
Pine	124,000	" "
Hemlock	71,000	" "
Chestnut	3,000	" "
Crossing plank—		
Oak	33,000	" "
Chestnut	6,000	" "
Ties—		
Cross	678	
Switch	70,000	board ft.
Bridge	57,000	" "
Fence posts	2,971	pieces
Charcoal	153,404	bushels.

The products that could not be used by the railway were sold to outside parties. All products taken by the company are charged at market prices, and on this basis the operations on this tract have netted a profit of over $12,000 to date, including in the expenses all supervision and technical administration of the work.

The cost of practising forestry in this manner is calculated by the department at about five cents for each thousand board feet. Since the net profit on the 1,200 acres logged has averaged about $23 per acre (stumpage not charged), and this is typical second growth land which has been considered of little value, it is evident that if the example of conservative logging set by the railway were followed by other land owners in the state the amount and value of forest products, both present and future, would be greatly increased.

The company's purchasing agent always gives the forestry department a chance to fill a requisition for lumber before an attempt is made to buy it elsewhere. If any of the material needed can be supplied from the company's tracts the order for it is placed with the forester. In order to provide seedlings for planting the company conducts a nursery at Morrisville, Pa., where commercial trees are grown and ornamental stock is carried for use on the system. The total area under cultivation is 38½ acres and the annual capacity is about one million trees. Comparing the cost of producing the trees at the nursery with the market price, the net saving to the company for the year 1910 was about $6,000. The planting of trees on unused land has been carried on since 1902. During the nine years up to and including 1910, there were set out 4,099,524 trees. This planting has been done on tracts of various sizes and under various conditions. Whenever a tract is turned over for forestry purposes a careful examination is made to determine how it can best be used. If it is already wooded the timber is inspected, and if the stand is sufficiently valuable the tract is carefully logged and conservatively managed. If it must be cut clean, or if it is already a clear area, the advisability of planting it is considered. If it is to be planted, the species which will grow best in that soil must also be decided on. The planting may be done either in the spring or fall, preferably in the spring. This work is done by squads of men who are employed locally. They work over the ground in two rows, the men in front cutting the sod and digging holes with mattocks, and the men behind, who carry the seedlings in buckets partly filled with water, planting them in the holes. The trees are set in rows, the location of each tree being determined by the planters by sighting stakes or by following stretched lines. Under favorable circumstances a squad should plant 400 trees per man per day. To grow tall and straight trees desirable for timber is is necessary that the seedlings be planted close together, the approved spacing in most cases being six feet in both directions. After several years this growth may require thinning if the stand is good, although the natural suppression of a considerable number of the seedlings must be expected. Along all such plantations which adjoin the right of way a fire line is kept plowed to guard against the spread of fire from locomotive sparks. Most of the older plantations are of black locust, and it is to be regretted that this species is being attacked by borers with considerable damage to the young trees. The borers attack both good and bad trees, and, although they do not kill the trees, the holes they make cause many of the trees to break and to a marked degree weaken the timber which can be made from the tree. The locust leaf miner is also attacking these plantations, with the result that the growth of the trees is retarded through lack of nourishment, since the leaves cannot perform their functions after they are attacked by the miner. Although the locust grows well in Pennsylvania and makes desirable trees, posts, etc., it does not seem practicable to continue its planting for these purposes until some method can be devised to prevent the damage by these insects.

Various lines of experimental planting are attempted from time to time. As an example of this class of work, two double rows of evergreen trees were planted near Glen Loch, Pa, in 1910, to serve as a snow fence. The wooden snow fences commonly used require considerable maintenance, and it is thought desirable to substitute growing evergreen trees where conditions are favorable. Their use, however, requires a wide space between the track and right of way line. In the planting made, the first row of trees is Scotch pine planted 100 ft. from the track, while the outer row, of Norway spruce, is planted along the property line. To save expense, small trees were used in this planting, but it is thought they will be large enough in a few years to drop the snow behind them successfully.

ELECTRIFICATION OF BRITISH RAILROAD.

The consulting engineers of the London, Brighton & South Coast Railway are preparing plans for the further electrification of the company's suburban services and the extension of the electrification schemes to the main line.

MANUFACTURING BUILDINGS.

The following data appeared in an address by Mr. E. H. Darling, assistant engineer of the Hamilton Bridge Works Company, Hamilton, given before the Engineering Society of the University of Toronto. The remainder of the address was printed in the November 9, 1911, issue of The Canadian Engineer under the title of Preliminary Problems in the Design of Manuafacturing Buildings.

1. Slow burning or mill construction.
2. Fireproof construction.
3. Steel frame construction or mill buildings.

Slow burning or mill construction is simply a special class of timber work. Such a building will have heavy brick walls with the interior columns, beams and floors of massive timbers so disposed as to present the least possible opportunity for the spread of fire. The columns are made of single timbers, usually square, capped with a corbel or short beam which forms a seat for the column of the next floor above, and supports the cross beams which carry the floor. This corbel may be replaced by a steel or cast iron cap which is more reliable when the loads are great. The cross-beams are also heavy single timbers, and on these are laid 2-in. by 4-in. or 2-in. by 6-in. pieces set on edge and spiked together, so as to form a floor 4 in. or 6 in. thick, as the case may be. A hardwood wearing floor 1 in. thick is usually laid on this. Note the absence of all joist and any thin projecting woodwork which might easily catch fire. In case a fire should start, the thick floors would tend to confine it to one story and the heavy beams and columns would burn slowly, thus giving the fire department a chance to put it out before it destroyed the whole building. This construction is only effective, however, when used intelligently, for unless all the many rules for preventing the spread of fire are carefully observed, the result may be disastrous.

The roof of such a building may be constructed like the floor, or, if the span between the rafters is not too great, matched sheeting may be used. This is covered with a felt and gravel roofing material or some one of a score of special roofings which will resist the attack of fire.

The cost of long timber of large cross-section practically limits the length of beams to somewhere between twelve and sixteen feet. This means that in a wide building there will have to be many columns, which take up room and interfere with the arrangement of machinery.

2. Fireproof Construction.—While there might be a difference of opinion as to how far it is expedient to go in making a particular manufacturing building fireproof, it is well understood that, if a building is to stand all the vicissitudes of a conflagration, it must be made entirely of brick, concrete, terra-cotta, and steel, the steel to be well protected from the direct heat of the fire.

It is in office buildings, hotels and tenament houses that fireproofing principles have been most extensively applied, and the manufacturer who requires a building of somewhat similar form will use similar methods of construction, adapting them to his special needs. Reinforced concrete may be used entirely for floors, beams and columns, or steel may be used for the beams and columns to form a framework to carry the floors. In this case the steel must be covered with at least 1½ in. to 2 in. of concrete.

Terra-cotta is being introduced for use in certain classes of manufacturing buildings, but, being more or less brittle and not suitable to withstand vibration and shocks, its use is limited. Its most extensive use is in the form of tile for roofs, where its lightness is an advantage.

3. Steel Frame Buildings.—This class of construction is used for rolling mills, machine shops, foundries, etc., which are usually classified under the head of mill buildings. Its distinctive feature is the steel skeleton which forms a frame to support the roof and side covering. This covering is usually corrugated iron, galvanized and sometimes painted also. When so constructed, the building is entirely metal, even the window sash may be made of steel. The result is that it can stand an immense amount of rough usage and unless filled with inflammable material, is not easily injured by fire, nor is it effected by the elements provided it is regularly painted and properly cared for.

But in a building of this class its function as a protection from the weather is really secondary, its main duty being to sustain cranes, hoists, and other machinery. In fact the structure is a huge machine itself. In its design the same engineering principles are applied which are used in the building of steel bridges. Every possible stress is estimated and provided for. Often the analysis of these stresses is made extremely complicated by special combinations of traveling cranes, bins, machinery and wind pressures, but all must be taken care of if the building is to be rigid and safe.

Each of the above three types of construction has its own special advantages, and they are often combined in various ways to obtain a desired result. The slow-burning construction has the advantage of being cheap in first cost. Until recently it had a further advantage of time in rapid erection, but it is now so difficult to obtain first-class lumber and the cost is such that these advantages are lost. The commercial size and length of timbers obtainable also limits the span of beams and the spacing of the columns, as explained above. However, for factory buildings, such as woollen and cotton mills, etc., where the machinery is small and light, this feature is not necessarily objectionable. But the one which weighs heaviest against it is its inflammability. That means, for one thing, high insurance rates and the ever present danger of fire.

The first natural variation, made in slow burning construction, is the substitution of steel for beams and columns. This permits longer spans for the beams and heavier loads on both beams and columns. Steel columns are often put in the outside walls as well. The steel work is then self-supporting and may be erected complete independently of other trades. As these columns relieve the walls of all beam loads, and also reinforce it, the walls may be made much lighter than would otherwise be permissible. As a fire risk, however, this combination is considered inferior to the slow burning construction. Steel becomes soft at a red heat and is entirely unable to resist stresses. If, when thus heated, a stream of water is directed on it, it warps and twists. While an ordinary fire will not actually destroy the metal, the physical state of the material may be so altered as to be entirely unreliable. Consequently its salvage value is only what it will bring as "scrap."

In buildings of three or four stories, round cast iron columns are sometimes substituted for the rolled steel. If neatly cast, they present a better appearance than the built-up steel column, but unless designed by one accustomed to working with cast iron, and unless they are most rigidly inspected, there is always a very great uncertainty as to their strength. Apart from this unsatisfactory feature, cast iron has the advantage over steel in being better able to resist heat. They will usually cost more than the steel column.

If, in buildings where steel is used, it is protected by about two inches of concrete, practically all the risk of damage from fire is eliminated. This is rarely, if ever, done if the floors are of wood, for if the fireproofing is carried to this extent, it only means one step more to make the building entirely fireproof. Wood floors, however, have this advantage, in addition to being cheaper. It is much easier to cut openings or bore holes in them than it is in concrete, and that is an item worth considering where there is likely to be much of this work to do.

As stated above, buildings which are to be fireproof must be constructed entirely of reinforced concrete, or steel covered with concrete or terra-cotta. Buildings of this type have come through conflagrations and earthquakes with credit. The one thing to remember in using reinforced concrete is that there must be no slighting of the work whatever. To get a good job, it is sometimes a continual fight against ignorance and carelessness, and sometimes dishonesty. A mistake once made is very hard to remedy. A defect may easily escape notice until a catastrophe occurs. Many accidents have already been recorded and there have probably been many more that have never reached the ears of the public. There are large new buildings which stand finished, but vacant, and condemned.

That this blot against reinforced concrete is not fair to this construction, is proved by the fact that many engineers, especially European engineers, get quite satisfactory results although they use much higher unit stresses than the average. The secret is that they take more time for the work, and give it more rigid supervision.

By using a steel frame work for a building, much of the uncertainty as to its safety may be done away with. There is also a saving of head and floor space, as the steel beams and columns are smaller than those of reinforced concrete. In a building of many stories a few inches to each story adds up to quite an item. The columns in the lower stories become so large that, as one writer has put it, the building resembles the Egyptian pyramids—most of the room is on the outside. Nor are engineers agreed as to how concrete sets when poured wet in large masses.

There are other objections to the use of reinforced concrete for certain classes of manufacturer's buildings. Where it is necessary to make frequent changes, alterations and repairs and, in fact, in any structure that is not intended to be permanent for many years, it becomes very costly. When it has outlived its usefulness it is expensive to remove and the materials have little or no value.

Referring to steel frame mill buildings, structural steel has other useful properties in addition to those referred to above. Such a building is not limited to any size, shape or form within reason. Any loads can be taken care of with certainty. The erection of the frame usually goes ahead very rapidly, forming a scaffold for other work. Steel must, however, be frequently painted if exposed to moisture or corrosive gases to prevent rust and corrosion.

REINFORCED CONCRETE.

Mr. G. C. Workman, M.S.E., M.C.I., read an interesting paper recently on "Some Recent Works in Reinforced Concrete," before the Concrete Institute of England.

The object of the paper was to describe a few of the numerous works recently executed in reinforced concrete, and to bring out some of the more interesting features of each particular case, and to show how various difficulties had been overcome. The author said that, owing to modern requirements, there was a growing tendency for the various barnches of engineering to become specialized in order to obain by a continual study of each subject, the maximum amount of economy and efficiency.

It was for that reason that a certain number of engineers had become specialists in the designing of reinforced concrete, each one adopting the particular method of reinforcement which he thought best suited for the purpose.

Personally, he had for the past ten years been identified exclusively with the "Coignet system," which was one of the first rational and scientific methods of reinforcing concrete.

As there were a certain number of different ways of reinforcing concrete, he first of all gave a short description of the methods employed in the various works which he described.

Commencing with the beams, which were usually considered the most important part of a structure, round bars of mild steel were used, the diameter varying between ½in. and 1⅝in. The steel frame-works were designed in such a manner as to form independent units which could be easily made on the site and placed on the centering when required. In some cases the tension bars for the lower portion of the beams were all straight with a corresponding parallel bar in the upper compressed portion of the beam; a mechanical bond between the upper and lower bars was provided by means of stirrups made of round mild steel wire varying between 3-16in. and ¼in. diameter. These stirrups had their ends bent over the top bar, and they were fastened by means of annealed wire to the main bars so that their position could not be changed during the process of concreting. The spacing of stirrups was, of course, varied in accordance with the shearing stresses.

Another method of preparing steel frameworks consisted in grouping together seven tension bars of comparatively small diameter; six of these bars were bent upwards at an angle of forty-five degrees and hooked over a longitudinal top bar ½ in. diameter in such a manner as to form a kind of truss. Additional stirrups were also provided, as in the first method described, to counteract any extra shear.

This last arrangement had the advantage of being more economical than the first one because the section of steel in tension was made to decrease gradually towards the points of support where the bending moments were less, the extra steel being used to resist shear or diagonal tension.

In regard to shear he pointed out that in the first method, comprising vertical stirrups and horizontal bars, the vertical shear was taken up by the main bars and the horizontal shear by the vertical stirrups, whereas in the last-mentioned alternative the vertical and horizontal shear, or, in other words, the diagonal tension, was counteracted by the bars bent at an angle of forty-five degrees.

The longitudinal top bar was, of course, necessary for the preparation of each unit. This bar was very useful to suspend the framework in the centering, and as it was situated in the upper portion of the beam it increased the resistance to the compression. The upper ends of the stirrups and shear members was secured by means of hooks to the top bar. That precaution was in accordonce with the new rules of the Joint Committee of the Royal Institute of British Architects, which state that in every case care should be taken to bend or otherwise secure the ends of the rods to prevent them from slipping in the concrete.

The negative bending moments in beams were counteracted by joint bars of sufficient length.

In many of the buildings the steel frames of the pillars were made horizontally and placed in position in the casings when required. The frames were composed of main bars bound together either by 3/16 in. or ¼ in. wire, forming spirals or horizontal ties with a pitch of about 6 in. The object of these ties was not so much for strength as to keep the vertical bars in their proper position during the concreting.

The reinforcement of rectangular floor slabs was provided by simply placing principal bars of about ½ in. to ⅝ in. diameter in the smaller spans and ¼ in. distributing rods at right angles to the others, so as to form a mesh, the bars of which are bent up gradually over the beams in order to resist contraflexure.

As previously mentioned, round bars had been used throughout because they had the advantage of being easily procurable in the open market, and because that section produces the minimum amount of contact between the various bars forming the units. It was obvious that flat surfaces of contact between bars should as much as possible be avoided because rust was likely to develop in such places, and that defect might ultimately become a source of danger. Another reason for round bars being favored was that they offer a better surface of adhesion than any other available section.

BOX LUMBER IN CANADA—1910.

The reported consumption of lumber for boxes and shooks in Canada during 1910 was over one hundred and fifty-eight million feet, valued at two million two hundred and seventy-three thousand dollars. These statistics have been compiled by the Forestry Branch of the Department of the Interior from reports received from one hundred and two box factories, over one-half of which are in Quebec. Seventy million feet of lumber or forty-five per cent. of the total was used in Quebec. Ontario used sixty million feet or thirty-eight per cent. of the total and the remainder was used in the provinces of New Brunswick, British Columbia, Manitoba and Nova Scotia. Pine, the chief species used in Ontario, formed forty-five per cent. of the total box lumber and cost only $13.93 per thousand. This comparatively low price for pine, indicates that with this more than with any other species, mill waste and cull lumber is being used in the manufacture of boxes. Spruce in 1910 was used in every province in which boxes were made, and formed forty-one per cent. of the total. The cost was $13.83 per thousand or twenty-eight cents more than the average mill run price, so that manufacturers using spruce demand the finest quality. The remaining fourteen per cent. of the total was comprised of fourteen other woods, of which hemlock, basswood and balsam were the chief. The most expensive box-wood used was a million and half feet of Douglas fir at $23.00 per thousand in British Columbia. Balsam fir used in the three eastern provinces was the cheapest box-wood reported in 1910 at $8.94 per thousand. It is a wood light in color, tasteless, fairly strong, and its use in the manufacture of boxes should be encouraged.

FORESTRY IN EUROPE.

The productive forest area in 1908 in the Grand Duchy of Hesse in Europe amounted to 182,263 acres. In general the standing timber is composed of sixty-nine per cent. hardwood and thirty-one per cent. coniferous forest. The fir ranks first among the coniferous species. The total yield of lumber in 1908 was 4,575,000 cubic feet. Refuse in so far as it is not suitable for lighter lumber, such as laths or for pulp, is used for firewood. The expenditures for salaries, forest cultivation and road building amounted to approximately $754,000, and the total gross income (from lumber and firewood) was $1,161,931. The capital represented by the forests ($52,665,354) brought interest accordingly at 2.21 per cent. Where intensive forestry of this kind is practised, forest fires are unknown. Sufficient money spent on Canadian forest reserves would greatly reduce the fire danger, maintain an adequate lumber supply for the country and in time become a source of revenue to the government.

Metallurgical Comment

T. R. LOUDON, B.A. Sc.

Correspondence and Discussion Invited

CAST IRON FOUNDRY PRACTICE.

The fight for the adoption of scientific metallurgical management in the cast iron foundry is one that still continues. Large strides have been made toward better conditions. Foundry superintendents are gradually discarding the old unscientific methods of judging the grades of pig iron. Greater reliance is being placed upon chemical analysis. Apathy, on the other hand, still contests the field with a stubbornness that brands it as having its source in ignorance.

Without the aid of chemical analysis, the great accuracy attainable in the making of given grades of steel wherein the carbon content, for instance, may be regulated down to hundredths of one per cent., could not exist. Metallography, a science that may be termed as comparatively new, has been readily and quickly adopted by the steel maker. In fact, history shows that the manufacturer of steel has been quick to reach out and call to his aid any scientific development that could be reasonably called practical. In this respect, the steel maker is far in advance of the cast iron manufacturer. That this is practically due to the fact that cast iron foundries are usually very small in comparison with the huge steel plants, has to be acknowledged; but, nevertheless, there undoubtedly has been and still is to a certain extent, an apathy on the part of the cast iron founder that is difficult to explain.

To take the case of chemical analysis: The wide-awake foundries not only buy their pig iron by analysis, but they also check the product when received. Now and again, though, one finds examples of foundries that are making a commodity, the specifications for which do not call for any particular analysis of iron, perhaps, merely specifying a certain limit of strength. In cases such as these very little attention is paid to the analysis of the pig iron used. To suggest to the foundry manager that it woud pay to check up the analysis even under such circumstances, is, in most cases, superfluous. Yet it would not be difficult to find cases where one-quarter of a day's output could often have been saved had more attention been paid to the iron being used. The fact that **metallurgical supervision pays always** does not seem to be grasped.

There is another factor besides the involved cost to the manufacturer that tends to perpetuate these conditions. If engineers would insist upon being furnished with chemical analyses as well as physical tests for cast iron **in all cases,** a large step forward would be made. In reality, as far as cast iron is concerned, physical tests on bars generally mean very little, as no attention is paid to the rate of the cooling of the bar, a point of extreme importance in determining the ultimate nature of the iron.

As with the making of steel products, so with the manufacture of cast iron; the man who does not recognize the advantages of scientific metallurgical supervision, is being gradually placed at a disadvantage, and the engineer who has to do with cast iron can help materially to bring about such a desired state of affairs by following the course as suggested above.

IMPROVEMENTS AT NOVA SCOTIA STEEL AND COAL COMPANY'S PLANT.

During the year 1911 many important improvements and betterments were effected at the various plants of the Nova Scotia Steel and Coal Company. Processes of manufacture absolutely unique in Canada were adopted, important departments brought to a point where they stand second to none in the world and generally the company maintained its position as the pioneer of the Canadian steel and coal trade.

The most important additions during the year were the installation of a fluid steel compression plant at the open hearth department, Sydney Mines, Cape Breton, and the substitution of hydraulic presses for steam hammers in the forging department at New Glasgow. In taking this step, "Scotia" has again been the first to bring the latest European methods of steel making to Canada and in consequence is prepared to handle a class of profitable business which no other Canadian company will be able to deal with until they adopt similar machinery.

The increased tonnage of finished product arising from recent additions to the rolling mill equipment necessitated the substitution of a 34-inch blooming mill for the old 26-inch mill which was no longer able to furnish the billet tonnage required by the various finishing departments. Many other improvements, but of a somewhat minor nature, designed to effect working economies in the various departments were also installed and the plant generally kept in a very high state of efficiency.

The fluid steel compression plant is designed to improve the quality of the ingots by expelling the gases generated during conversion and pouring, thus eliminating blow holes and other similar flaws. The process, which is fully patented in all the principal countries of the world, will be worked under arrangements with the inventor, M. Harmet, of St. Etienne, France, whose experience and advice are at the disposal of the company. The plant consists of a group of four hydraulic presses capable of dealing with ingots weighing both three and five tons and a mammoth single press capable of compressing ingots of twenty tons and upfards. The machinery is exceedingly massive, several single pieces weighing 80,000 lbs. each and both presses are capable of exerting a pressure of 4,000 tons on the steel while still in the fluid state.

An entirely new ingot car casting and electric stripping plant has also been installed in the open hearth department which it is expected will effect considerable reduction in costs.

During the last two or three years the New Glasgow works have been practically reconstructed and are now perhaps the most efficient in their particular lines of manufacture in the Dominion. The process of modernization was greatly enhanced this year by the erection of the hydraulic forge and new engineering shops. These cover an area of 40,000 sq. feet and are of steel, brick and concrete construction. The hydraulic forge plant contracted for in Europe some nine months ago consists of two presses, the smaller of 600 tons, the larger of 4,000 tons capacity. The latter will be able to deal with ingots weighing up to sixty tons. The presses are operated on the steam hydraulic principle, all the accessories being electrically driven.

To handle the ingots while being heated and forged in this department, two electric cranes, one of 60 tons and the other of 30 tons capacity have been installed. A 30-ton electric crane is installed in the engineering shop and a similar one in the ingot assembly yard.

The completion of this plant will place the Scotia Company abreast of any forge shops in Europe, probably in advance of any on this continent and will certainly enable it to undertake the heaviest work of this class which the growing demands of the Dominion will call for in a number of years.

Within a short time all the ingots produced at the company's open hearth plant will be rolled on the new 34-inch blooming mill now being installed. This mill, which was built by Lamberton and Company, Catebridge, Scotland, is complete with all the latest electric and hydraulic equipment and will add very materially to the efficiency of the plant. To drive it, a new engine of 4,000 horse power has been erected.

During the year there was completed the installation of an exhaust steam turbine electric plant. This consists of two units of 500 k.w. each operated by exhaust steam from the blooming and bar mill engines. The power thus generated will be used in all the various departments of the plant. Space is provided for a third unit which will be installed as soon as the electrification of the various departments has been completed.

The 800-foot shipping building erected in 1910 was completed during the year and has greatly increased the efficiency of this department. It is equipped with a 50-ton electric travelling crane having a span of 75 feet. The new manufacturing building in which will be housed the spike, rivet, bolt and nut, machinery steel, polished shafting and other smaller finishing departments has been largely equipped. A new department here is a pick-making plant which will produce all kinds of clay and miners' picks. Ample space for further extensions has been left in this department.

All the equipment in the new engineering shop will be motor driven and the entire building is designed along the lines of the greatest possible efficiency and economy. Among the machinery installed here will be one high speed 20 ft. by 6 ft. by 6 ft. Loudon planer; one Smith and Coventry 10-ft. boring mill; one 30-in. and one 21-in. Hulse lathe, two Bertram horizontal boring and drilling machines and one Dallett portable drill and shaft centerer.

THE INFLUENCE OF OXYGEN ON COPPER CONTAINING ARSENIC OR ANTIMONY.

The experiments described in this paper, by Mr. R. H. Greaves, B.Sc., were made to determine the influence of oxygen on certain mechanical and physical properties of copper containing either arsenic or antimony in quantities up to 0.5 per cent. A number of comparative tests in which the metals were cold-rolled down to 0.02 in., or drawn into fine wire, showed that with increasing arsenic, the metal may take up more and more oxygen without suffering deterioration in its capacity for rolling. This quantity of oxygen increases from about 0.05 to 0.2 per cent. as the arsenic increases from 0 to 0.2 per cent., then more slowly to about 0.28 per cent., with 0.05 per cent. arsenic. Above this point the malleability falls off, and with still more oxygen the metal becomes "cold-short." The action of oxygen on copper containing antimony is similar, but in this case a small quantity (about 0.1 per cent.) effects a distinct improvement in the malleability of the metal. The ductility was similarly affected by oxygen. Tensile tests on the case metals showed that increase in oxygen from 0.15 to 0.4 per cent. caused a rapid diminution in elongation; the effect on the maximum stress was not marked. Oxygen has little effect on the hardness (measured by the Shore scleroscope) until a limit is passed, depending on the arsenic or antimony present; above this, the hardness increases rapidly. This limit is at about 0.3 per cent. with 0.4 per cent. arsenic, but is less in presence of antimony. The first addition of arsenic or antimony decreases the hardness of copper containing oxygen. Measurements of electrical resistance show that oxygen diminishes the conductivity of copper containing arsenic, but increases that of copper containing antimony; the quantitive effect of the oxygen has not yet been determined. In an appendix, methods of determining oxygen in copper are discussed. Without denying the accuracy of other standard processes, the author suggests that oxygen may conveniently, and with a high degree of accuracy, be determined by reducing in hydrogen, and weighing the water formed.

*Abstract of a paper read before the Institute of Metals.

STASSANO ELECTRIC STEEL FURNACES.

In connection with the industrial development of the Stassano furnace, the following is of interest:

Since 1909 Major Stassano has been the sole owner of the patents and since then up to the present time he has made the following installations:

For the Societa Elba one 250-kw. Stassano furnace is in operation at Porto Ferrario and an 800-kw. Stassano furnace is to be installed in one of its works in Liguria.

For the Milan steel foundry, Fonderia Milanes d'Acciaio, one 250-kw. and two 100-kw. Stassano furnaces have been installed; for the J. J. Hoehn concern two 250-kw. furnaces, this plant being located at Odessa; for the Electro-Flex Steel Co., Ltd., of Newcastle-on-the-Tyne, three 250-kw. furnaces. A steel works is also being installed in Dunston-on-the-Tyne exclusively with Stassano furnaces.

After several years ago the Italian War Department had adopted the Stassano furnace for their Artillery Construction Shop. The Italian Navy Department will shortly likewise adopt it for the Navy Yards.

UNITED STATES GOVERNMENT REPORT ON THE COST OF STEEL.

The investigation shows that, as would be expected, the large companies have lower costs, partly due to superior efficiency, but also to monopolistic control, especially in ore.

Below are given some average unrevised book costs, which in several cases include transfer costs:

Open hearth billets	$20.87
Universal plates	21.82
Structural shapes	26.52
Merchant bars	28.12
Wire rods	27.21
Black sheets	39.37
Tin and terne plate	71.23

NEWS ITEMS.

The Steel Company of Canada has let the contract for plant extension at Hamilton to the Hamilton Bridge Co.

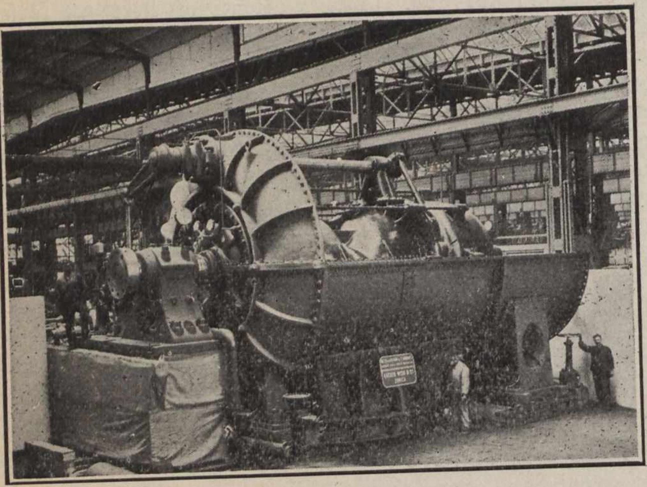
Marsh and Henthorne purpose erecting a new foundry at Belleville, Ont.

NEW ELECTRIC PUMPS.

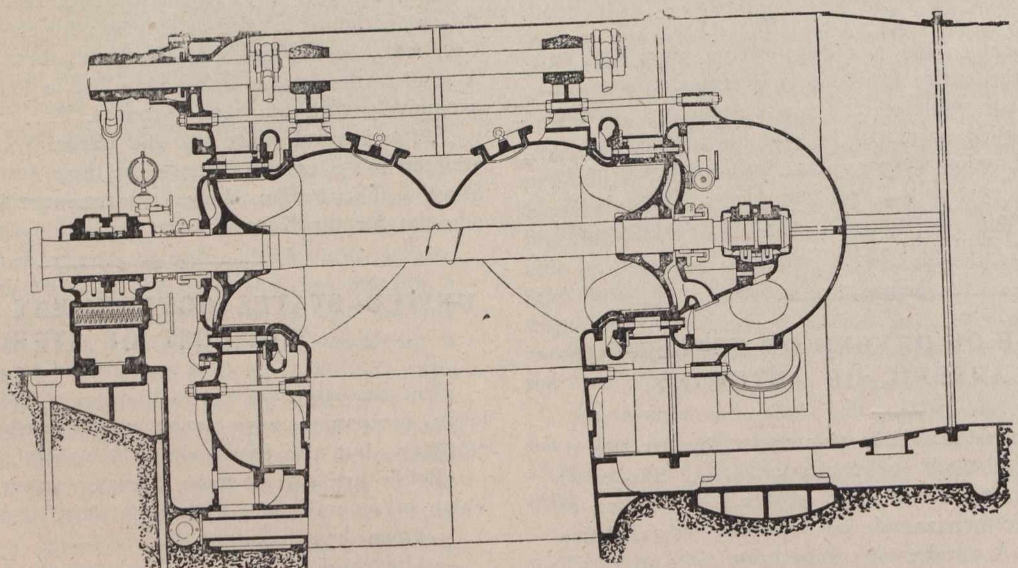
One or two of the five hundred horse-power electric motors for Toronto's high level pumping station have been in operation for a few hours each day during the past week.

INSTALLATION OF HYDRO-ELECTRIC UNIT.

The first large unit installed by the Western Canada Power Company, Stave Falls, B.C., was started on the 16th of December, last. This unit, which is the largest in Canada, excepting those at Niagara Falls, was put into service without the slightest trouble developing. After the valve was opened no adjustment was found necessary and the turbine was not again shut down. The present installation comprises two units of 13,000 h.p. each, working under a head



Turbine During Erection.



Section Through Turbine.

of about 110 ft. The hydraulic equipment is supplied by Messrs. Escher, Wyss & Co., of Zurich, Switzerland, Canadian office 408 Lumsden Bldg.. Toronto, and the electrical equipment by the Canadian General Electric Company, of Canada. The accompanying photograph shows the assemblying of one of the hydraulic units.

DEPUTATION FOR GOOD ROADS.

A representative deputation waited upon the Federal Government to urge a comprehensive system of main highways and appropriations for county road construction.

They represented the Good Roads Association of Ontario, the Quebec-Miami International Highway Association, the Toronto and other boards of trade, Ontario Motor League and many municipal and other bodies. The delegation numbered four hundred.

The deputation was introduced by Richard Blain, M.P. for Peel, who laid stress upon the claim that Mr. Borden was the first public man to make good roads a part of his policy. There were two classes who used the roads—the automobilists, who used the middle of the roads, and the farmers and their wives, who were compelled to use the sides of the roads.

Major T. L. Kennedy, president of the Ontario Good Roads Association, pointed out that Ontario possessed 50,000 miles of road, and that there was now no chance of keeping up these roads with the present methods of finance. The Ontario Government had voted a million dollars, but this had all been expended, and if good roads were to be secured Federal assistance was absolutely necessary.

C. J. Foy, of Lanark, emphasized the necessity for Federal aid in the construction and maintenance of good roads. His county (Lanark) had expended $75,000 on 130 miles of road, but it had now come to a point where it could not proceed any further without Federal aid.

Mr. Rankin, M.P.P. for Frontenac, suggested that the Federal Government should pay fifty per cent. of the cost of construction of highways as well as fifty per cent. of the cost of maintenance. There should be township, county, and State highways, and the Federal Government might justly be asked to aid the latter roads.

In reply Rt. Hon. R. L. Borden expressed his pleasure in meeting the delegation and receiving its suggestions. Establishment of good roads, he said, was primarily a matter of provincial jurisdiction. Therefore, it was obvious that the government had a genuine interest in the subject in proposing, as it did, to make grants for the purpose. The condition of roads in Canada was not what should be expected. The civilization of a people was often indicated in its highways.

For Construction.—The premier announced that the supplementary estimates would provide grants to the various provinces for the purpose, but he intimated plainly that the money would be for construction and not for maintenance. In doing the former the government would exceed the B.N.A. Act though doing nothing more than its duty. Details of method of outlay had not yet been determined, but it would be by co-operation with the provinces.

Engineers L. M. Talbot, of Middlesex; H. J. Bowman, Berlin, and E. A. James, of York, were the three engineers accompanying the delegation.

THE CANADIAN FORESTRY ASSOCIATION.

The thirteenth annual convention of the above association has been successfully concluded at Ottawa. The elections resulted in Mr. John Hendry, of Vancouver, being elected president.

Several measures tending toward an increased lumber output were recommended to the Federal Government, among them being the necessity for providing a system of examinations to test the qualifications of appointees and of making appointments permanent during good behavior, and that Federal Government appointments for this purpose should be placed in the hands of the Civil Service Commission. Also, in view of the fact that the expenditure on forest management in Canada is less than one cent per acre of the forest lands, while the average in other countries ranged from two to three cents per acre to $1.90 per acre, that the Federal Government and the Governments of the Provinces should provide large appropriations to assure efficiency of management and increasing profit from the forests of Canada.

It was resolved to impress upon the Government the necessity of maintaining in connection with the forestry branch an experimental laboratory for testing and investigating the physical and mechanical properties of Canadian woods, with a view to extending the possibilities of their use and for other purposes.

The association deprecated the practice of exporting in large quantities of Christmas trees of spruce and balsam, and recommended legislation to prevent that practice.

An executive committee to meet every three months was appointed as follows:—The president, the vice-president, Hon. Sidney Fisher and Messrs. Gordon C. Edwards, R. H. Campbell, G. Y. Chown and Dr. B. E. Fernow.

The committee on forest fire laws reported at very considerable length. This committee is composed of Dr. B. E. Fernow, Dean of the faculty of forestry of the University of Toronto, chairman, and Messrs. Thomas Southworth, ex-Superintendent of Forestry and Colonization for Ontario; W. C. J. Hall, Chief of the Forest Protective Service of Quebec; Ellwood Wilson, forester of the Laurentide Paper Company, Quebec; Dr. Judson F. Clark, forest engineer, British Columbia; Frank Davison, lumberman and member of the Commission of Conservation, Nova Scotia, and G. C. Piche, F. E., chief of the Forest Service, Quebec.

They reviewed the laws of all the provinces, and taking all things into consideration they state that the law of Nova Scotia is probably the most efficient for the conditions there. New Brunswick, Quebec and Ontario have laws which are good in many respects, but they were all primarily designed to protect unorganized territory, and they need to be supplemented by provisions looking to the co-operation of county and township authorities in the organized districts with the officers of the province and the rangers of the lumbermen in the unorganized districts. The laws of the prairie provinces were designed in the first place to stop prairie fires and need to be very considerably supplemented. In British Columbia and the Dominion generally, fire protection is largely a matter of executive administration.

The three main causes of forest fires are railroads, settlers, and persons like sportsmen and prospectors passing through the forests. Regarding railroads, safety there should be sought in improved equipment of locomotives, clearing of the right of way and patrol. In regard to settlers the first suggestion is an educative campaign. Times should be fixed in which settlers must burn the slash from their cleaning operations and in each case a permit to burn the same should be secured from the fire warden of the district. Regarding those whose business takes them into the woods, it is suggested that persons like tourists and prospectors passing through the woods should not be allowed to start fires for any purpose without having a permit from the proper officer. Such permits should be for a short time only and renewable upon good conduct. To reduce the danger from lumbering operations the report recommends the burning of slash while the logging operations are going on, or the "downing" of tops and branches so that they may lie close to the ground and rapidly decay.

ENGINEERING NEWS.

Victoria, B.C.—It is anticipated that information relative to the report on the proposed improvements to the outer harbor of Victoria, prepared by Mr. Louis Coste, will shortly be forthcoming.

Victoria, B.C.—That the municipal council select a consulting engineer to confer with the city engineer relative to the necessary work of repair of Smith's Hill reservoir was the suggestion made by Mayor Beckwith.

PERSONAL.

Mr. Willis Chipman, the newly-elected president of the Engineers' Club, of Toronto, is a member of the firm of Chipman and Power, engineers, of Toronto. Mr. Chipman was elected to this position at the annual meeting of this club on February 1st last. Other members elected to office were: 1st vice-president, Mr. T. S. Young; 2nd vice-president, Mr. J. J. Ashworth. 3rd vice-president, Mr. C. H. Heys, Directors; Messrs. Edmund Burke, R. A. Baldwin, W. A. Bucke, E. L. Cousins, W. E. Douglas, H. E. T. Haultain, E. A. James, Jas. McEvoy, A. L. McAllister, G. G. Powell and A. J. Von Nostrand. Secretary-treasurer, Mr. R. B. Wolsey.

Mr. Willis Chipman.

Mr. Ross Thompson has accepted the position of chief engineer of the St. John and Quebec Railway.

Mr. S. B. Wass has been appointed assistant chief engineer of the St. John and Quebec Railway.

Mr. C. W. Powers has been appointed civic engineer of railways, bridges and docks for the city of Toronto.

Mr. Henry Harvie has been appointed chief engineer of the Lake Superior Power Co., Sault Ste. Marie, Ont.

Mr. H. B. Silcox, head of the supply department of the city of Toronto, intends to resign from that position shortly. He will go into business on his own account.

Mr. A. J. Latornel, city engineer of Edmonton, Alta., has reconsidered his resignation notice forwarded to the city officials. He will remain in that position.

Mr. J. D. Whitmore, who has officiated as acting engineer for Moose Jaw since the resignation of Mr. J. M. Wilson some three months ago, has severed his connection with that city. He will return to Regina.

R. O. Wynne-Roberts, M. Inst. C.E., has been appointed by Regina as consulting engineer in connection with that city's additional water supply. Mr. Roberts has also been appointed consulting engineer to report on water supply at Watrous, Sask.

COMING MEETINGS.

THE CLEVELAND ENGINEERING SOCIETY. Special Meeting February 27, 1912, Chamber of Commerce Building, Cleveland, O. "Technical Education (Illustrated)," by Prof. J. F. Barker, Technical High School, Cleveland. Secretary, F. W. Ballard.

THE ENGINEERS' CLUB OF TORONTO, 90-96 King St. West.—Thursday, Feb. 15th. Dinner at 6-30; Lecture at 8 p.m., in Dining Room. After dinner address by Prof. W. R. Lang, Major Canadian Engineers, "Organization, Administration, Duties and Achievements of the Engineering Forces of the Crown," illustrated with models and lantern slides of Bridges constructed by the Royal Engineers in different parts of the Empire, R. B. Wolsey, Secretary.

CANADIAN NATIONAL ASSOCIATION OF BUILDERS.—The Sixth Annual Convention will be held in Toronto, February 20, 1912.

ONTARIO GOOD ROADS ASSOCIATION.—Annual Convention to be held at Toronto, February 26, 27, 28. Secretary, J. E. Farewell, Whitby.

THE ENGINEERS' CLUB OF TORONTO, 90-96 King St. West.—Thursday, Feb. 29th, 8 p.m. Meeting of Toronto Branch of Canadian Society of Civil Engineers. R. B. Wolsey, Secretary.

ENGINEERING SOCIETIES.

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

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

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

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

VANCOUVER BRANCH—
Chairman, Geo. H. Webster; Secretary, H. K. Dutcher, 319 Pender Street West, Vancouver. Meets in Engineering Department, University.

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

MUNICIPAL ASSOCIATIONS.

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

UNION OF ALBERTA MUNICIPALITIES.—President, H. H. Gaetz, Red Deer, Alta.; Secretary-Treasurer, John T. Hall, Medicine Hat, Alta.

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

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

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

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Bee, Lemberg; Secretary, Mr. Heal, Moose Jaw.

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

CANADIAN TECHNICAL SOCIETIES.

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

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

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

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

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

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

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

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

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

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

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

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

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. Frank D. Adams, McGill University, Montreal; Secretary, H **Mortimer-Lamb, Windsor Hotel, Montreal.**

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

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

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

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

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

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

DOMINION LAND SURVEYORS.—President, Thos. Fawcett, Niagara Falls; Secretary-Treasurer, A. W. Ashton, Ottawa.

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

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, W. B. McPherson; Corresponding Secretary, A. McQueen.

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

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

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

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

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

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

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

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

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, W. H. Pugsley, Richmond Hill, Ont.; Secretary, J. E. Farewell, Whitby.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, J. Whitson; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

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

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

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

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

SOCIETY OF CHEMICAL INDUSTRY.—Dr. A. McGill, Ottawa, President; Alfred Burton, Toronto, Secretary.

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

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

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

CONSTRUCTION NEWS SECTION

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

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., concrete substructures, etc.	Feb. 18.	Feb. 8.	59
Calgary, Alta., electric machinery	Mar 15.	Feb. 8.	68
Calgary, Alta., sluice gates	Feb. 29.	Feb. 1.	68
Galt, Ont., Y.M.C.A. building	Feb. 24.	Feb. 1.	59
Edmonds, B.C., steel pipes	Mar. 11.	Feb. 8.	68
Esquimalt, B.C., schooner	Feb. 15.	Feb. 8.	59
Little Lameque, N.B., wharf	Feb. 14.	Jan. 25.	59
Kerrisdale, B.C., valves, hydrants, etc.	Feb. 19.	Feb. 1.	59
Keremos, B.C., quarantine station	Mar 1.	Feb. 8.	59
Lake Quinze, Que., dams and sluiceways	Feb. 15.	Jan. 25.	59
Lethbridge, Alta., extension to power house	Feb. 15.	Feb. 1.	59
London, Ont., engines and pumps	Feb. 14.	Feb. 1.	70
Lockport, Man., Red River bridge work	Feb. 20.	Feb. 8.	59
Meaford, Ont., construction work on E. Breakwater; dredging	Feb. 26.	Feb. 1.	59
Moose Jaw, Sask., elevator water tank	Feb. 26.	Feb. 8.	68
Ottawa, Ont., civic supplies	Feb. 13.	Feb. 8.	68
Ottawa, Ont., waterworks supplies	Feb. 13.	Feb. 8.	70
Ottawa, Ont., launches	Feb. 24.	Feb. 1.	59
Ottawa, Ont., contracting machinery	Feb. 26.	Jan. 11.	59
Ottawa, Ont., outlet pipe	Feb. 15.	Feb. 8.	70
Saskatoon, Sask., subway	Feb. 23.	Jan. 25.	68
Saskatoon, Sask., pavements	Feb. 16.	Jan. 18.	86
Saskatoon, Sask., concrete sidewalks	Feb. 16.	Jan. 18.	86
Swift Current, Sask., theatre	Feb. 16.	Jan. 25.	59
Toronto, Ont., track intersections, etc.	Feb. 20.	Jan. 25.	72
Toronto, Ont., bridges	Mar. 2.	Feb. 1.	59
Toronto, Ont., sewer, Toronto Junction	Feb. 27.	Feb. 8.	68
Toronto, Ont., macadam highway road	Feb. 15.	Feb. 8.	68
Upper Salmon River, N.B., pier	Feb. 14.	Jan. 25.	59
Winnipeg, Man., drawings for Parliament Buildings	Mar. 31.	Jan. 25.	70
Winnipeg, Man., pumping machinery	Mar. 1.	Jan. 25.	72
Winnipeg, Man., piers and abutments, Red River bridge	Feb. 14.	Feb. 1.	59

TENDERS.

Calgary, Alta.—Plans for the proposed theatre on Eighth avenue, and an application for a permit for the building have been filed at the office of the city building inspector. The cost of the structure is estimated at $30,000.

Calgary, Alta.—Ex.-Ald. J. S. Mackie is contemplating the erection of a $250,000 business block, corner of 8th Ave. and Second Street West.

Calgary, Alta.—Tenders for electric machinery consisting of: One 2,500 K.W. turbo generator; one 1,000 K.W. synchronous motor generator; one 50 K.W. motor driven exciter; one 25 K.W. motor driven exciter. All delivered and erected in Calgary, will be received until March 15th, 1912. J. M. Miller, City Clerk.

Edmonton, Alta.—The school board contemplate calling for tenders for the erection of a $112,000 school building.

Hamilton, Ont.—Tenders will be received until February 28th, 1912, for the supply and delivery of 2,200 lineal feet of 48-inch steel intake pipe with expansion joints, intake and flanged specials, sluice valves, bolts and gaskets. S. H. Kent, City Clerk, City Hall. (See advt. elsewhere in the Can. Eng.)

Hamilton, Ont.—Tenders will be received by the chairman of the Board of Control, City Hall, until February 19th, 1912, for supplying the corporation of the city of Hamilton with the following supplies: Lime, jute packing and reinforced concrete pipe. Specifications at the office of the City Engineer of Hamilton, where forms of tender can be obtained. S. H. Kent, City Clerk.

Hamilton, Ont.—Tenders will be received until February 28th, 1912, for the supply and delivery of 2,200 lineal feet of 48-inch steel intake pipe with expansion joints, intake and flanged specials, sluice valves, bolts and gaskets. Plans and specifications can be obtained from A. F. Macallum, City Engineer, City Hall, Hamilton. S. H. Kent, City Clerk. (See advt. elsewhere in Can. Eng.)

New Westminster, B.C.—Tenders for the erection and completion of two concrete dams, excavation of river channel, in the Nicomeki and Serpentine Rivers in the Municipality of Surrey, New Westminster district, will be received until noon, March 10th, 1912. Drawings, specifications, etc., may be obtained at office of Harvey C. Brice, C.E., Room 3, Westminster Trust Block, New Westminster, B.C.

Ottawa, Ont.—Tenders for structural modifications to Fishery Protection Vessel "Canada," will be received until noon, February 15th, 1912, by G. J. Desbarats, Deputy Minister of Naval Service, Dept. of Naval Service, Ottawa. Full particulars obtained on application to Commander in Charge, H.M.C. Dockyard, Halifax, N.S.

Ottawa, Ont.—Tenders will be received until February 19th, 1912, for interior fittings, Post Office and Customs, Grand Falls, N.B. Plans, etc., at office of Mr. F. L. Dixon, Clerk of Works, Grand Falls; Mr. D. H. Waterbury, St. John, Clerk of Works, and Dept. of Public Works, Ottawa.

Ottawa, Ont.—Tenders are invited for the construction of a Quarantine Station at White Rock, B.C., to be received until March 15th, 1912; specifications, etc., obtained from S. Ranson, V.S., Post Office Building, Vancouver, or S. F. Tolmie, V.S., Victoria, B.C. A. L. Jarvis, Asst. Dep. Min. and Secr. of Agriculture, Ottawa.

Ottawa, Ont.—Tenders will be received unil February 28, 1912, for the reconstruction of approach to the Government Wharf at Sault Ste. Marie, Ont., plans, etc., of which can be seen at the offices of J. G. Sing, Esq., district engineer, Confederation Life Building, Toronto. H. J. Lamb, Esq., district engineer, Windsor, Ont., on application to the Postmaster at Sault Ste. Marie, and the offices of R. C. Desrochers, Secr. Dept. of Public Works, Ottawa.

Ottawa, Ont.—Tenders will be received until noon, February 22nd, 1912, for the installation of new fittings in the Drill Hall at Windsor, Ont. Specincifications, etc., at the offices of the Officer Commanding the 21st Regiment, Windsor; the Officer Commanding 1st Division, London, Ont.; and the Director of Engineer Services, Headquarters, Ottawa. Eugene Fiset, Deputy-Minister, Department of Militia and Defence, Ottawa.

Saskatoon, Sask.—Tenders will be received by the City Commissioners until February 22nd, 1912, for furnishing meters, transformers, wire, globes, and other electrical supplies required by the city during the year 1912. (See advt. elsewhere in Can. Eng.)

Saskatoon, Sask.—Tenders will be received by the City Commissioners until March 8th, 1912, for electrical equipment. (See advt. elsewhere in Can. Eng.)

Saskatoon, Sask.—Tenders will be received by the City Commissioners until March 1st, 1912, for furnishing sewer pipe and junctions, cast-iron pipe and specials, etc. (See advt. elsewhere in Can. Eng. for full details.)

Swan River, Man.—Tenders will be received until February 29, 1912, for the erection and completion of a six-room brick school, for all trades except excavating, concrete and plumbing. Drawing and specifications may be seen at the offices of C. A. Lewis, secretary-treasurer, Swan River, Man.; T. C. Silverthorne, superintendent, Bowsman River, Man., and E. D. Tuttle, architect, 701 McArthur Building, Winnipeg.

Toronto, Ont.—It was decided at a meeting of the Harbor Board to ask at once for tenders for the rental of the city docks, which were recently turned oved to the board by the city. Mr. E. L. Cousins, Engineer to the Board.

Toronto, Ont.—The chairman of the board of control will receive tenders until March 7th, 1912, for the grading and construction of the concrete abutments and wing walls for Coxwell Avenue Subway. G. R. Geary (Mayor), chairman, Board of Control, City Hall, Toronto. (See advertisement in Canadian Engineer).

Toronto, Ont.—Tenders will be received by the board of control up to noon, February 27th, 1912, for the annual supply of asphalt for the year ending December 31st, 1912. G. R. Geary (Mayor), chairman, Board of Control, City Hall, Toronto. (See advertisement in Canadian Engineer.)

Toronto, Ont.—Wm. Panton, County Clerk, Milton, Ont., will receive tenders up to noon, March 4th, 1912, for completing the construction of a reinforced concrete arch of 135 foot span and 340 feet of concrete viaduct approach on the Middle Road between the town of Oakville and the Township of Trafalgar. Frank Barber, Consulting Engineer, Toronto. (See Advertisement in The Canadian Engineer.)

Victoria, B.C.—Tenders will be received until February 16th, 1912, for furnishing and fitting in place steel shelving, etc., required for the vaults of the government offices at New Westminster. Plans, etc., at the offices of the government agent, New Westminster; the Provincial Timber Inspector, Court House, Vancouver; and J. E. Griffith, Public Works Engineer, Dept. of Public Works, Victoria.

Winnipeg, Man.—Tenders will be received until February 20th, 1912, for the supply and delivery f.o.b. Winnipeg, of the following crushing plant: One No. 3 gyratory crusher without back gear driving attachment; to be fitted with chilled iron head and concaves. One No. 5 stone elevator complete with buckets, length 60-ft. One No. 5 revolving screen complete, length 16-ft., in 3 sections, and dust jacket screen. Sections to be made of ¼-in. plate and perforated as follows: 1st section, ¾-in.; 2nd section, 1¼-in.; 3rd section, 2-in.; dust jacket, ⅜-in. M. Peterson, Secretary, Board of Control Office, Winnipeg.

Winnipeg, Man.—Tenders will be received until March 1st, 1912, for the supply and delivery f.o.b. Winnipeg, of the following equipment: 1 44-ton or 45-ton steam shovel equipped with a dipper of at least 1¼-yard capacity, with a clear lift from rail to bottom of dipper door, when open, of not less than 16 feet; 1 locomotive of regular standard gauge to have a hauling capacity of at least 350 tons on a 1 per cent. grade and equipped both front and back with attachment for coupling to standard 80,000-lb. railway cars. Full specifications and drawings must accompany each proposal. M. Peterson, Secretary Board of Control Office, Winnipeg.

Winnipeg, Man.—Tenders will be received by the Chairman, Board of Control, until February 13th, 1912, for the supply and delivery f.o.b. Winnipeg, of one only 24-inch disk rock crusher complete. M. Peterson, Secretary, Board of Control Office, Winnipeg.

Winnipeg, Man.—Tenders will be received by the chairman, board of control, until March 25th, 1912, for the manufacture and delivery f.o.b. Winnipeg, of impregnated paper lead covered cables, to be used in connection with the city's fire and police telegraph system. Full particulars at the office of the city electrician, City Hall, Winnipeg. M. Peterson, Secretary, Board of Control Office, Winnipeg.

Winnipeg, Man.—Tenders will be received until February 22nd, 1912, for supply of three 50 k.w. transformers, motor, and accessories for installation at Well No. 4. Specifications, etc., at office of city engineer, 223 James Avenue. Mr. Petersen, secretary, Board of Control Office, Winnipeg.

Winnipeg, Man.—Tenders will be received by the chairman, board of control, until March 1st, 1912, for the supply and delivery f.o.b. Winnipeg, of a quantity of C. L. water pipe, gate valves, and hydrants for extension of the domestic waterworks system. Specifications and forms of tender may be obtained at the office of the city engineer, 223 James Avenue. Mr. Petersen, secretary, Board of Control Office, Winnipeg.

Victoria, B.C.—Mr. W. Ridgway Wilson, architect, will receive tenders until March 5, 1912, for the construction of St. John's new church edifice. Material used to be brick and terra cotta.

CONTRACTS AWARDED.

New Westminster, B.C.—Messrs. J. Coughlan & Sons have received the contract of raising the high tension wires of the British Columbia Electric Railway Company on the Government bridge across the Fraser River. Contract will involve an expenditure of about $10,000.

St. John, N.B.—The contract for the development of the Grand Trunk Pacific Terminals in Courtenay Bay, St. John, has been awarded by the Government to Norton Griffiths, the English contractor. The contract involves an expenditure of $7,500,000.

Winnipeg, Man.—Messrs. McMillan Bros., railroad contractors, have secured from J. D. McArthur a sub-contract for 185 miles of the Hudson Bay Railway, commencing at Le Pas and extending eastward to a point west of Split Lake.

Vancouver, B.C.—Tenders dealing with the Waterworks Committee in regard to supplies for the Seymour Creek work, have been awarded as follows: The lead piping tender was awarded to Messrs. Robertson, Godson & Company for $3,920. That for the galvanized iron pipe was given to Messrs. Crane & Company at the price of $3,472.50. The contract for the pig lead was secured by Messrs. Evans, Coleman & Evans at $94.08 a ton. The successful tender for the brass goods was that of Messrs. Simson, Balkwill & Company at the sum of $1,054.

Victoria, B.C.—Mr. Harrison, Victoria, has a contract for the erection of a modern two-story factory on Garbally road. Latest kind of electrical machinery to be installed. Owners, Messrs. Hallwards, Limited, furniture manufacturers. W. D. H. Rockfort, architect.

Victoria, B.C.—The contract for the erection of a one-story brick structure for a manual training centre at the North Ward school, was awarded to Messrs. Luney Bros., at a cost of $3,230.

RAILWAYS—STEAM AND ELECTRIC.

The Board of Railway Commissioners for Canada will hold a sittings at the Court Houses at Calgary, Alta., Thursday, March 14th, 1912; Edmonton, Alta., Monday, March 18th 1912; Regina, Sask., Friday, March 22nd, 1912, and at the City Hall, Winnipeg, Man., Monday, March 25th, 1912. At these sittings the board will consider the matter of freight rates in western Canada.

Calgary, Alta.—Surveyors are at work preparing the route for the Calgary Street Railway's extension to the Canadian Pacific Railway Company's shops site, east of the Bow River, and work will be started in the near future.

Fredericton, N.B.—A very attractive station for the I.C.R. is almost completed at this point. Messrs. M. Ryan & Son are the contractors. Considerable concrete paving will be necessary in the spring.

Galt, Ont.—The franchise of the Galt, Preston and Hespeler Railway has been renewed for ten years.

Kingston, Ont.—A contract for 25 locomotives has been placed by the Grand Trunk Pacific Railway with the Canadian Locomotive Company, Kingston, Ont., for delivery May, 1912. These are of simple consolidation type, with Schmidt superheaters, having cylinders 25 inches in diameter by 30 inches stroke, 63-inch driving wheels, and a boiler pressure of 180 pounds.

Moose Jaw, Sask.—The Canadian Northern Railway have closed an agreement with the city council for the entrance into the city, and for the station site. The new station will be at the east end of the city, facing and immediately east of the Crescent Park and baseball ground.

One of the methods of applying and spreading Dolarway Bitumen on Concrete Base.

Finished Dolarway Pavement.

North Bay, Ont.—Town Solicitor McNamara is taking necessary steps to apply for a street car charter for the town, to co..nect with Callander, Trout Mills and Sturgeon Falls.

Northern Ontario.—J. L. Englehart, chairman of the Commission, T. & N. O. Railway, stated that tenders for the construction of the Elk Lake line would be called in the spring.

Ottawa, Ont.—The matter of requiring all electric railway companies in Canada to equip their cars with automatic fenders will be discussed by the Railway Board on March 5 next.

West Toronto, Ont.—It is the intention of the Grand Trunk Railway to double-track its main line from West Toronto to Weston, Ont.

Winnipeg, Man.—The Canadian Northern Railway contemplate building new yards at this point.

Victoria, B.C.—The Canadian Mineral Rubber Company have a large crew at work laying concrete between the double tracks on Burnside road for the Saanich extension of the B. C. Electric Railway Company.

LIGHT, HEAT AND POWER.

Calgary, Alta.—W. R. Martin, of Medicine Hat, one of the promoters of the Canada Western Gas, Heat, Light and Power Company, is reported to have stated that the construction of the pipe line from Bow Island to Calgary will be commenced from the east at an early date.

Calgary, Alta.—Another flow of natural gas has been struck at Bow Island, which will be piped across 181 miles of country to this city.

Duncan, B.C.—A company to supply Duncan with electric light and power is being formed. The promoters expect to have the town lighted by electricity before next autumn.

Guelph, Ont.—A report states that the power consumption in Guelph for January last amounted to $2,300.

Halifax, N.S.—The street railway receipts for the week ending February 7th, 1912, were $3,979.44, an increase of $66.16 over the same period last year.

London, Ont.—Mr. C. B. King, manager of the London Street Railway Company, has been instructed by the directors to secure tenders on a new steam power plant.

Nelson, B.C.—The flat rate system of supplying electric light to citizens was severely criticized by H. P. Thomas, the new superintendent of the city's power and light system. He recommended to the council that the flat rate system be abolished and meters installed in all houses.

Orillia, Ont.—The town of Orillia during this session of the legislature will seek authority to issue debentures for $80,000 to construct a connecting pole line to the Simcoe Power Company's plant at the Big Chute on the Severn River.

Ottawa, Ont.—Hon. Adam Beck is reported to have stated that the provincial government will develop power at Chats Falls on the Ottawa River.

Prince Albert, Sask.—The committee in charge of the municipal power plant recommended that a supply of motors be purchased for renting purposes. F. A. Creighton, City Engineer.

Province of Saskatchewan.—A bill is at present before the provincial government to develop the deposits of lignite, known to exist throughout the province, for power purposes.

Saskatoon, Sask.—The superintendent of the civic power plant, Mr. H. G. Sangster, has been notified that the council approve of the calling of tenders for the following plant: Five hundred housepower water tube boilers with automatic stokers, economizers and independent draught appurtenances; a 2,000 k.w. high pressure steam turbine with generator, condensers, air pump, exciters, and all the necessary equipment for a complete plant. The machinery, which will be placed in the power house will cost $175,000. It will be ten months or a year before the installation is completed.

Winnipeg, Man.—Work on the underground distribution system is to be resumed at once so that the underground district connections may be ready as soon as possible after current is available from the King Street sub-station.

Verdun, P.Q.—The municipal council are considering plans for the extension of the electric light system. Mr. H. Hadley, jr., engineer.

GARBAGE, SEWAGE AND WATER.

Niagara Falls, Ont.—The waterworks board are about to consider certain plans being prepared to improve the intake and waterworks plant. One of the ideas is to introduce a tube below the flow of water at the intake to increase the volume. Other radical changes in the wheelpit and the underground flume will be suggested in the plans which are expected from Mr. Kennedy, Montreal, in a short time. Mr. R. P. Slater, water commissioner, is interested in this work.

Port Stanley, Ont.—This municipality will vote on a waterworks by-law in the near future. Mr. Bell, city engineer of St. Thomas, Ont., is interested in the matter. There are twenty fire hydrants and a large standpipe in the plans now prepared.

Regina, Sask.—Mr. R. O. Wynne-Roberts, who has prepared a report on the new water supply of this city, states that the construction of the first section will entail 6 miles of earthenware pipe from 6 to 18-inches diameter, 5 million gallon reservoir, 3 million gallon water softening plant, meters, etc. The second section will consist of 8 miles of 27-inch steel mains, 8 miles of earthenware pipe from 8 to 40-inches, pumping plant, water softening plant, buildings and small reservoir.

Toronto, Ont. — A report, with estimated costs, on a scheme to supply Toronto with water from Scarboro Heights will be presented to the council at an early date. Mr. I. Randolph, Chicago, is chairman of the board preparing the report.

Verdun, P.Q.—The municipal council are considering plans for the extension of the municipal water system and the filtration plant. Mr. H. Hadley, jr., engineer.

Victoria, B.C.—Mr. William W. Northcote, municipal purchasing agent, is contemplating the purchase of one or more motor trucks to be used in the collecting of house garbage. He is also making inquiries relative to the purchase of twelve garbage waggons.

BUILDINGS AND INDUSTRIAL WORKS.

Edmonton, Alta.—Messrs. Revillon Bros., Ltd., of this city, will erect a six-story warehouse on the Fourth Street spur; the building to be 150 by 150 feet.

Galt, Ont.—The community is seeking authority to overcome certain legal difficulties in connection with the eerction of a municipal abattoir. Mr. McArthur is secretary to the board of health.

Fort William, Ont.—A report states that the Grand Trunk Pacific Railway will erect a thirty million bushel grain elevator at Fort William.

Galt, Ont.—Messrs. Goldie & McCulloch will spend $80,000 on improvements to their buildings and machinery. The Y.M.C.A. will erect a $70,000 structure.

Montreal, P.Q.—A report states that the Dominion Steel Corporation will erect a large warehouse and make Montreal a distributing point for their manufactured goods, such as nails, rods, and all the wire goods which are soon to be turned out by the plant that is now being constructed at Sydney, C.B., Nova Scotia, for this purpose.

Montreal, P.Q.—Mr. Arthur Beauchesne is taking charge of the publicity work in connection with the erection of a monument to Cartier. The cost of the monument will be $10,000.

Moose Jaw, Sask.—An agreement has been reached whereby the Robin Hood Mills of the Saskatchewan Flour Mills Company, will be rebuilt at Moose Jaw. According to agreement the mill must be of concrete construction and the buildings will include a 3,000-barrel flour mill and a quarter million bushel elevator. A 600-barrel oatmeal mill is also on the programme.

Moose Jaw, Sask.—The Rumley Company, manufacturers of threshing machinery, have decided to locate in Moose Jaw. Mr. William Crosbie has been appointed manager of the Moose Jaw branch.

Nanaimo, B.C.—This municipality contemplates spending $50,000 on new school buildings during 1912.

Niagara River, Ont.—The Sanitary Packing Company will erect a large dock half way between Queenston and Niagara-on-the-Lake. The head office of this company is in Toronto, Ont.

Orillia, Ont.—The sum of $60,000 has been placed in the supplementary estimates for the building of an armory, and it is probable that the early summer will see the work of erection well under way.

Ottawa, Ont.—Mr. G. F. Hodgins, of Shawville, P.Q., is president of a new shale brick industry, building operations on which have been started at Russell. It will employ about 100 men and will have a capacity of 100 tons per day.

Ottawa, Ont.—Ald. Lapointe secured the approval of the city council for an initial expenditure of $20,000 on public lavatories this year. A committee will be formed.

Ottawa, Ont.—The civic building programme for 1912 includes the erection of a $45,000 smallpox hospital, $12,500 tubercular hospital, $30,000 fire station and equipment, $20,000 public lavatories. The estimates also include an item of $10,000 for an incinerator site. John Henderson, town clerk.

Ottawa, Ont.—A new telephone exchange for the Glebe section of the city, in addition to the second exchange to be opened shortly in Lower Town, is planned for the near future by the Bell Telephone Company.

Point Grey, B.C.—The Board of Education have applied to the municipal council for $114,200, to be used for the erection of three new school buildings. Mr. M. C. Gordon, secretary of the board of school trustees.

Port Arthur, Ont.—The Canadian Northern Railway will erect a $40,000 dock at this point.

Port Mann, B.C.—The International Milling Company, Minnesota, Iowa, U. S. A., contemplate the erection of a 5,000 barrel flour mill at this point. Mr. F. A. Bean, Moose Jaw, is interested.

Saskatoon, Sask.—The St. James' Anglican Church congregation contemplate spending $10,000 on a new church building. Mr. J. Eadon-Reaney is vestry clerk.

St. Catharines, Ont.—The Sterling Bank of Canada and the Traders Bank of Canada contemplate the erection of bank buildings in this city.

St. Thomas, Ont.—Secretary W. H. Tallman of the board of education states that the plans prepared by Architect John T. Findlay for the proposed extension to the collegiate, had been approved. Work is to be commenced as soon as the weather will permit.

Thorold, Ont.—A new paper plant for this town will employ between 150 and 200 men. The plant will be erected on the frontage facing Grand Trunk Railway tracks.

Toronto, Ont.—The I.O.O.F. Hall Association of Toronto, Limited, decided to build a new $100,000 hall on their property at 229 College Street. The new building will be 130 feet long by 65 feet wide and will be fireproof throughout. It will be five stories high, and will have a large auditorium.

Welland, Ont.—The Canadian Steel Foundries are considering the erection of a $150,000 plant in Welland. B. J. McCormick, Welland, has been looking after a suitable site, etc.

Welland, Ont.—Mr. Wellington Downing, of Erie, Pa., is interested in a project to erect a large hotel in this town during the coming year. The cost is estimated at $150,000.

Winnipeg, Man.—The board of control has ordered the completion of plumbing work at the King Street sub-station, at an estimated cost of $900. Mr. Glassco, power manager.

Victoria, B.C.—It is stated that certain improvements to the outer harbor, now pending, will necessitate the British Columbia Soap Co., and the British America Paint Co., building new plants.

Victoria, B.C.—Mr. M. Warren, architect, has completed plans for a new building to be erected for the Canada Mosaic Tile Company. The structure is to cost $25,000. Mr. Warren will call for tenders for its construction shortly.

Vancouver, B.C.—Plans for the extension of the Great Northern Railway Company's docks at this point are being considered. These plans call for an additional 200 feet of concrete work. The head office of this company is in St. Paul, Minn., U.S.A.

Vancouver, B.C.—It is expected that two oil storage tanks will be constructed near the site of the present one at the Western Transfer shed. The tanks to be built will have a capacity of 55,000 barrels. They are to be built for the Canadian Pacific Railway.

Vancouver, B.C.—Mr. Abraham Grossman is interested in a ten-story structure to be erected in this city. It will be of steel and brick, and cost about $500,000.

Verdun, P.Q.—The Federal Government are planning changes on the river front, where an up-to-date wharf and a properly dredged approach is expected to materialize early in the spring, thus enabling the corporation to complete the dyke and boulevard scheme, that is now practically finished, from the southern limits of the town to this point. Mr. H. Hadley, jr., town engineer.

Victoria, B.C.—A large warehouse being built for Messrs. R. P. Rithet & Co., is nearing completion. It is to be covered with galvanized iron.

BRIDGES, ROADS AND PAVEMENTS.

Niagara Falls, Ont.—The chairman of the board of works and the city engineer, Mr. J. C. Gardner, will visit several near-by cities to inspect the pavement, in order that they will be able to render a report as to which kind of road covering is the most suitable.

Ottawa, Ont.—A deputation waited upon Hon. Frank Cochrane to urge a grant toward the construction of a bridge across the Rideau Canal at Pretoria Avenue. The estimated cost of the bridge, on plans prepared by the city engineer, Mr. N. J. Ker, is $133,500. The land and building damages will total $53,450, making a total of $185,950. A report will be made.

Province of Ontario.—The Ontario Government intend spending an additional million dollars on country roads.

Penticton, B.C.—Mr. H. A. Turner, who has been superintending the surveys for new roads to be opened throughout the Okanagan during the coming summer, has plans for a new steel and concrete bridge which will span the Okanagan River on Fairview Road, near Penticton. Construction is to commence in the early spring.

Thorold, Ont.—The Thorold town council decided to do considerable permanent paving in the near future.

Toronto, Ont.—The Board of Control will advertise for tenders for the year's supply of asphalt. Specifications are to be drawn up by the City Engineer, Mr. Rust.

FIRES.

Guelph, Ont.—$1,000 damage was caused by fire to the biological building of the Agricultural College.

Hamilton, Ont.—The printing and stationery establishment of Robert Duncan was damaged by fire to the extent of $200,000. Several nearby buildings were also damaged.

Owen Sound, Ont.—The Owen Sound Wire Fence Company was lately damaged by fire. Damage is estimated at $3,000.

Parry Sound, Ont.—The ratepayers passed the by-law to bonus the iro n works. Major Peuchen, of the Standard Chemical Company, Toronto, is interested.

St. Boniface, Winnipeg, Man.—The sash and door factory of the D. McCormick Company, in St. Boniface, was totally destroyed by fire with a loss of $25,000 in buildings and machinery.

CURRENT NEWS.

Edmonton, Alta.—The building permits of Edmonton and Strathcona for January 1912 amounted to $167,600, an increase of 107.5 per cent. over the corresponding period in 1911. Strathcona is a recent addition to the City of Edmonton.

Fort William, Ont.—The municipal Board of Works are considering appointing a purchasing agent for all supplies not purchased by tender. A. McNaughton, city clerk.

Masset, Queen Charlotte Islands, B.C.—Residents of the town are asking the provincial government for an experimental farm, donkey engines for road work, a large appropriation for road construction, and for assistance for the settlers in draining the large areas of semi-swamp lands.

New Liskeard, Ont. — At the Temiskaming Telephone Company annual meeting a report was read which showed that the gross income of the company for 1911 was $32,041.40.

which compared with the gross income of $31,042.05 for 1910 shows an increase of $999.35. The net ncome for 1911 was $16,416.09, as compared with $15,933.96 for 1910.

Creston Valley, B.C.—A reclamation survey of 40,000 acres of flats in the Kootenay valley, will be made by the provincial government with a view to reclamation. It is estimated that the reclamation work will cost half a million dollars. The survey will take nearly a year.

St. John, N.B.—Mr. William Murdoch, municipal engineer, will offer for sale at public auction on Saturday, February 17th, 12 o'clock noon, one steam dredge and two hopper scows belonging to the city.

Toronto, Ont.—The cost of dredging the River Don from Winchester Street to its mouth, the city engineer, Mr. Rust, reports, would be $200,000, and to construct retaining walls, with twelve foot sidewalks on each embankment $290,000, a total of $490,000. The river bed is full of weeds and muck, and the piling on each side has broken away in many places.

Winnipeg, Man.—A. N. Stokes, president of the British Institute of Architects, has been appointed assessor to award the prizes in the competition for the new Manitoba Provincial Government building plans.

Victoria, B.C.—Mr. Harry Worswick, superintendent of construction on civic works, is arranging for the better and more expeditious handling of his force in the matter of more detailed daily reports of progress on the various works, cost of same, etc.

COPY OF ENGINEER WANTED.

A copy of our issue of No. 1 of volume 17 is required. (The first issue of January 1907.) The usual extension of one month will be made to the party sending in this paper.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

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

15844—January 27—Disallowing G.T.R. and C.P.R. tariffs on application Consumers Cordage Co., Ltd., until further order of the Board. Rates on rope.

15845—January 26—Authorizing C.P.R. to construct its Pheasant Hills Branch across thirty-one highways, mileage 202 to 252.92.

15846—January 27—Adding County of Halton party to application of Twps. of Nelson for protection of Plains Road crossing west of Burlington Jct. on G.T.R.

15847—January 25—Authorizing G.T.R. to reconstruct bridge No. 236 over Chateauguay River, mileage 43.82, at Bryson's, Que.

15848—January 25—Amending Order 15498 of November 28, 1911, to read Twp. 10 instead of Twp. 9, C.P.R. Spur Order.

15849-50—January 25—Authorizing C.P.R. to construct spur to premises of Redcliffe Realty Co. and Redcliffe Brick & Coal Co. in Sec. 5, Twp. 13, R. 6, West 4th M., Alberta, and for Quinlan-Carter Co., Ltd., on Lot Subdivision No. 21, in Block "E" of Sec. 17, Twp. 24, R. 1, West 5th, Calgary, Alta.

15851—January 25—Directing C.N.R. within six weeks from date to provide suitable undercrossing on farm of A. J. Hunter, Sleeman, Ont.

15852—January 25—Approving plans and specification of Morden drain to be constructed under track of M.C. Ry. in Twp. of Aldborough, County of Elgin, Ont.

15853—January 31—Amending Order 15802 of January 11, 1912, to read Lot 9, instead of Lot 11, Canadian Copper Co.'s spur.

15854—January 31—Naming express collection and delivery limits for town of Magog, Que.

15855—February 8—Extending for three weeks time for filing plans by C.P.R. for interlocker at Woodstock, Ont., required by Order 15451, November 7, 1911.

15856—January 31—Authorizing Smart-Turner Machine Co., Ltd., to construct travelling crane across G.T.R. siding at Hamilton, Ont.

15857—January 31—Directing that cost of gates at crossing east of Welland Station, Ont., on M.C.R. be borne as follows: 15 per cent. town of Welland, 10 per cent. town of Crowland, remainder by M.C. Ry. See Order 10568, February 26, 1910.

15858—February 1—Disallowing Supplement No. 1 to Boston & Maine Joint and Proportional Class Rate and Commodity Tariff C.R.C. No. 1219.

15859—February 1—Authorizing T.H. & B. Ry. to construct siding into premises of Armstrong Supply Co., Ltd., Hamilton, Ont. Rescinding Order 15745, January 23, 1912.

15860—January 31—Approving revised location of G.T.P.B.L. Co. Cutknife Branch, mileage 31.86 to 55.84, Saskatchewan.

15861—January 31—Directing that town of Simcoe pay G.T.R. 15 per cent. of cost of protection of crossing protection required by Order 15387, November 15, 1911, Norfolk St., Simcoe.

15862—February 1—Authorizing G.T.R. to construct siding into premises of Watrous Engine Works, Brantford, Ont. Rescinding Order No. 15255, October 11, 1911.

15863—Authorizing G.T.R. to reconstruct swing bridge over Richelieu River, mileage 8.75, 13th District, Quebec.

15864-65—February 1—Authorizing C.P.R. to open for carriage of traffic its Moose Jaw Southwesterly Branch near Moose Jaw, Sask., to mileage 27.4, and its Swift Current Southeasterly Branch near Swift Current to Neville, Sask., Mileage, 27.4, speed limit 15 miles per hour.

15866—February 1—Authorizing T.H. & B. Ry. to cross at grade Newport St., Brantford, Ont.

15867-68—January 29—15869—February 1—Approving location of C.N.R. through Twps. 10-11, Ranges 3-4, West 3rd M., Saskatchewan, mileage 25.38 to 51.68, Saskatchewan, and through Twps. 5-6, Ranges 26-28, West 4th M., Alberta, mileage 120.27 to 141.09.

15870—February 1—Approving location of C.N.O. Ry. station grounds at Richmond, Ont., Twp. of Goulbourn.

15871—January 27—15872—January 29—Authorizing C.N.R. to cross thirteen highways with its Calgary Southerly Line, Alberta, and ten highways on its Swift Current Line.

15873—January 30—Authorizing C.P.R. and Montreal Street Ry. to operate over crossing at Papineau Ave., Montreal, without coming to stop, acct. interlocker completed.

15874—January 27—15875—January 31—Authorizing C.P.R. to construct spur for McGillivray Creek Coal & Coke Co., Ltd., near Coleman, Alta., and spur for Nicola Valley Pine Lumber Co., near Canford, B.C.

15876—January 30—Authorizing C.N.R. to open for carriage of traffic its Rossburn Extension from Hamton to a connection with main line east of Canora, 15 miles.

15877—February 1—Approving location of C.N.O. Ry. station grounds in village of Newburgh, Ont.

15878-79—January 27—Approving location of C.N.R. through Twps. 9-6, R. 25, West 4th, Alberta, mileage, 106.37 to 120.27, and through Twp. 52, R. 24, West 4th M., Alberta, mileage 44.40 to 45.97, Province of Alberta.

15880—January 31—15881—January 29—Authorizing C.N.R. to cross with its Grosse Isle Branch, Manitoba, fifteen highways in R. M. Woodlands and with same branch nine highways in R. M. Rockwood, Manitoba.

15882—January 26—Authorizing C.N. Pacific Ry. to use crossing for construction purposes only until June 30, 1912, under further condition that all trains be brought to a stop subject to terms of Order 14577 (C.P.R. Mission Branch crossed by C.N.P.).

15883—January 27—Approving location of C.P.R. station on Yahk Branch five miles north of Kingsgate, B.C., station to be standard portable.

15884—January 27—Authorizing C.P.R. (G.B. & S. Ry.) to construct farm crossing at mileage 25, in Lot 3, Con. 6, Twp. of South Orillia, County of Simcoe, Ontario.

15885—February 1—Relieving C.P.R. from further protection at crossing in the village of Blind River, Ontario.

15886-87—February 1—Approving change in location of C.P.R. stations at Ste. Rose, County Laval, Quebec, and at St. Martin Jct., Parish of St. Martin, Quebec.

15888—February 2—Authorizing C.P.R. to construct spur for Construction & Paving Co., North Toronto, Ont.

15889-90—January 30—Authorizing C.P.R. to use and operate bridge over Scugog River, near Lindsay, Ont. (G.B. & S. Ry.), and to use and operate ten bridges on G.B. & S. Ry. between mileages 20.64 and 81.13, Ontario.

15891—January 30—Authorizing C.P.R. to operate its trains under bridge 4.37, Walkerton S.D., Ontario.

15892—January 27—Authorizing C.P.R. and G.T.R. to use and operate crossing of G.T.P.B.L. Co. crossing C.P.R. Pheasant Hills Branch account interlocker completed, Saskatchewan. See Order 11627, September 9, 1910.

15893—January 27—Certificate of correction to G.T.P.B.L. Co. plan of location Tofield-Calgary Branch.

15894—January 29—Authorizing G.T.P.B.L. Co. and C.N.R. to use interlocking plant at crossing in N.E. ¼ Sec. 20, Twp. 38, R. 26, West 2nd, at Dana, Sask.

15895—January 29—Directing Pere Marquette Ry. to erect and maintain fences in middle part of Lot 14, Con. 2, Colchester South, owned by James Murray, County of Essex, Ontario.

15896—January 31—Authorizing Twp. of Gloucester, County of Carleton, Ont., to construct Queen Mary St. over tracks of C.P.R. (Prescott S.D.).

15897—February 2—Authorizing C.P.R. to open for carriage of traffic its second track from Romford Jct. to Crete, on Cartier S.D., Ontario.

15898—February 3—Approving location of Lake Erie and Northern Ry. from Grand River in city of Brantford to village of Port Dover, in County of Norfolk, Ont.

15899-15900—February 1—Approving standard clearance of G.T. P. Ry. coal chutes, also for new ice house for use on side tracks.

15901—January 1—Relieving C.N.R. from further protection of highway between mile post 475 and 476 east of Aberdeen, Sask.

15902—January 30—Amending Order 15692, December 27, 1911, by providing that bell be installed before June 29, 1912. C.P.R.

15903—February 5—Extending until March 15, 1912, time for installation by G.T.R. of interlocking plant at Nipissing Jct. crossing C.P.R. to connection with T. & N.O.

15904—February 6—Approving revised location of C.N.O. Ry. through Twp. of Loughborough, County of Frontenac, mileage 164.59 to 164.76.

15905-06—January 27—Authorizing C.N.R. to cross public roads (two) on its Grose Isle Branch, in R.M. Rockwood, Manitoba.

15907—February 5—Authorizing C.N.R. to cross with its Strathcona-Camrose Branch seven highways in Alberta.

15908—February 6—Further extending until June 30, 1912, time for completion by C.P.R. of work required by Order 10462, May 3, 1910.

15909—February 6—Authorizing C.N.R. to construct spur line from its Vegreville-Calgary Line into premises of Rose Deer Coal Mining Co., Ltd.

15910—February 7—Amending Order 15709 of December 29, 1911, by striking out word "two" and substituting word "three."

15911—February 5—Authorizing C.P.R. to construct across and divert highway at mileage 210.03 at west boundary of Sec. 18, Twp. 18, R. 16, West 3rd M., Saskatchewan.

15912—February 7—Authorizing C.P.R. to construct spur in Moose Jaw, Sask., for Saskatchewan Flour Mills Co., Ltd.

15913—February 6—Amending Order 15816, January 17, 1912, by adding words "and registered in the Land Titles Office for the North Alberta Land Registrar under No. 5010 Day Book A.1" at end of recital to said Order.

15914—February 6—Authorizing V.V.E. & N. Co. and Vancouver, Fraser Valley & Southern Ry. Co. to use and operate crossing near Ardley, B.C., account interlocker completed.

15915—February 5—Dismissing application of city of St. Thomas, Ont., to construct Inkerman St. across G.T.R.

15916—February 5—Removing speed limitation on G.T.P.B.L. Co. Yorkton Branch from Melville to Canora, Sask. Order 14241 dated July 17, 1911.