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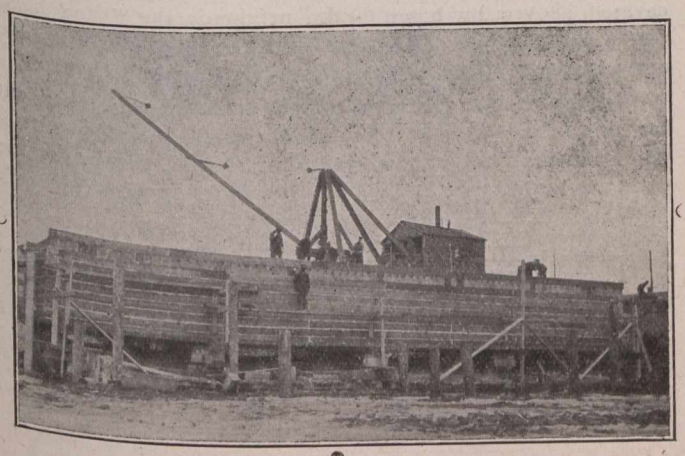
PNEUMATIC CAISSONS AT FORT WILLIAM.

By A. GILLIES, B.A.Sc.

In the construction of the foundations for the Kaministiquia River Bridge for the C.P.R. at Fort William, it was found necessary to use pneumatic caissons, in getting down to bed rock, for the two main piers.

A. C. Stewart & Company have recently finished their contract for the foundation work, which proved to be a rather difficult proposition. The soundings showed bed rock at an elevation of from thirty to forty-five feet below water level, and the central piers were required to have a level bearing on solid rock.

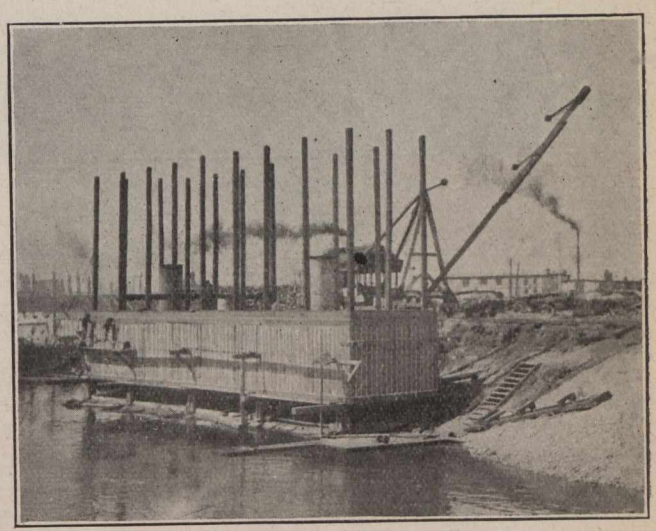
As soon as the pneumatic caisson method was decided upon, an up-to-date air plant was at once ordered. This consisted of two Rand, Class C, air compressors, having steam cylinders 12-inch by 18-inch stroke and air cylinders 15-inch by 18-inch stroke, 515 cu. ft. each per minute at 140 R.P.M.; a 48-inch by 12 feet vertical air receiver; a water-tube aftercooler; a 50 horse-power feed-water heater; duplex



1. Caisson Under Construction.

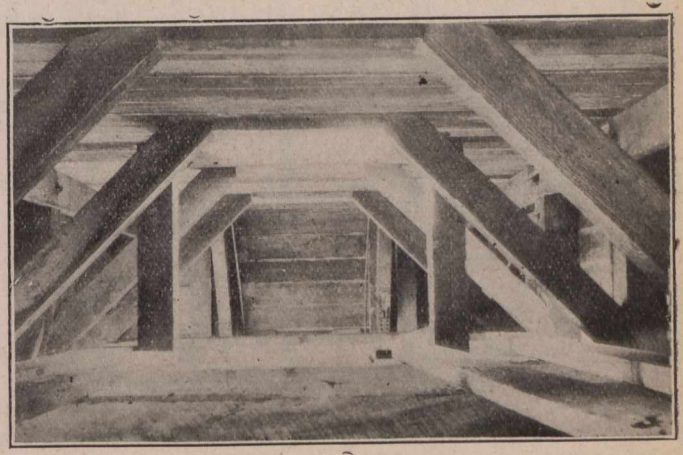
feed pumps; two duplex water supply pumps; one high pressure air compressor, steam and air cylinders 6-inch by 8-inch stroke, capacity 50 cu. ft. per minute at 195 R.P.M. with air receiver, pneumatic wood-borers and drift bolt drivers; and two 50 horse-power locomotive type boilers.

The caissons were 18 by 80 feet and built of British Columbia fir. (Fig. 1.) The walls were of 12-inch by 12-inch timber, caulked both inside and out, and planked outside with 3-inch by 12-inch vertical plank, which was also caulked. The inside posts and struts were of 12-inch by 12-inch, and the braces of 8-inch by 10-inch timber, placed at 6 feet 3-inch centres, and strengthened by 1-inch steel strut and roof rods, the roof consisted of two layers of 12-inch by 12-inch timber transverse and longitudinal; ¾-inch by 26-inch drift bolts at 36-inch centres were used in the heavy timber and ⅜-inch by 7-inch ship spikes in the plank. The working chamber was 8 feet deep and divided in the centre by a timber bulkhead of 12-inch by 12-inch timber, having 3 ft. by 4 ft. man-hole for free passage between chambers. One man-lock three feet in diameter was used and two



2. Caisson Ready to Launch.

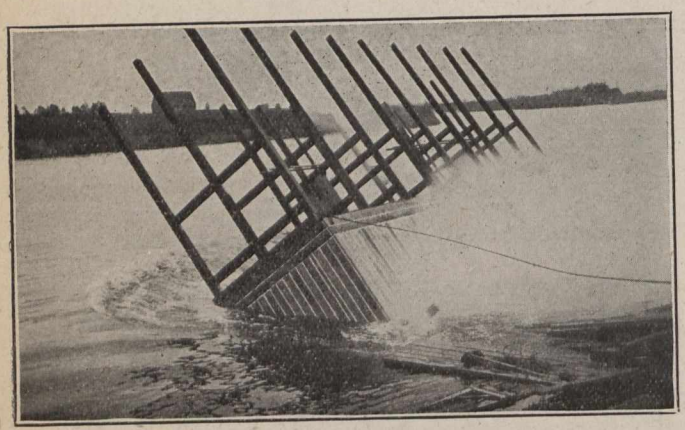
material locks 4½ feet in diameter, of the Moon type, allowing the free passage of the bucket cable through the top doors for use in excavation of rock, etc. The working chamber of the caisson was built of 60,500 ft. B.M. of timber and 10,300 lbs. of bolts, ship spikes, etc., and had 21,800



3. Inside View of Caisson.

feet of caulking. The caisson was built on a skidway having a slope of 1:5. There were five skid timbers, each skid being supported by eight piles driven to hard-pan. When

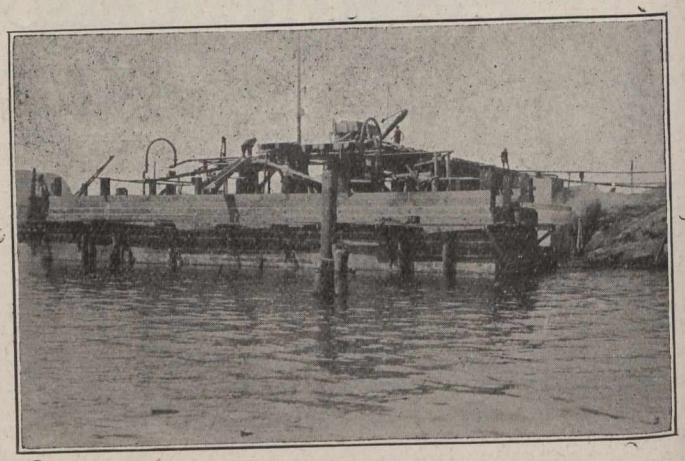
the caisson was ready to launch, the supporting timbers were, one at a time, lowered down to the skid timbers which had been well greased, and the caisson allowed to slide out in a horizontal position. Before launching, the first sections of the man-lock and two material locks were bolted into position, also all pipe connections through the deck and inside fittings placed. These consisted of two 5-inch pipes with flap valves for the air; one 3-inch pipe for water connections, with valves, hose, etc., for three jets; three 4-inch pipes, with valves, hose, etc., for blow-off pipes; one connection for high pressure air; two whistle pipes; and electric lighting connections.



4. Launching Caisson.

After launching the caisson, it was towed into position and secured there by means of cables and piles. There is very little current in the river at this place, so little difficulty was met in keeping the caisson in position.

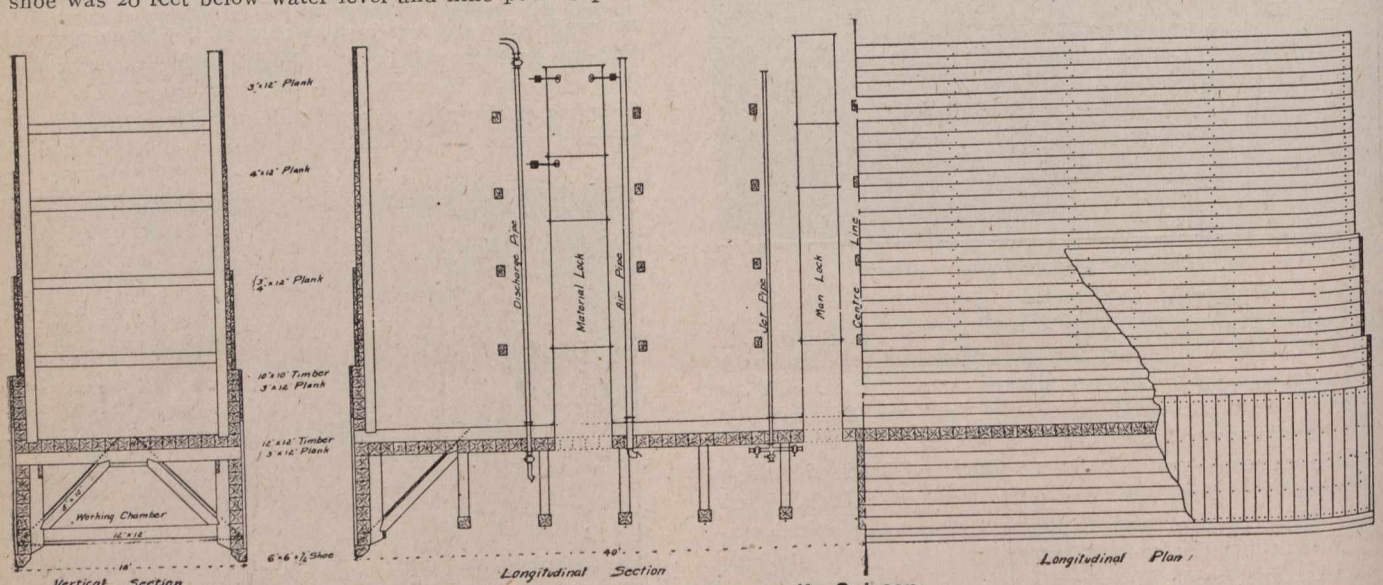
The caisson was then sunk by placing concrete on the deck, forms having first been built around the air lock shafts and piping so that they could be recovered; and the coffer dam kept well above the water level. When the shoe of the caisson was bedded in the river bottom, the air pipes were connected with the compressors and the caisson filled with compressed air. On starting operations in No. 1 caisson, the shoe was 20 feet below water level and nine pounds pressure was used. The water inside the caisson being driven out under the shoe, the air men, or "sand hogs" as they are called, entered the caisson through the man-lock; and excavation began. Three eight-hour shifts of about twenty men each were worked continuously. The air pressure and upper weight of concrete were increased as the caisson sank until, at bed rock, 38 feet down, an air pressure of 16 pounds was used. Boulders and rock were excavated in buckets through the material locks; but all clay, gravel and small stones were blown out through 4-inch pipes by the pressure within the chamber. The upper excavation was a boulder clay, the boulders ranging from small stones up to some the size of a barrel. The lower excavation was a gravelly hard-pan, also full of boulders. This had to be picked and spaded before the jets would have much effect on it, the blow-pipes were governed by 4-inch cast-iron plug-cocks which were opened



5. Sinking Caisson.

and closed as required. A ¾-inch plug-cock tapped into the pipe above this valve and left open while blowing out material, helped considerably. A 4-inch hose, 15 feet long with a 3½-inch nipple on the end, was kept with its nozzle in a pool of water formed by the jet; and the material to be excavated shoved by hand to the nozzle by the "sand hog" operating the pipe. The pressure of the air forced it up and out without the loss of very much air from the chamber.

In the hard-pan excavation, the material was taken out for from three to four feet below the shoe of the caisson but leaving a bank of material, clear around, supporting the caisson. Excavation was then suspended, and this bank was picked down to a level bench, leaving the caisson suspended by the friction on its sides. When everything was clear below the shoe, the blow-pipes were opened and the air pressure lowered three or four pounds. The weight of concrete on top was so regulated that the caisson would then

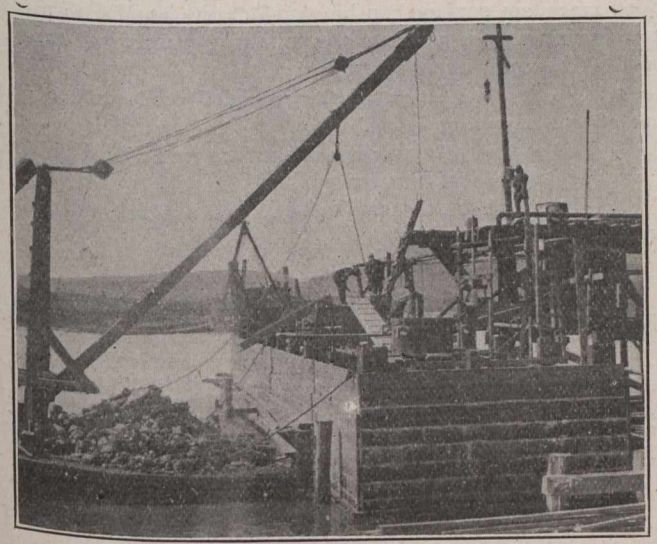


Sections and Plan of Pneumatic Caisson.

settle down on to the hard bench below the shoe. Clay was then used to "mud-up" underneath the shoe, to prevent the leakage of air; and excavation commenced again.

About 900 cubic yards of material was excavated from No. 1 caisson, including about 50 cubic yards of bed rock which had to be blasted out in one end of the caisson to get a level bearing for the pier.

When the excavation was completed, the work of concreting the caisson began. The concrete was poured on to the bottom door of the material locks and then dropped into the caisson. Wet concrete was used until the caisson was filled to within four feet of the deck. It was then sent down very dry; and benched and packed tight against the deck, leaving a narrow passage down the centre. This passage



6. Excavating Stone.

was then packed full, up to the locks and the air taken off. Six weeks was the average length of time required to excavate and concrete each caisson.

Two other caissons of the same construction were sunk for the McKellar bridge. These caissons, however, went down 45 feet and required 18 lb. pressure.

Mr. A. C. Stewart was in charge of the work; the writer was contractor's engineer; and G. N. W. Otty, B.Sc., resident engineer for the Canadian Pacific Railway.

NEW OCEAN DOCKS.

Messrs. Harland and Wolff, the famous Belfast shipbuilding firm, intend to establish ship repairing works at Liverpool.

At a meeting of the Mersey Docks and Harbor Board, it was recommended by a committee that the North dock yard at Bootle should be let to Messrs. Harland and Wolff, and the motion was adopted. The site has been taken on a sixty years' lease. It will not be necessary to construct a new dock in connection with the scheme.

Lord Pirrie, head of Harland and Wolff, is largely concerned with the White Star, American, Leyland, and Dominion lines, and with Elder Dempster and Company, Lamport and Holt, and the Pacific Steam Navigation Company, which have all been managed from Liverpool. Their tonnage aggregates over two million. The new works will employ nearly 1,000 hands.

STEAM ROLLING OF WATER-BOUND MACADAM ROADS.

General directions for the steam rolling of water-bound macadam roads are given the Road Board (Great Britain) specification No. 7. This was issued in December last, and will be of interest to all municipal and good roads engineers. We publish it in full.

1. General.—These general directions are intended for use in cases where a new surface coating is to be laid with steam-rolled water-bound macadam on any road which has a proper foundation or sub-crust of adequate thickness.

2. Trial Trenches.—Before laying the new surface the thickness of the old crust, including the foundation, should be ascertained by opening trial trenches at intervals averaging about 150 yards apart, extending from the side to the centre of the road, such trenches to be made alternately on opposite sides of the road. A careful record of the facts disclosed by these trenches should be kept, with plans and sections, for future reference.

3. If a proper foundation or sub-crust of adequate thickness does not exist, or if the road is weak at the haunches, the following steps should be taken:—

In the case of heavily trafficked roads the haunches should be strengthened and the crust thickened either with stone of any kind suitable for bottoming work, broken to a gauge of from 3 in. to 4 in., or with hard core, clinkers, or other suitable materials, according to the nature of the subsoil. In some cases, where the surface of the broken stone, after being steam-rolled, is sufficiently smooth for the purpose of traffic, it may be possible to allow the bottoming material to be used as the wearing surface of the road for a short period, not exceeding twelve months, if it is important for financial reasons to postpone for that period the laying down of the final surface coating in accordance with the other provisions contained in these general directions.

4. Total Thickness of Crust.—Even when there exists a good natural foundation, the total thickness of the road crust, including the old and the new macadam after consolidation by rolling, should not be less than 4 in. In the case of well-drained sub-soil, which cannot be materially softened by the infiltration of surface water, the total thickness, including the new consolidated surface coating as well as the sub-crust and foundations (if any), should not under ordinary circumstances be less than 5 in. In the case of fairly hard clay or other yielding sub-soils the total thickness, including foundations, should not be less than 9 in. In the case of soft wet clay or bog or marshy sub-soil, foundations of a special character may be required. (See No. 10, Appendix.)

5. Thickness of New Surface Coating.—The thickness of the new surface coating of macadam when consolidated by rolling should be from 2 in. to 3 in., according to the traffic requirements. If it is desired that the new coating should have a greater thickness than 3 in. when consolidated the stone should be applied in two coatings separately rolled.

6. Cross-fall.—The finished surface should have a cross-fall of 1 in 24, or ½ in. to the foot. If the old crust is not sufficiently thick at the crown to enable this cross-fall to be obtained when a new coating of the thickness above mentioned is super-added, the old surface should be left intact and unscarified, and the thickness of the new coating of macadam should be increased as far as may be necessary. If the crust is of ample thickness, but the cross-fall excessive, it should be reduced by scarifying the surface and removing material from the crown to the sides previous to the application of the new coating. The material so loosened by scarifying should be screened, and all material finer than ½ in. should be put on one side to be used for top dressing during rolling operations.

7. Stone and Screenings.—The road stone for the new surface coating should be stone of approved quality, broken as cubically as possible, and should contain about 70 per cent. of stone, which will pass through a 2½-in. ring, but which will not pass through a 1¾-in. ring, about 20 per cent. which will pass through a 1¾-in. ring, but which will not pass through a screen with rods ¾ in. apart. The screenings forming the residue from the above, which will be obtained by the use of the ¾ in. rod screen, should be kept separate and used as a top dressing during rolling operations.

8. Spreading.—The stone must be spread by careful men selected for their knowledge and experience of such work, as the durability and evenness of wear of the surface obtained by steam-rolled coatings greatly depends on judicious uniform spreading. The whole of the stone should be turned over in the process of spreading. Care must be taken not to allow the stone to be tipped upon the road close to the point of spreading, as this prevents a thorough turning over of the material in the act of spreading. When stones are transported by rail or by road over long distances the different sizes of stone are liable to separate themselves, and it is important that during the act of spreading they should be well mixed, so as to obviate the possibility of having larger stones on some parts of the road and smaller stones on other parts.

Note.—One ton to cover 8 to 9 square yards may be taken as an average quantity required to give a consolidated thickness of 3 in.

When stones are spread in thick coatings so that 1 ton covers less than 8 yards, there is a greater liability to unequal consolidation, inasmuch as stones are pushed in front of the roller until the roller surmounts them and thus a corrugated or wavy surface is formed.

9. Rolling.—The rolling should be carried out by a roller of a weight of about 10 tons. This must be in charge of a skilled driver who has been specially trained for the purpose. The macadam should be consolidated by starting the work at the sides and gradually working towards the centre. No water or binding should be applied until dry rolling has been carried out to a sufficient extent to form a smooth, hard surface with the correct cross-fall, with the stones well knit together, and showing their faces on the surface. The cross section of the newly rolled surface should be frequently checked by the use of a long straight-edge and level to ensure that the cross-fall of 1 in 24 is correctly obtained. No spreading or rolling is to be carried out in frosty weather. When the road cannot be entirely closed to traffic, care should be taken to minimize inconvenience to the travelling public during the progress of the work by coating one-half of the width at one time. No unrolled stone should be left on the road overnight. Care should be taken not to leave a vertical or steep edge of the new coating, but the edge should be thinned out so as to afford an easy passage from the new coating to the old surface. Notice boards warning the public that steam rolling work is in progress should be placed at reasonable distances from each end of the work.

10. Binding.—The binding material should be the best reasonably obtained. It should be either of the same material as the new coating, or of granite, lime-stone, or slag chippings, or, failing these, suitable pit gravel and the largest stone in it should not exceed ¾ in. in its greatest dimension. The binding material is not to be applied until the stones have been tightly rolled, as above described. It should then be spread, watered, and swept over the surface during the final rolling operations, working it from the channels towards the centre so as to fill the interstices or voids between the rolled stones. Care should be taken not to use more binding material or water than is absolutely necessary to ensure proper consolidation. The success of water-bound steam rolling so greatly depends on the quality and quantity of the binding material used that extreme care should be taken in its selection and application.

11. Re-rolling.—In some cases it is advisable that a steam-rolled waterbound macadam surface should be lightly watered and re-rolled from a week to a fortnight after the first rolling.

12. Records.—A careful daily record should be kept of all particulars of the work, the number of men employed, the time occupied, the quantity of material used, the area of new coating finished, and also of the state of the weather and other details.

Appendix to Road Board Specification No. 7.—In preparing for the reconstruction of roads which require a preliminary examination and reformation of contour before a steam-rolled macadam surface can be satisfactorily applied to them, attention should be given to the following points and careful records kept for future reference:

1. The relative levels of the intended road surface and that of the adjoining lands.
2. The means of disposing of surface water by drainage.
3. The nature of the fences.
4. The width of the carriageway and the full width between fences.
5. The gradients of the road.
6. The character and condition of the existing carriageway and indications of any special features of weakness or wear.
7. The cross-section of road from fence to fence.
8. The material previously used for surfacing work and most readily obtainable for road construction and the cost thereof.
9. The requirements as to foundations.
10. The points at which, on account of soft wet clay or bog or marshy sub-soil special means are to be adopted. Good results can be obtained in some cases by supporting the road crust on a layer of dry ashes or clayey gravel, or by spreading heather or faggots, but in each case the local circumstances and conditions must determine the means to be adopted.
11. Whether it is desirable to have footpaths on one or both sides of the road.

LOS ANGELES AQUEDUCT HYDRO-ELECTRIC PROJECT.

The city of Los Angeles has recently approved a bond issue amounting to $357,367 to complete the equipment of the hydro-electric project to be operated in connection with the 250-mile aqueduct by which the city water is brought from Owens Lake, near the Yosemite National Park.

The generating equipment will be installed at Power House No. 1, located at San Franciscedo, 47 miles from Los Angeles, to which point current is sent at 60,000 volts.

In the power house there will be installed three 9,375-kva., 6,600-volt, 50-cycle, three-phase water wheel generators running at 200 r.p.m.; and two 250-kw., 250-volt direct-current water wheel generators used as exciters; ten 3,150-kva., single-phase, 50-cycle oil insulated water-cooled transformers for raising the generator voltage (6,600) to that of the transmission, 60,000.

In the sub-station there will be installed nine 5,000-kva. single-phase, oil insulated water cooled transformers for stepping down the transmission voltage to either 33,000 or 16,000 for secondary distribution.

The contract for the entire equipment was awarded to the Westinghouse Electric & Manufacturing Company.

FEDERAL AID FOR GOOD ROADS.*

By Herbert J. Bowman, C.E., County Clerk and Treasurer; Berlin, Ont.

The present Dominion Government came into power committed to the policy of Federal aid for good roads. On this plank of the Halifax platform we can all stand, no matter what may be our party allegiance. In the past, the Canadian press on both sides of politics has uniformly condemned the old statute labor system. In lieu of this relic of pioneer days, a cash payment system is necessary and Federal aid for good roads will command journalistic support in all quarters and the endorsement of public bodies generally.

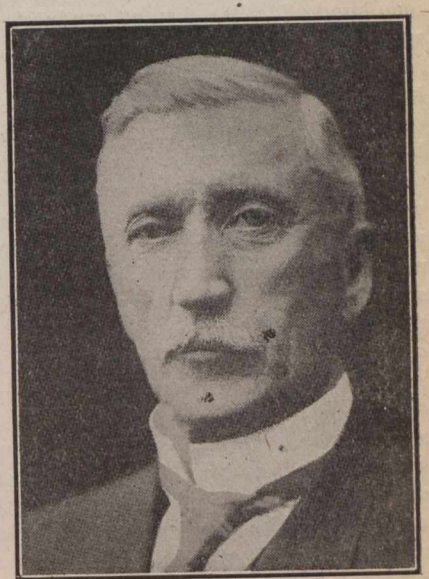
Raising Money for Roads.—To build good roads requires money, which must ordinarily be raised by taxation. The tax should be borne by the different sections of the community, as far as possible, according to the benefit received by each. Good roads throughout the country benefit both the producer on the land and the consumer in the city, so a portion of the cost should be levied upon the urban as well as upon the rural municipalities. Moreover, the country highways are used more and more by motor cars from the towns and cities and more expensive roads are required for this traffic. For these reasons urban municipalities should contribute towards the construction and maintenance of the highways in the adjoining rural municipalities. In the Province of Ontario, however, as now organized and administered, there is no tax on city municipalities for country roads. A remedy for this resulting injustice is supplied by Federal aid for good roads. Through it all classes will contribute towards the building of the King's highway. The splendid roads of England, France, Germany and other European countries are, as a rule, built and maintained by the national governments, under expert supervision. In the United States the Federal Government has for years maintained the Office of Public Roads in connection with the Department of Agriculture. Through this office, expert engineers are supplied free of charge and object lesson roads are built in those counties assuming county road systems. Large sums are voted by different States for building good roads, and the cities, moreover, not being separated from the counties in which they lie, contribute towards the county rates, so that there the farmers do not carry all the burden of maintaining the highways. The city of Buffalo, for instance, has already contributed towards the building of roads in Erie County over a million dollars, and pays besides, its share of the $50,000,000 voted a few years ago by the State of New York for good roads. For these reasons contributions from the Federal treasury are less necessary in the United States, and yet several bills are now before Congress for this purpose. In Canada, however, no better way can be found to defray the cost of building and maintaining roads than by annual appropriations from the surplus revenue of the Dominion.

Hon. R. L. Borden.

*Paper read at Ontario Good Roads Convention, Toronto, Feb. 27th, 1912.

Grants to Provinces.—When the large delegation waited on Premier Borden on February 8th he assured us that the Dominion Government would make substantial grants to the nine provinces for highway improvement. If $1.00 per annum for every man, woman and child is given for this purpose the total sum to be voted by Parliament would be about $8,000,000. This amount could hardly be expended to advantage this year as we are not prepared as yet for such extensive operations, probably one half of this amount would be sufficient. However, if one dollar per head of population is considered a reasonable sum, it will be safe to say that $50,000,000 will be required for good roads within the next six or seven years. To divide this grant fairly between the different provinces should not be a difficult task. Some provinces have greater need of good roads than others. Where agriculture is the chief industry, improved highways are very essential, but where lumbering, mining or the fisheries are principally depended upon, the need is not so great. In the new country, branch lines of railway rather than roads are in great demand. Some of the older provinces have splendid water transportation but require improvements to canals and harbors, the deepening of river channels and other public works. By attention to the peculiar needs of each section Parliament should have no great difficulty in apportioning the good roads grant, those provinces that do not require as much money for improved highway transportation being compensated in some other way.

Effect in Ontario.—On the basis of one dollar per head of population, it would be reasonable to expect the sum of $2,000,000 per annum as our share of Federal aid for Good roads in Ontario. Half of this sum might be used to build and maintain a system of provincial highways, one great road to connect Montreal and Windsor, with branches touching all the counties to be added as soon as possible. New Ontario would continue to be developed by colonization roads as at present, but on a more extensive scale.



Hon. Frank Cochrane.

The county road systems in Ontario should receive the benefit of the balance of the Federal grant, namely, $1,000,000 per year. The provincial grant of one-third for county road work has been found to be entirely too little in the past. Federal aid will enable county roads to be built on a just basis in the future, with the burden shifted from the farmers' backs. In Massachusetts the State Highway Commission builds the roads and the county repays 25 per cent. of the cost. This generous treatment of the farmers, it should be remembered, is given by the State without Federal aid. Surely with Federal aid a certainty, we can better afford to be just to the rural municipalities in Ontario.

County Roads in Ontario.—A fair division of the cost of county roads in future would be: One-half payable by Do-

minion; one-quarter payable by province; one-quarter payable by county. With forty counties in Old Ontario, this would mean an annual expenditure in the average county of $50,000 per year. One-quarter of this ($12,500) would be added to the county rates, or, if the county council found it necessary, this amount could be raised by debentures guaranteed by the province and sold direct to investors in the mother country instead of being peddled around to our local people at a comparatively high rate of interest.

Conclusion.—Proper supervision of this great national undertaking is absolutely necessary. Let the Dominion Government establish a Highway Commission with expert engineers to advise the provinces how to proceed and to inform Parliament of the results obtained.

Let our Ontario Government establish a Highway Commission or a department with a minister at the head of it. Then employ engineers to assist the counties in building roads adapted to their needs. This will be a simple matter in some counties, but in others it will call for the most careful consideration. Adopt as a motto for the future, "Be sure you are right, then go ahead."

NOTABLE WORK ON THE CATSKILL AQUEDUCT.

The construction work going on in connection with the carrying out of the Catskill Aqueduct project is deservedly attracting widespread attention. It is inevitable that important problems have to be solved when it is proposed to bring an enormous supply of water from a mountain district one hundred miles distant conducting it across a score of valleys some of them several miles in width, as well as across so deep and broad a river as the Hudson. The problems have especial interest for the municipal engineer because of the very character of the enterprise. They have large interest for the concrete engineer for the reason that the construction of the aqueduct is everywhere involving the use of Portland cement and concrete. The steel siphon work should have the earnest attention of the engineer and manufacturer concerned in the possibilities of steel construction. The mining engineer has his interest claimed by the shaft and tunnel construction. Portland cement (in cement mortar or in concrete) plays a most important part in all of this. It is not only involved in the concrete of the cut-and-cover sections, but it is relied on to make possible a protective covering for the inside and outside of the steel siphons. It has been found of exceedingly great value in the sinking of one of the deep working shafts; in fact, it may be questioned whether the sinking of this shaft would not have failed without it. Consider, then, the Rondout pressure tunnel and the steeel siphons.

The Rondout Pressure Tunnel.

The Catskill Aqueduct may be said, if one speaks broadly, to parallel the Hudson River. Consequently, the route cuts across the tributary streams. These are creeks or brooks of no especial importance, so far as size goes. However, they mark the positions of valleys, some of which are a number of miles in width. One of the largest is the valley of Rondout Creek In making the crossing at this point the aqueduct drops far below the surface of the ground, far below the bottom of the creek, and thus makes the 4½ mile passage from one side to the other. A vertical shaft at each end, and a third located at an intermediate point will remain permanent features. In addition, five other shafts were sunk to the tunnel grade in order to facilitate construction. One of these, Construction Shaft No. 4, is 500 feet deep. It is 10 x 22 feet in horizontal section. Eighteen months were occupied in putting down this shaft. It was flooded six times. The strata passed were:—

	Feet.
Glacial drift	6
Helderberg limestone	226
Binnewater sandstone	39
High Falls shale	92
Shawangunk grit	134
Total	497

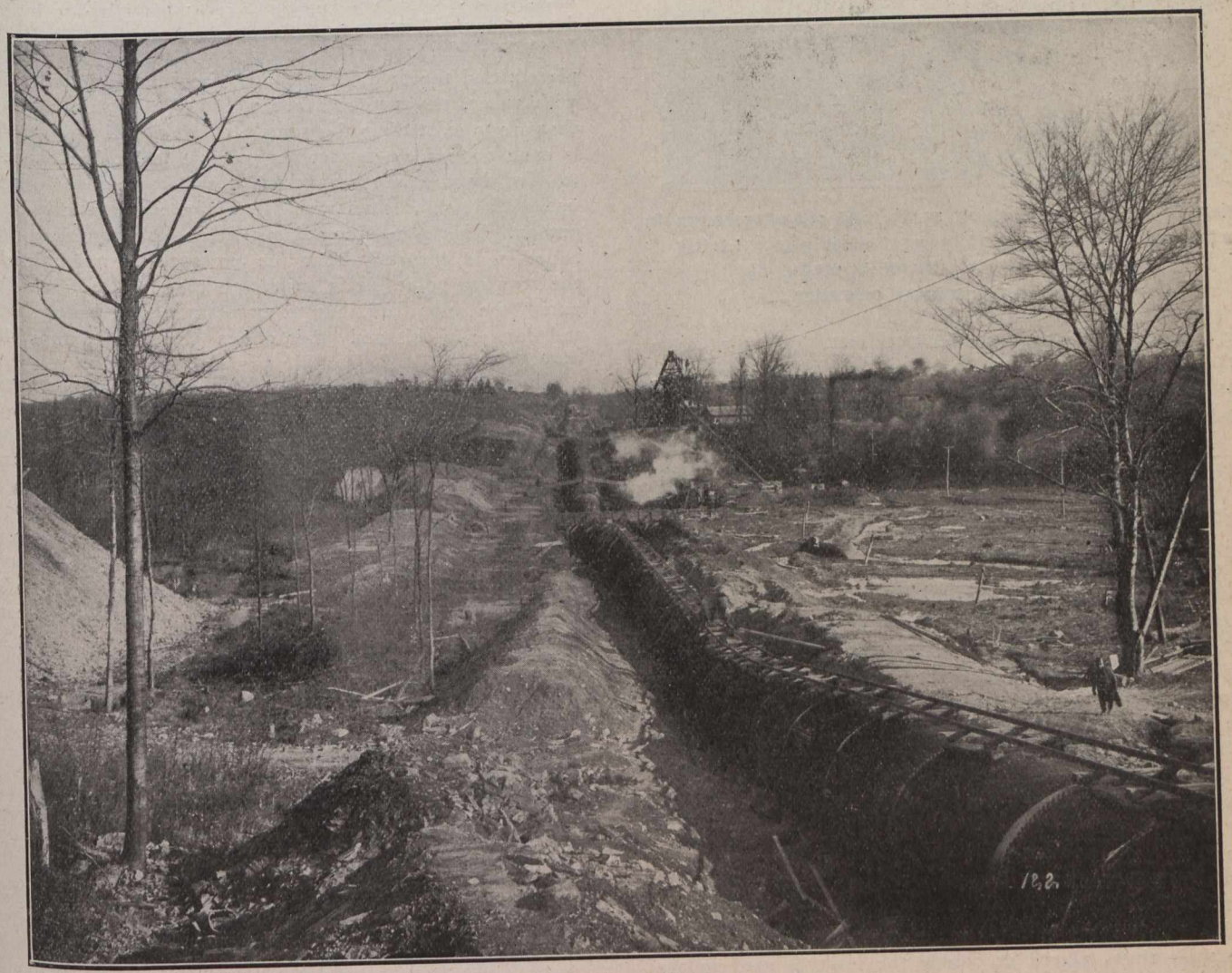
The trouble with the water came, no doubt, almost altogether from the sandstone and the shale. But the water made its presence felt long before these strata were reached. The site of the shaft included the location where a 4-inch test-hole had been put down. When a depth of about 80 feet had been reached a sudden inrush occurred through this hole filling the shaft half full. The emergency pumping plant had not yet been delivered, so that the contractors were caught unprepared. However, by the use of an air-lift and a couple of sinking pumps the water level was lowered to a point near the bottom. A nipple was driven into the hole and casing attached to it. The purpose was to grout up the hole. In order to carry out this plan a 1-inch pipe was put down to the level of the Shawangunk grit; that is, to the 363-foot level. The water was now permitted to return. Pressures were thus equalized and currents prevented. The grout was made according to the formula 1:1 and poured down the 1-inch pipe. This latter was withdrawn as the grout filled in.

The problem of this one hole was solved in this way. But fears began to be entertained as to whether the ordinary methods of shaftsinking would prove successful. It was understood that there was below a great deal of water under considerable pressure. With subsequent events in mind, it is not difficult to see that a special pumping chamber in the side of the shaft should have been provided before permitting the excavation to pass out of the limestone. This arrangement was made later, but the delay was the source of much trouble. However, excavation went on, and the sandstone was penetrated. At the 260-foot level the amount of incoming water was only about 225 gallons per minute. However, during the drilling of the sump an additional 600 gallons per minute came in suddenly through one of the drill-holes, with the result that the shaft was flooded again. After some trouble the shaft was unwatered, only to be flooded three additional times in as many weeks. Pretty much all this water came in through bore-holes, none of which was probably over two inches in diameter. When the fifth unwatering had been completed the conditions below were known to forbid further progress apart from special precautions. In fact, it had been ascertained that large crevices were a short distance beneath the bottom of the excavation. One of the largest of these crevices was distant only a foot and a half. The size of the crevices ran up to 8 inches. As compared with the 2-inch bore-holes, they promised plenty of trouble.

Grouting up the Crevices.—It was now proposed to deal with the water question by means of grout. Four special machines were set up at the mouth of the shaft. A 2½-inch pipe led down the shaft to the bottom where a 2-inch hose carried the grout to the point of use. At the beginning of operations the grout gave trouble by leaking back. It would come in through the spaces around the pipes and through cracks in the bottom. This difficulty was successfully met by mixing finely ground hose manure with the grout. The manure produced a clogging effect. Some grout was wasted, but success was eventually obtained. In this procedure a

total of 2,900 bags of Portland cement was consumed. When the grout had hardened in the crevices a few more holes were drilled. Water having a head of 65 pounds was found 14 feet below. These holes were soon grouted up, only 60 bags of cement being required.

But sinking was not at once resumed. It was deemed advisable to deal further with the question of the water. The grit was now about 100 feet farther down. It was proposed to grout up the intervening water-bearing strata with more grout. Accordingly, six diamond drill-holes were put down to the grit. Half were of the size corresponding to a 1-inch core and half to a 2-inch core. With a pressure of 275 pounds per square inch, these holes were grouted up with 175 bags of cement. Nobody knew whether this small quantity of cement meant that the problem was a small one, or whether it had been only partially solved. It would seem that the thorough application of the method of grouting aheead of the excavation should have been employed sooner; that is, before the water-bearing strata had been penetrated. Sinking was now begun again, and prosecuted until a depth of 320 feet was reached. A couple of collecting rings had been arranged, and many sinking pumps installed in the shaft. The working space was much impeded. Besides, it was difficullt to secure easy, certain and adequate pumping capacity by the use of sinking pumps alone. It was determined to construct a pumping chamber off to one side at the 309-foot level. This chamber was quite large, being 10 feet high and having horizontal dimensions of 17 and 24 feet. Beneath its floor a sump, 5½ feet deep and 16 x 22 feet in area, was arranged. It had a capacity of 14,500 gallons. In the special chamber were installed three Cameron horizontal condensing pumps furnished by the Cameron Pump Works, New York City. These were all the 24 x 10 x 20-inch size, and had a combined capacity of 1,050 gallons per minute. They were run by steam supplied by three 100 horse-power boilers set up at the mouth of the shaft. As the pumps were of the condensing type, this whole arrangement was a possible one. Before the installation of this powerful pumping plant the sixth flooding of the shaft took place. Subsequently no especial difficulty was encountered from the water. More grouting was done, but none of the seams required more than 100 bags of cement, with one exception. When the grit was reached a hole gave trouble, and required 348 bags of cement. The amount of water pumped from this one shaft was 86,181,000,000 foot gallons. The total amount of Portland cement consumed in the grouting operations was 971 barrels.

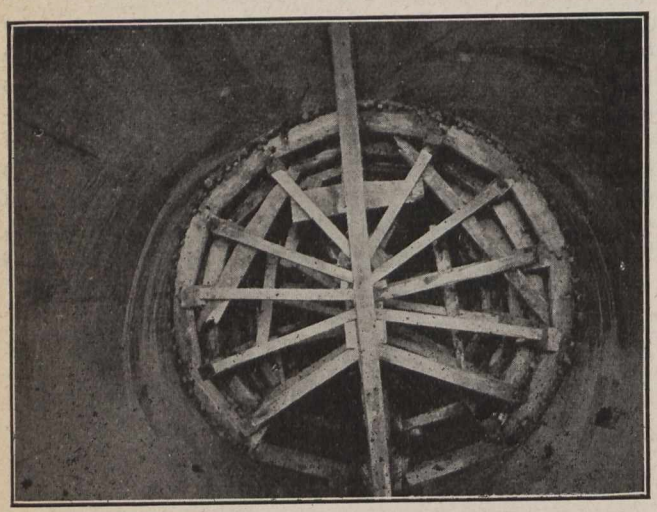


Bryn Mawr Siphon—Southern End.

The Steel Siphons—Grout Inside, Concrete Outside.—Where the Catskill Aqueduct crosses a very broad valley a permanent vertical shaft is put down on each side, and the two bottoms connected by a more or less horizontal tunnel through the solid rock; but where the valleys are quite narrow, the practice is to make the crossings by means by steel tubes. These are of enormous dimensions. Three parallel tubes are required for each crossing in order to furnish full capacity. Only one is being put in at present—the middle one. There are to be, in all, fourteen steel siphon crossings of an average width of 0.455 mile. This work is divided

into two contracts, one of which is held by the T. A. Gillespie Company, of New York City.

Altogether, the fourteen siphons will require for the single central tube something over six miles of steel pipe.



Indian Brook Siphon, looking north, and showing forms in place or cement mortar lining of steel pipe. Lining is two inches thick. Invert is placed by hand on a preliminary operation,

The diameters are 9.50, 9.75 and 11.25 feet. The thicknesses of the steel plates vary from 0.438 to 0.750 inch. The variations in diameter and thickness of plate are made in order to permit a standard capacity to be maintained under varying conditions, and to enable varying bursting pressures to be withstood. The joints are riveted ones. Circular joints are lap-riveted. With the thinnest plates (0.438 inch), the longitudinal seams are also lap-riveted. For plates thicker than 0.500 inch the longitudinal seams are butt-riveted. For the 0.500-inch thickness both methods are employed on longitudinal joints. The butt-riveting is done by bringing the edges together—edge to edge—and then covering the joint, inside and out, with a steel strap. The inner strap is wider than the outer one. The rivets securing the outer strap to the tube are also the central rows of rivets for the wide inner strap. They thus hold together three thicknesses of plate. In addition, two single rows of rivets are arranged outside the narrower strap, holding the tube and the inner strap together. Altogether, six rows of rivets are employed. The two central rows—one row to each side of the joint—have their rivets arranged abreast of each other. The rivets of the rows just outside of these are arranged in staggered positions relative to the two central rows. The two rows outside of all which secure only two thicknesses of plate, have their rivets placed at double the interval used in the other rows.

In crossing the Peekskill Valley over a mile and a quarter of pipe is required. All of it is of the smallest diameter. A short length (139 feet), presumably at the lowest point, is of the thickest plate (0.750 inch); then there is a total of 1,000 feet or more of the 0.688 inch thickness. Apparently no other of the crossings required such thick plate as the 0.750 inch thickness. This will be understood when it is stated that the maximum head at Peekskill is 340 feet—45 per cent. greater than in any other case. It is the widest and the deepest of the steel siphon crossings.

The steel pipe is furnished in 15-foot lengths. A circular joint has, accordingly, to be made every 15 feet. This fact has to be taken into account in the preparations for the reception of the giant tubes. Concrete cradles are arranged at such intervals as to permit the shop and field joints to come between them. The concrete cradles are eight feet or more across, measured transversely the line of the aqueduct, and about three feet wide. The same style is not used everywhere. A typical cradle has, however, a curved depression above to fit the pipe. It is then continued horizontally for a short distance. Underneath, a vertical section across the line of the aqueduct discloses a flat curve. The manner of casting is quite simple. Two bulkheads of the required form are placed on the earthen surface, which has been given the required curvature. The bulkheads are held temporarily in position by a couple of wooden strips nailed across. The concrete is poured in and the upper surface formed by hand. However, a transverse and several longitudinal grooves are desired where cradle and pipe are to come into contact. These are provided by using short lengths of wooden strips. The object of these depressions will appear later.

When the cradles have been cast, the pipe suitably placed, and the field joints made, the entire siphon is filled with water, the pressure being brought to the conditions that are to exist when the aqueduct is in actual service. This is done not merely to test for possible leaks, but especially to give the pipe the exact form it will have when in actual use. While filled thus with water the concrete envelope is put on. This is a proceeding requiring time. During this period it is important that the pressure be maintained at the required point. It is necessary, therefore, not merely to pump the pipe full, but to maintain the pressure night and day. In this and other duties Cameron pumps have been used.

It is necessary, or at least advisable, to clean the surface of the pipe thoroughly preparatory to the application of the concrete envelope. It is possible that the concrete would absorb and take care of a thin coating of rust. But no chances are being taken on that. Removable ribs are employed to hold the lagging in place. At Bryn Mawr narrow wooden strips, making lap joint with each other, were in use upon the writer's visit. The concrete is dumped upon the crest of the pipe. The jacket of concrete completely envelops the tube, except where the cradles themselves are located.

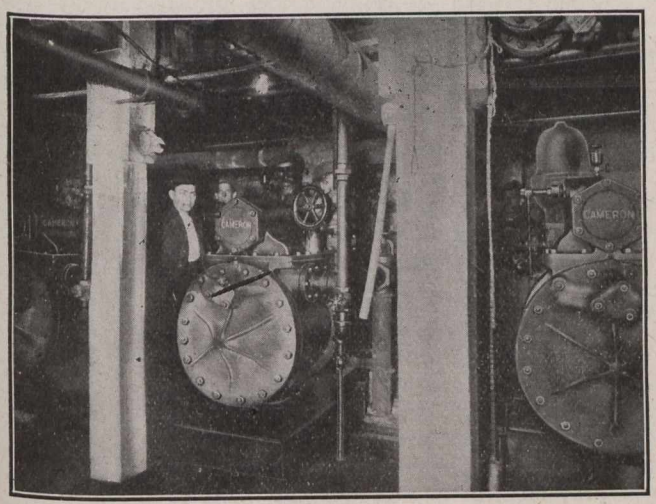
Kensico Siphon—15 ft. Section of 9 ft. 9 in. x 7-16. in. Steel Pipe. Size shown by automobile.

Prior to placing the concrete of the envelope a grout is poured into the grooves arranged on the upper surface of the cradles. Access is gained from the side. This grout fills the system of grooves beneath the steel plate and effects a close joint.

The placing of the interior shell of cement mortar is one of the most interesting and important matters connected with the steel siphon work. This lining is required to have a minimum thickness of two inches and a smooth internal

surface when finished. A little consideration will show that we have here a considerable problem. Of course, any satisfactory solution of the problem must be a commercial one. Considerable experimenting has been done.

A steel form presents, perhaps, the best surface adapted to securing the desired smoothness. It would, perhaps, be



Special pump chamber arranged to one side of shaft at depth of 300 ft. Equipped with three horizontal Cameron pumps.

difficult to provide ribs strong enough, and yet sufficiently flexible, to permit slight variations in form to be made. The tube is not a circle—it is, rather, an ellipse. A device for blowing the grout on to the steel, and thus building up the required thickness was tried for a while. It seemed to put the mortar on satisfactorily, except that it left a rough surface expensive to smooth. On the Gillespie contract wooden forms are used. The bottom of the lining is put in by hand. The remainder—about 270 degrees—is placed at a single pouring when a section of form, perhaps 20 feet long, is ready. This consists of nine segments, each covering about 30 degrees. Each segment is a unit. They are all alike, so that no mistakes can occur in arrangement. Ribs giving strength to one segmental form interlock with ribs of the next one, and so on. The interlocking is secured by providing a tongue or protuberance on one end of a rib and a corresponding notch in the other. The tongue of one rib is placed in a notch of the rib next to it around the circle. We thus get a long rib of 270 degrees. Five struts are now put in place at a number of the 270-degree ribs. These extend from a joint on one side to the joint opposite on the other. They are easily placed and easily taken down. Altogether, there are about twenty such struts used in setting one section of form. The struts contact at each end, not with the joints, but with intervening longitudinals. There is a simplicity and flexibility about this form that makes it quite successful. Metal stops are employed to regulate the distance between form and pipe. When all is ready the pouring is accomplished by means of a tube running up through the roof. This permits the cement mortar to be furnished from an outside point. The tube is arranged at one end of the form. The end selected is the lower one. A hole is left open at the other end to provide a suitable vent. No provision is made for expansion and contraction. It is assumed, perhaps, that with the pipe full of cold water and the exterior well protected there will be but a small variation in temperature.

The concrete on the outside and the cement mortar on the inside are to be considered as having no other service of importance to perform besides that of protecting the steel pipe. Time will alone tell how perfectly this has been accomplished.

CLAY TILE FREIGHT RATES.

The following information has been compiled and is issued by the Department of Physics, Ontario Agricultural College. The tables give the weight of tile and approximate freight rates in Ontario.

The railways state their traffic as so many cents per hundred-weight for a given distance, in car lots, the car to be loaded to its capacity. As the farmer wants to know the freight per 1,000 tile an effort has been made to supply this, as closely as may be. The weight of a tile of given size varies somewhat with the different makers, but those given in Table I. have been determined by actual test and may be taken as fairly representative.

Knowing the freight rate for any distance and the weight of 1,000 tile, the freight per thousand is easily worked out. The results are given in Table II.

Table I.—Approximate Weight of Tile of Various Sizes.

Size of Tile	Weight of one Tile lbs.	Weight of 1,000 Tile lbs.
3 inches	5¼	5,250
4 "	8	8,000
5 "	10½	10,500
6 "	14	14,000
7 "	18	18,000
8 "	22	22,000
10 "	27½	27,500
12 "	33	33,000

Table II.—Approximate Freight Rates of Tile.

Distance in miles	Rate per cwt.	Rates per 1,000 Tile. 3 inches	4 inches	5 inches	6 inches	8 inches	10 inches	12 inches
0—10	3 cents	$1.58	$2.40	$3.16	$ 4.20	$ 6.60	$ 8.25	$ 9.90
10—20	3½ "	1.84	2.80	3.68	4.90	7.70	9.62	11.55
20—30	4 "	2.10	3.20	4.20	5.60	8.80	11.00	13.20
30—40	4½ "	2.36	3.60	4.72	6.30	9.90	12.37	14.85
40—50	5 "	2.62	4.00	5.25	7.00	11.00	13.74	16.50
50—60	5½ "	2.88	4.40	5.76	7.70	12.10	15.11	18.15
60—70	6 "	3.14	4.80	6.30	8.40	13.20	16.50	19.80
70—80	6½ "	3.41	5.20	6.82	9.10	14.30	17.86	21.45
80—100	7 "	3.67	5.60	7.35	9.80	15.40	19.25	23.10
100—125	7½ "	3.93	6.00	7.87	10.50	16.50	20.62	24.75
125—150	8 "	4.20	6.40	8.40	11.20	17.60	22.00	26.40
150—175	8½ "	4.46	6.80	8.92	11.90	18.70	23.37	28.05

CANADIAN ROAD LAWS.

By E. A. James, B.A. Sc., Engineer for the York Highway Board.

Good roads have become a necessity in Canada, the rapid development of our agricultural districts demands good roads for the output of the farms. The work of our mineral districts necessitates good roads from the mines to the railway station or to the steamboat wharves. The day of the horse drawn freighter is almost gone and the demand now is for roads that will withstand the traffic of vehicles propelled by motor power.

The demand for good roads in Canada is more than necessary, it is imperative.

There are approximately 26,650 miles of steam and electric railroads in Canada to-day. No one knows exactly how many miles of highways there are, but most careful calculation one can make will place it at 1,010,000 miles.

Before taking up the question of building of good roads we would present a resume of the road laws of the various provinces of Canada.

It is necessary that the highway engineer, who has to give one-half of his time to administration work, should know the leading features of road system laws as it is, that he should know the main points in road building.

Good roads may be built under many systems of organizations and control and different systems under different conditions may give equally good results, however, the engineer must be informed on the various systems, so that he may select the best for the condition in which he is working.

The engineer is not a legislator, but he is frequently consulted when legislation is framed, therefore a study of Canadian legislation dealing with Canadian roads is naturally of interest to highways engineers.

Canadian Highway Act.—The most recent and most important legislation dealing with highways in Canada is bill 77, introduced in the House of Commons, Ottawa, by the Hon. Frank Cochrane, Minister of Public Works, in January of this year.

It is entitled: An act to encourage and assist the improvement of Highways, and although it has not yet become law, still it is of such importance that we give the full text of the bill.

Bill 77.—Whereas the highways of Canada constitute an important part of the facilities which are necessary for any efficient national scheme of transportation and inter-communication; and, whereas, with the increasing progress and development of the country it is desirable and expedient to improve and extend the existing highway facilities, and for that purpose to give assistance to the various provinces of Canada: Therefore, his Majesty, by and with the consent of the Senate and House of Commons of Canada, enacts as follows:

1. This Act may be cited as The Canada Highways Improvement Act.

2. In this Act the word "Minister" means the Minister of Railways and Canals.

3. The Governor-in-Council may, in any year, and upon such terms and subject to such conditions as are prescribed by Order-in-Council, grant to any province in aid of the improvement of existing highways or the construction of new highways in such province, or for both such purposes, a subsidy not exceeding such sum as may in such year be voted by Parliament for that purpose.

4. Any highway for which aid is granted to a province shall be improved or constructed, as the case may be, according to descriptions, conditions, and specifications approved by the Governor-in-Council on the report of the Minister, and specified in each case in an agreement between the Minister and the Government of the province, which agreement the Minister, with the approval of the Governor-in-Council, is hereby empowered to make.

5. Each highway to be constructed or improved shall be defined and described in such agreement, and provision may be made therein for the future maintenance of such highway in good condition according to a specified standard, and to the satisfaction of the Governor-in-Council.

6. The Minister, with the approval of the Governor-in-Council, and upon such terms and conditions as are prescribed by Order-in-Council, may undertake the construction of any new highway or the improvement of any existing highway in any province, and may expend in such improvement or construction the whole or any part of the sums voted by Parliament, for such subsidy to that province. Provided, however, that the Minister shall first obtain the necessary authority from the Legislature of such province and the consent of the Lieutenant-Governor-in-Council.

This measure is the first step by the Dominion Government to give aid for the building of the King's highway. Since Confederation the Dominion Government has granted eighty million dollars to build and improve our railways and eighty-eight million two hundred thousand dollars (exclusive of G.T.P.) to construct our canals, but not one cent for highways. With a Canadian Act granting aid to highways, new interest will be taken in the subject and a new impetus given to road-building

Provincial Road Laws.—Each province has its own road law and, as might be expected, the laws vary with the provinces, as the conditions peculiar to those districts warrant.

Prince Edward Island.—Prince Edward Island, with the exception of the city of Charlottetown, and the town of Summerside, has no municipal government of any kind; however, the highways of the province have been placed entirely under the Department of Public Works. For the purposes of administration, the province is divided, by the department, into thirty-eight road divisions, each containing about 100 miles of road. These divisions are under road inspectors, who have a certain amount of machinery under their control to be used on this section. The general soil of Prince Edward Island is of a soft, loamy character, and about 90 per cent. of the roads are earth roads. During 1910 there was spent on the highways about $32,000, or a little over $8.00 a mile.

The Public Road Act of this province, as amended in 1910, contains a clause which provides for tax of $1.00 per head per annum upon all persons between the age of twenty-one and sixty except clergymen and overseers, and a tax of 25 cents per head per annum upon all horses over three years of age, except those used by clergymen and overseers.

During this year a Good Road Association has been formed, and it is expected that the following educational campaign work of constructing permanent highways throughout the provinces will shortly be undertaken.

Nova Scotia.—In the province of Nova Scotia the roads are under the control of the municipalities who have direct control of the statute labor.

The Provincial Government, however, make expenditure upon these highways, dividing their expenditure into two accounts.

(a) Contribution to bridges costing more than $500.00 to construct.

(b) Expenditure on the construction and maintenance of highways constructed by the municipalities under direction of the commissioner of roads.

The municipal councils have no control over the expenditure of these moneys, as all charges are paid from the provincial treasury.

An amount of about $250,000 is assessed by the municipalities under the statute labor law, and the work is carried on under the control of these authorities.

Yearly reports, showing the amount collected or uncollected in each district, are submitted to the road commissioner, and by him to the government, but outside of the regulations of the statute labor law, the government exercises no jurisdiction with regard to statute labor, as this law was enacted after consultation with the wardens of the various counties.

It is proposed to borrow money on capital account and to expend it under the same system as that of larger bridges, that is, under some authority appointed by the government. This is to supplement the present expenditure from revenue which, with 18,000 miles of road to keep up, is insufficient to do more than make the roads passable and to attend to the most urgent cases of reconstruction or the building of new roads.

In 1880 the municipalities had full control of the roads and bridges, but neglected the same, and the government enacted various laws, first, taking over the construction of larger bridges, and secondly, the repair of same; then, thirdly, the construction and repair of smaller bridges, and fourthly, the maintenance of public highways to a great extent.

The expenditure for roads and all structures connected therewith, not included in the foregoing, arising from two sources:

(a) Government grant.

(b) Statute Labor.

The control of the government grant is placed in the hands of a road commissioner appointed by the government, and is apportioned into sums required for the painting and repairs of larger bridges for the construction and repairs of other structures, for the purchasing of road machinery, and according to a scale approved by the government for any construction and repairs of highways in the different municipalities of the province.

The statute labor is entirely in the hands of the municipal councils, and is also expended on the construction and maintenance of the highways, there being a working arrangement between the municipalities and the commissioner of roads in the localities in which the work is performed.

Ontario.—The roads of Ontario in the newer sections are under the control of the Department of Public Works, and are known as colonization roads. When the districts become organized the roads come under the control of the township councils. Township councils have full control of these highways and they maintain them either by statute labor or direct taxation.

In some counties certain roads have been set apart as leading highways, and come under the Highway Improvement Act of Ontario. Under this Act provision has been made that where certain roads are set apart and approved of by the government on being constructed according to the specifications submitted by the province, the province will pay one-third of the cost. So far the department have taken the stand that a grant will only be made to county systems.

Alberta.—Alberta has not yet been divided into rural municipalities, but it is expected that at the present session of the Legislature a Municipality Act will be passed giving rural municipalities control of the highways. Up to the present the Public Works Department of Alberta has had charge of road improvement works.

Where portions of the country are organized into Local Improvement Districts (which is the first step towards municipalities) the Provincial Government frequently makes an expenditure, conditional upon an equal amount being paid by the Local Improvement District, and practically always insisting upon supervision by their engineer, inspector, or general road foreman, as the case may be.

All highway bridges so far in the province of Alberta have been constructed by the government.

Saskatchewan.—The rural highways of Saskatchewan, in settled districts, are under local improvement boards, which usually represent a district of four townships.

In the newer districts roads are under the control of Department of Public Works, and for the construction and maintenance of these roads the government levy a tax of $2.00 per quarter section.

To supplement this sum the government vote a special grant annually, which amounts to approximately a three-quarters of a million dollars. Where the municipality undertakes improvement work which has been sanctioned by the Department of Public Works, the government will pay a subsidy of 25 per cent., provided not more than $1,000.00 is spent in any one year to any one road, and providing that not more than two roads in any municipality receive a grant during the current year.

British Columbia.—In the early days of this province road building was undertaken by military engineers. Later the Department of Public Works undertook the management of the highways and provincial roads are now the main traffic arteries of the provinces.

In road building British Columbia has the advantage of good material with which to build and centralize authority to undertake the work. Five million a year for the next three years is the sum they anticipate spending on highways.

Outside of the towns and cities the roads are largely provincial highways.

CONSISTENCY OF CONCRETE.

A circular letter of inquiry on the subject of the Consistency of Concrete was addressed to the members of the Concrete Institute of Great Britain, in which it was suggested that a specification as drafted would be of service, pending experiments and tests that ought to be made to determine the exact proportion of water to be used in concrete in order to obtain the best mixture. This specification, as now slightly modified by the committee, is as follows:—

Consistency of Concrete.—For mass concrete the quantity of water added to the other constituents shall be sufficient to make a plastic mixture which, after thorough ramming, will quiver like a jelly.

For reinforced concrete the quantity of water added to the other constituents shall be such that the plastic mixture is capable of being rammed into all parts of the moulds and between the bars of the reinforcement.

Note.—In dry or hot weather the quantity of water shall be increased in order to allow for evaporation.

Fifty-eight replies were received, which have been carefully considered by the Reinforced Concrete Practice Standing Committee, who have come to the following conclusions:

1. It is inadvisable to lay down any definite rule as to the percentage of water to be used in mixing concrete, owing

to the varying conditions which obtain. The proposed specification is difficult to improve upon, and seems to meet with general agreement.

2. The strength of concrete apart from any reinforcement increases as the amount of water used in mixing is decreased, this being more particularly the case during the earlier stages of the maturing of the concrete. Eventually the wetter of two mixtures will approach more nearly to the drier in strength.

3. In reinforced concrete, particularly in such portions as may contain a large amount of reinforcing bars or the like placed closely together, it is essential that the concrete should be sufficiently wet to pass between the reinforcing bars, and to thoroughly surround every portion of the steel. This should be ensured even at the expense of having the concrete wetter than would otherwise be desirable.

Where the reinforcement is not very closely spaced it is unnecessary for the concrete to be so wet.

4. Other conditions being the same, the drier the concrete the more quickly will it set and mature. This is of importance when there is any danger of green concrete being attacked by frost.

5. The wetter the concrete the greater is the tendency to contract during the process of setting and maturing. Appreciable contraction may sometimes continue for a period of several years.

6. The committee is divided as to the advisability of determining by some means of mechanical test the exact degree of "wetness" or consistency of concrete after mixing. If some scale of consistency were adopted, it would be possible to specify that concrete for any particular portion of the work should be of such and such a consistency, after mixing. This would not, of course, be at all the same as specifying that any particular amount of water should be used in mixing such concrete owing to differences of atmospheric temperature, aggregate, &c.

The advocates of the institution of some such scale of consistency are of opinion that the Concrete Institute should carry out tests on the subject.

DEFINITION OF ELASTIC LIMIT.

The Engineering Standards Committee of Great Britain gives standard definitions of the terms "yield point" and "elastic limit." The former, specified as "the point where the extension of the bar increases without increase of load," is defined as follows: "The yield point is the load per square inch at which a distinctly visible increase occurs in the distance between gauge points on the test piece, observed by using dividers or at which when the load is increased at a moderately fast rate there is a distinct drop of the testing machine lever, or, in hydraulic machines, of the gauge finger." To this is appended this note: "A steel test piece at the yield point takes rapidly a large increase of extension amounting to more than 1-200th of the gauge length. The point is strongly marked in a stress-strain diagram." The Elastic Limit is defined as "the point at which the extensions cease to be proportional to the loads. In a stress-strain diagram plotted to a large scale it is the point where the diagram ceases to be a straight line and becomes curved," and it is added that "the Elastic Limit can only be determined by the skilful use of very delicate instruments and by the measurement of the extensions for small successive increments of load. It is impossible to determine it in ordinary commercial testing." In a note added by request of the Ships Committee, it is remarked that the committee does not recommend the use of either "Yield Point" or "Elastic Limit" in the standard specifications for ship material, because in regard to the ascertainment of the Yield Point there is considerable divergence of opinion as to the best method of determining it, and all methods involve greater time and care than can be expected in the works. While it is possible in works by careful testing at a greatly reduced speed to obtain the Yield Point in ordinary mild steel and wrought iron, some of the harder steels and other constructional materials have no definite Yield Point at all, and some have no Elastic Limit. Further, it is quite impossible to determine the Elastic Limit in the time available for ordinary commercial testing. In its determination a specially delicate and accurate extensometer must be used, in the hands of a careful and competent observer, and the determination for each test bar would require a considerable time. It is properly a matter to be left to laboratories organized for scientific purposes. The Ships Committee is therefore of opinion that the present method of fixing, by experience, the working stress for any material as a proportion of the ultimate breaking stress, rather than as a proportion of the Elastic Limit or Yield Point, is the best practical method, and it considers that the inclusion in the British Standard Specifications for ship material of tests to ascertain either the Elastic Limit or the Yield Point would not justify the dislocation of the ordinary commercial testing as carried out in the works' test rooms which would thereby be entailed.

STEAM POWER PLANTS.

At the recent convention of the Coal Mining Institute of America, held in Pittsburg, December 19, there was read a paper on "Steam Power Plants," prepared jointly by O. S. Lyford, Jr., consulting engineer, and R. W. Stovel, mechanical engineer, Westinghouse, Church, Kerr Company. The paper read in part as follows:

"Owing to the diversity of fuels used in steam power plants in various sections of the country and the difficulties to be encountered in making comparisons of the values of the different fuels, we have taken Pittsburg coal with a thermal efficiency of 14,000 B.t.u. per pound as a standard for the calculations made.

"As to power plants, the ideal plant would be one that could be planned and made up in the shop, taken down and erected where it was required, but unfortunately this system of building power plants is impracticable from the fact that each plant has its peculiarities and offers different conditions to be met with so that it is very rarely that the same plans would answer for two different plants. As there are power plants for a great variety of purposes, we have, to simplify matters, considered only electric plants for railways and power stations, operated by steam turbines and where bituminous coal is used as fuel. Ten plants of this type have been selected ranging in capacity from 79,000 down to 1,000 kw., located in various parts of the country and operated under a variety of conditions."

Views were shown of foundation plans, floor plans, sectional, exterior and interior views of various plants. From the costs of constructing these plants the authors of the paper had prepared a table giving the maximum and minimum costs of each item of importance entering into the erection and equipment of the plants and the totals showed that the costs ranged from $38 to $83.75 per kw. The cost of boiler installations ranged from $23.15 to $50.25 per horse-power.

"It will be seen that the fuel to be used has been decided, the geographical location of a plant has little to do with the design or equipment, but that the location of the water supply and the method of receiving fuel are important facors; also that a proper design and proper arrangement of the apparatus have more to do with the cost of the plant than any other factor."

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

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CONTENTS OF THIS ISSUE.

HIGH BUILDINGS.

In a recent newspaper report we note that Winnipeg is to have a fifteen-story building. The larger cities in Canada have come to the stage where they must settle their policy with respect to high buildings. At the present time there is little or no restriction of height, and, to our mind, that is a very serious condition.

High buildings tend to cause congestion of traffic, and, while in some cases, such as New York, they are necessary, we doubt very much as to the necessity in Winnipeg. Here the city has plenty of chance to expand and develop, and there is no immediate necessity for very high buildings. The present building by-law in Toronto limits the height to 100 feet above the curb line, except in the case of buildings higher than this, when they must be passed by both the City Architect and the City Council. The city of Montreal has always restricted the height to 130 feet and ten stories above the sidewalk level of the principal front. The committee there, who are now revising these by-laws, propose to keep to the 130 feet, but they may permit eleven stories. Boston keeps within the 130 foot limit. Quebec has no building height restrictions whatever, and the reason for this is that up to the present time there has probably been no necessity for one.

The recent terrible disasters which have overtaken Baltimore, San Francisco, and some of the other American cities has shown the danger of concentration of a number of people in a small area.

The development of fire-breaks prevents the very extensive spread of fire in the congested districts, and the development of sprinkler devices, both inside and outside the building, have aided in protecting individual buildings.

At the same time, it remains an absolute fact that a fire occurring in these very high office buildings is a fearful menace to the inmates. With the increased height comes increased danger, and we believe that modern civilized communities are beginning to appreciate this fact. The only way to safeguard the danger, or at least to minimize it, is to limit the height.

In an address to the Montreal Builders' Exchange Mr. Walter J. Francis, the engineering expert on the Montreal City Building By-laws Committee, said that in his opinion the iron fire escapes on the outside of buildings are a very much over-rated device. These escapes, he said, generally open from windows, through which, in case of fire, smoke and flames are pouring, making the escape-bars red hot like furnace grates.

Aside from the fire danger, there are many other disadvantages from the use of high buildings. Mr. Ernest Flagg, a New York architect, in a recent interview drew attention to some of the abuses flowing from the use of sky scrapers. Mr. Flagg states that in the use of very high buildings the owner perpetrates a serious wrong on his neighbors in depriving them of light. He draws attention to the fact that in many cases the use of high buildings is not only justified, but required. The street plan, however, should be modified by widening. If we double the height of a building we should double the width of streets in order to provide light and the capacity for handling the traffic of the street. He also

lays emphasis on the innate ugliness of the sky scraper, and the difficulty of providing æsthetic treatment in its use. Mr. Flagg states that very often these buildings are a monument of individual or local vanity.

Our cities in Canada are comparatively young, and there seems little reason why high buildings should be allowed now, if adequate transportation facilities in the shape of well-laid-out streets are made. The consequent danger from fire with high buildings is far too serious to allow us to enter on this without first exhausting every other means for the easy handling of business and interchange of traffic.

THE ONTARIO GOOD ROADS ASSOCIATION.

The Ontario Good Roads Association met this week in Toronto. Mayor Geary extended a civic welcome on Monday morning to delegates from all parts of Ontario. It is easy to see the increased interest that is being taken in the good roads question throughout the province by the numbers in attendance at the Convention and the interest taken in the papers read and the discussions thereon.

The Ontario farmer is beginning to appreciate the advantages which will be his from a good system of highways connecting all parts of the province and allowing of easy traffic and intercourse. President Kennedy, in his annual address, expressed gratification that the federal and provincial Governments had recognized the necessity of helping to shoulder the burden of constructing and maintaining the highways. He referred to the vast sums which had been granted as bonuses for railway construction, and said that it was now time for bonuses to the highways system.

Mr. Kennedy stated that in his opinion the clause in the bill now before the Dominion Government, which allows the Federal Government to build roads in the province, is a mistake. He said: "The federal highway is only a trunk road; it would not reach the individual. What Ontario wants, especially the farmer, is a provincial system of main highways reaching from county town to county town. Such a system would comprise nearly 2,500 miles."

In our opinion Mr. Kennedy is right, for there will certainly be difficulty in administering that clause of the bill which states that the Minister, with the approval of the Governor-in-Council, may undertake the construction of any new highway or the improvement of any existing highway in any province, and may expend on such improvement or construction the whole or any part of the sums voted by parliament for such subsidy to that province. There is a qualifying clause in the bill which states that the Minister shall first obtain the necessary authority from the legislature of such province and the consent of the Lieutenant-Governor-in-Council.

The administration of these funds must be more closely brought under the control of the several provinces, while the administration, experimental work and general organization of the good roads question should be placed in the hands of a Dominion Good Roads Department.

EDITORIAL COMMENT.

Among the letters written to the Editor as a result of the recent editorial on the "Employment of Engineers," the following ideas predominate: In all work of a public nature the best man should be secured for the position. In many cases where foreign expert advice has been secured it would have been found, if a close examination had been made, that the best advice could have been obtained from a Canadian. We are rather inclined at times in this country to underrate the capabilities of our own people; in other words, "the prophet in his own country."

* * * *

The Department of Industrial Research of the University of Pittsburg, is entering upon the study of the smoke problem in the broadest possible manner. The Department is taking as the chief lines of investigation the effect of smoke on health, plant life and buildings. The increased cost of living, due to damage and dirt caused by smoke, and the legal, as well as the engineering side of the question, are also to be considered. Each of these investigations will be carried on by one or more men, each a specialist in his line. The Department hopes that by co-ordinating these various researches it will be possible to obtain valuable technical as well as scientific data. They will, at least, be able to establish the status of the problem on a scientific basis. The University of Pittsburg are to be congratulated on the attitude they have taken in this matter. If our Canadian universities, through their Applied Science Departments, would devote more time to the chemical, industrial and manufacturing problems throughout the country, in place of fostering the theoretic side of pure science to the neglect of the practical, they would be doing more towards deserving private and government aid.

CORRECTION.

In our issue of February 15th we published an article, entitled "Underground Street Construction," and neglected to credit our contemporary, "Good Roads." We are glad at this time to correct the omission.

TORONTO BOARD OF TRADE.

An important address was delivered recently by Mr. R. S. Gourlay, retiring president of the Toronto Board of Trade, at the annual meeting. It reviewed at length the work of the year and was characteristic for its broadminded tone. Among the important matters before the Board during 1911 was the proposal to enlarge and deepen the Welland Canal. An impetus had been given to the agitation started four years ago by the improvement of the Erie Canal in the State of New York at a cost of $100,000,000. The work of the board in 1910 made the deepening of the Welland Canal more than a by-word. It became an important issue before the Government, and disappointment was felt when the estimates for 1911 did not include an appropriation for the commencement of the enterprise. The project also had the endorsement of the Associated Boards of Trade of Ontario.

THE PRINCIPLES OF SPECIFICATION AND AGREEMENT WRITING.

By C. R. Young, A.M. Can. Soc. C.E.

Third Article.

SUBJECT-MATTER OF THE SPECIFICATIONS.

Because of their content, the clauses of the specifications fall naturally into two classes—Specific and General. In the former are treated all those matters referring to the extent, character and details of the work, while the latter concern the authority, privileges and procedure of the parties or their representatives in office and field. In order of development the specific clauses come first, for on them the major portion of the time given to the preparation of the specifications must be spent. It is often possible to adopt general clauses from previous specifications with little alteration, but the specific clauses must generally be specially prepared for each piece of work, due to the changed conditions and types of construction.

SPECIFIC CLAUSES.

Among the most important matters to be covered in the specific clauses of the specifications for a typical piece of construction work are the following:—

(1) Extent of the Work.
(2) Dimensions and Proportions.
(3) Accompanying and Contemplated Drawings.
(4) Capacity or Required Performance.
(5) Designing Rules.
(6) Classification and Estimating Rules.
(7) Quality of Materials.
(8) Quality of Workmanship.
(9) Methods of Construction.
(10) Inspection.
(11) Condition of Finished Work.
(12) Acceptance Tests.
(13) Cleaning up.

The order to be pursued in the writing of a specification is not necessarily that outlined above, nor would these matters be wholly treated in individual sections under the foregoing captions. For example, the required character of the cement, concrete, brick, stone, timber and steel for a piece of work would not ordinarily be completely covered in one section, entitled "Quality of Materials," but rather under headings denoting the class of construction, as "Concrete Work," "Brick Work," "Stone Work," "Carpentry," and "Structural Steel." By this means the specification is divided up into portions corresponding to the various trades or constructional interests affected—a proceeding which greatly facilitates the preparation of bids by contractors.

(1) **Extent of the Work.**—In the interests of convenience and in furtherance of accuracy in bidding, the amount of the work to be done should be described both as a whole and in detail.

The portion containing the description of the work as a whole is probably the most important single clause in the specification, and generally it is the first of the specific clauses. In it is given a concise and clear statement of the extent and scope of the work, from which the Contractor is able, not only to decide whether it is worth his while to bid, but to roughly check his total estimate and ascertain if all the important operations and the principal quantities have been provided for. This clause should, therefore, contain the following information:—

(a) An enumeration of all the important steps or operations involved in the work:—

(b) Mention of any portion of the work to be performed by the Owner or by another Contractor, or any materials to be supplied by these parties.

(c) A statement of quantities, if practicable.

The following clause, from a slightly-altered contract covering the construction of both the substructure and the superstructure of a steel bridge, is typical of the method of describing the work as a whole where a statement of quantities is not given:—

> "The work comprised in this Contract will include taking down the old superstructure and abutments; neatly piling the old material at the side of the road near the bridge in such a manner as not to obstruct traffic; erecting and maintaining a temporary bridge, utilizing the material from the old bridge in so far as practicable; excavating materials to the depth required for foundation beds; filling in the excavated spaces around the abutments up to the original ground level; the construction of two concrete abutments; making earth approach fills behind the abutments; placing a gravel surface upon this filling; procuring, fabricating and erecting a steel superstructure of thirty (30) feet clear span on the completed abutments; constructing a reinforced concrete floor after the steel superstructure has been erected; removing all falsework, surplus material and débris from the site of the work and leaving the structure complete and ready for traffic."

In general, the embodiment of a schedule of quantities in the description of the work as a whole is to be desired. It is of especial assistance to the Contractor where the project is of considerable extent or where many different classes of work are covered in the contract. The waste of time and effort involved in requiring every bidder to compute the plan quantities is most regrettable. These calculations should be made by the engineer, and the responsibility for their accuracy should be assumed by him quite as much as the responsibility for computations of distances, stresses or sections.

The extent of each kind of work should also be described in detail in a section of the specification devoted to that purpose. Detail should, of course, be excluded from the description of the work as a whole, since the value of that portion of the specification largely depends upon its conciseness. An illustration of a detailed provision fixing the extent of a particular kind of work would be the following abridged clause from a contract for the construction of a sewer:—

> "The ground on the line of the proposed sewer is to be excavated in open cutting. . . . the depth of the bottom of such excavation being in all cases as shown on the profile, or as laid down by the Engineer, as he may think necessary to secure a firm foundation and proper level. . . . For pipe sewers the cutting at the bottom is to be at least eight (8) inches wider than the pipe to allow the haunches to be well packed and rammed with suitable tamping irons."

Where several classes of work of a similar character occur in a piece of construction the limits of these classes should be carefully defined, as the lines of demarcation

of concrete of different mixtures in the same structure. This may be done by stating the elevations of the top and bottom faces of each class or by mentioning the various portions of the structure in which a given class is to be used.

In most contracts there are operations to be performed and material to be supplied for which the Contractor receives his compensation in the prices for other work. Thus, embankment work and back-filling are commonly paid for in the prices for excavation. The remuneration for sheet-piling, cofferdamming, pumping and baling is received in the prices for excavation or masonry. Falsework, forms and staging are covered in the price for the permanent work, whether it be steel, concrete or masonry. Obviously, therefore, the contract should indicate such of these items as may be paid for directly and such as are covered by prices for a different class of work. For all those paid for in the first manner, prices should be set down in the agreement, and those covered in the second way should be so described in the specific clauses of the specifications.

It is particularly desirable that each kind of work for which a price is named in the agreement should be clearly described in a paragraph of the specifications. The applicability of these prices to any particular work in question may thus be readily judged, and numerous disputes over extras thereby obviated.

(2) **Dimensions and Proportions.**—There are many facts of a dimensional nature which it is not convenient to put on the plans, and which, because of their amenability to written descriptions, are inserted in the specifications. In grading contracts, it is very common to specify in writing the width of cutting and embankment and the side slopes in both cuts and fills. The engineer who prepares a general specification for a bridge without accompanying plans, sets forth the required clear span, clear width of roadway, clearance above the bridge floor, and, for the abutment and pier heights, the clearance above some specified water level. Certain limiting sizes or sections for main material, and also for details, are commonly established in any structural specification. The municipal engineer specifies a certain minimum relation of the width of a sewer trench to the internal horizontal diameter of the sewer.

(3) **Accompanying and Contemplated Drawings.**—For purposes of identification, and also for ease of reference, a list of the accompanying drawings is incorporated in the contract. Preferably it is placed in the specifications rather than in the agreement. If either the Owner or the Contractor is to prepare future detail drawings for use in the construction of the work, this fact should be stated, and the stipulation made that no work based upon such drwaings is to be executed until they have been approved by the engineer. While the inclusion of future illustrative or detail drawings in a contract is permissible and consistent with the legal requirements, it is not allowable to include drawings establishing principal or primary features unless such drawings are in existence at the time of signing of the contract.

In the section devoted to drawings it is customary to state that figured dimensions are to be given precedence over scaled ones, except in case of obvious clerical error, when the one most consistent with the contract as a whole is to be adopted.

(4) **Capacity or Required Performance.**—Specifications for most engineering work set forth some particular performance of which the construction must be capable. If it be a bridge, building or analogous structure, it must safely accommodate certain superimposed loads, and frequently this must be done without exceeding a specified deflection. In addition to this the structure must be able to resist at the same time the stresses brought to bear upon it by impact, wind, traction and temperature changes. If the contract concerns a pumping engine, the latter is required to pump so many gallons of water per pound of dry steam or per one hundred pounds of coal. A generator must have an output of so many kilowatts, and be able to carry a stated overload without a rise of temperature of over a certain number of degrees. For certain kinds of construction, as pavements and sidewalks, it is frequently required that the work shall show a specified endurance against wear, or resist the various destructive agencies brought to bear upon it for a stated term of years without abnormal deterioration.

(5) **Designing Rules.**—Where the work is to be designed by the Contractor on the basis of general data submitted by the engineer, comprehensive designing rules must be inserted in the specifications. Even when the work is designed by the engineer himself, and only the details are worked out by the Contractor, it is necessary to include certain of such rules for the guidance of the Contractor in designing the details.

The stipulations respecting design may be conveniently divided into three classes: (a) Assumptions of design, (b) permissible stresses, and (c) approved details. The assumptions of design include such matters as effective spans of beams, girders, floor-beams and trusses; effective depth of plate girders and reinforced concrete T-beams; maximum allowable slenderness ratio for columns; width of slab to be counted as flange in a T-beam, and many other matters of the kind. Under permissible stresses are set forth the intensities of tensile, compressive, bending, shearing, bearing and torsion stresses, or combinations of them, which must not be exceeded for the various materials to be employed in the work. In order that objectionable details may be obviated, the engineer should be careful to fix by the specification the character of the details desired, in so far as it is possible to do so. It is, therefore, common to specify such matters as that plate girder flanges shall be made up of a certain minimum percentage of area in the angles; that compression chords shall be of box rather than T-section; that rockers or bolsters shall be used for the bearings for all spans over a certain length; that reinforcement steel shall be spaced, lapped or spliced in a certain manner; that the lower ends of longitudinal rods in reinforced concrete columns shall rest on bearing plates, and many other analogous requirements respecting details.

FOREST FIRE WASTE.

An important phase of Canada's fire waste was discussed by Mr. Percy Robertson, insurance broker and fire prevention engineer, at a recent meeting of the Toronto Insurance Institute. His address was illustrated with stereopticon views.

As an illustration of the extent of past losses by fire in our forests, he referred to estimates made by the Dominion one-half of the original timber supply has already been destroyed by fire; that government stumpage dues at the moderate rate of 50c per 1,000 feet on the timber destroyed would have yielded a revenue of $1,000,000,000; and that for every foot of timber ever cut in Canada, seven have been destroyed by fire. Serious forest fires continue to occur, and such a state of affairs demands the adoption of vigorous and intelligent preventive measures.

COUNTY ROAD CONSTRUCTION IN ONTARIO.*

By W. A. McLean, Provincial Engineer of Highways, Ontario.

Canadians are universally proud of their country, and of its resources of mine, forest and field. The possession of such a splendid land carries with it certain obligations to do as our forefathers have done, to make and leave it a better place to live in than we found it. A tremendous energy is now being exerted to develop Canada, and one of the striking phases is in relation to agriculture, in which, more and more, improvement is being sought, and the farmers of the country have entered upon what we trust may be a long period of advancement and prosperity.

To aid in the development of Canada one of the larger enterprises has been the construction of steam railways. Over 25,000 miles have been built, and the capital invested exceeds 1,500 millions. So intent have the Canadian people been upon securing railway facilities, that land and cash subsidies and other aid have been granted by the Federal and Provincial Governments, and municipal corporations, amounting in value to about 600 millions; or nearly one-half the capital investment in railway construction.

Railway construction has been supplemented by canals, harbors and steamship lines so that, at a very large cost, the people of Canada have generously provided for an important section of the transportation problem. Having great resources, and having magnificent railway and waterway facilities, we are still very much like the man who had a wagon and a team of horses, but was without harness; and so neither wagon nor horses were of any use. The need of Ontario and of Canada to-day, is a system of good roads that will harness our railway and waterway team to the farm, whereby both the farm and the greater transportation systems will attain their full value and usefulness.

At the present time the roads of Ontario are largely maintained by the townships with statute labor, while important construction is being carried on by county councils. Proposals of Federal aid suggest that the road organization of the Province may be broadened out so as to include three classes, township, county, and state, on a basis such as has created the good roads systems of older countries and of a number of the American States.

The actual building of good roads is an important engineering problem too seldom recognized as such, with the result that there is and has been much wasted energy. But while it is important to know how to build roads, the great object is to so organize as to get the work done. If proper organization is provided, all the rest will be taken care of by this organization; and such an organization will include or create skilled planning, efficient direction of labor, and good finance. It is needless to condemn the ordinary township system of statute labor. It has done much good in the past under pioneer conditions, but its faults are fully apparent to those who are accustomed to good business organization. What is advocated and urged, is that a more effective system be put in its place. The abolition of statute labor is advisable only because there is a more efficient, more equitable and more business-like system available. It is useless to commute statute labor and retain fifty or 150 pathmasters to scatter the money. It is a mistake to commute or abolish statute labor, and then appoint councillors as commissioners to spend the money in such a way as to make votes instead of roads.

The best method is to follow the organization of every well-conducted business. Appoint one capable road superintendent to act as manager for the council, in supervising and carrying out works of road improvement. Centralize responsibility in one man, the council acting as a board of directors.

As previously stated, the abolition of statute labor is merely a means to an end—to make room for a better system, and every municipal councillor can render his best service by having a thorough understanding of the principles that constitute that better system. By doing away with statute labor entirely, levying a rate with ordinary taxes for road purposes, centralizing responsibility in one efficient road overseer, creating a policy of building permanent bridges and culverts, doing some permanent road work each year, and caring for all roads by the systematic use of the log drag—by such measures can a township council fully justify the abolition of statute labor.

While township councils are doing something to patch and repair roads, the most important construction is now being carried on by county councils under the Highway Improvement Act. A tree is known by its fruit; and "a corrupt tree cannot bring forth good fruit." The results under county road systems have been more or less satisfactory according to the efficiency of the organization under which they were produced. The same principles as those outlined for townships are applicable to county work; and the most important factor is the ability of the county road superintendent. There are now twenty counties of the Province building systems of roads. Returns have not been made for last year, but to the end of 1910 their expenditure has been as follows:—

Road construction and supervision	$1,790,253.91
Permanent bridges	476,765.49
Machinery, plant, etc.	145,743.32
Special grants to townships, villages and towns	112,674.84
Toll roads purchased	155,997.98
Total expenditure	$2,681,435.54

Of the foregoing total expenditure of $2,681,435.54 the Provincial contribution under the Highway Improvement Act has been one-third, or $893,811.84. Of one million dollars set aside by the Legislature in 1901 under the Highway Improvement Act there remains, after meeting payments for the work of 1910, the sum of $106,188.16; which sum will not be sufficient to meet the Provincial obligations to be incurred by work carried out during the year 1911, but as you are aware, a second million has been appropriated by the Provincial Government to continue this work.

Main Roads.—Broken stone roads of the best class have been reduced to a few well-defined types, through more than a century of experience in England, France, Germany, and on this continent. The true macadam road has a well-drained and crowned earth sub-grade, over which is spread a uniform coating of broken stone of about two and one-half inches in greatest dimension. The Telford road has a foundation of flat quarry stones, placed by hand, on edge, the angular points being chipped off by hammer and wedged into the interstices; and over all is spread a coating of fine broken stone, in thickness about one-third of the total depth of the stone surface. The earth sub-grade is flat, and larger stones are used at the centre of the road, with smaller at the sides, to give the desired camber. The roads built by Tresaguet in France were substantially the same as the Telford road, and are usually included with it. In the French type, the sub-grade was cambered, and the foundation stones of uniform depth. A distinct type of foundation is that developed in Massachusetts, in which there is a slightly V-shaped sub-grade with a filling of cobble or field stone, a method which is claimed to give, more effectively than other types, the desirable under-drainage.

*Address delivered to Ontario Good Roads Association, February 27, 1912.

Experience has shown the superiority of roads with a foundation, such as the Telford type, in reducing the cost of maintenance under heavy traffic. Settlement is more uniform, and defective drainage is less destructive. If the natural sub-soil is strongly supporting, such as a dry, well-cemented gravel, the foundation may be omitted with saving of cost. Whether the Telford or Massachusetts type of foundation be followed, the writer believes that local material suitable for either should largely govern.

County roads in Canada cannot, as a rule, follow closely English, French, German, or other standard, but must be built with a view to the particular needs of this continent, and of the locality. The need in Ontario is a long mileage, to be built as rapidly as possible, through districts where population is comparatively sparse, where there may be little or no roadmaking material, and the available expenditure necessarily restricted by these and other conditions.

European engineers would undoubtedly, if it were possible to reconstruct many of their roads, lay them with foundations, but the cost is prohibitive. No more is it practicable on this continent to build any but the most heavily-traveled roads with expensive foundations. Instead, it is necessary to depend on good drainage, carefully maintained, to keep the sub-soil dry and strong enough to sustain the road surface.

Drainage.—Bridges have to be strong enough for the maximum load, and with waterway enough for the maximum freshet. So roadbeds should have sufficient drainage for the severest test, which in northern countries is a period of thaw in the early spring, lasting usually for two or three weeks. If sub-soil drainage is sufficient for that test, no break-up of the road crust need be feared at other seasons.

Old specifications for roads built in Canada before the period of railway construction, required open drains on each side of the road, with bottom at least two feet below the crown. In many places the drain was deeper; and hills or spouty places were under-drained by trenches filled with field stone. Such roads have stood the test of time, and may be accepted as the standard of drainage required for the north; except that tile under-drains are taking the place of open ditches where they would otherwise be dangerous, unsightly, or difficult to maintain. Drains of porous farm tile keep the sub-soil at its dryest and prevent uneven settlement of the road crust into mud, which is as destructive to a road when below the surface as when on the surface. Some counties of Ontario are using tile drains the full length of all their roads. Others use them only on wet and spouty hills, on level land which is exceptionally wet and retentive, or where the open drain would otherwise have to be dangerously deep to give sufficient fall and outlet. In the last case, the tile may carry some surface drainage, receiving it in catch-basins.

Grading and Surfacing.—Closely associated with drainage is the grading of the road. Before a road is surfaced it should be brought to grades that insure permanence. Hills should be cut down, low places filled, and the earth work brought to a substantial turnpike. The road surface will need renewal, but the grade, if properly made, will outlast even the bond issue. On roads of a secondary class elaborate surveys are unnecessary. A good foreman can obtain easy-flowing gradients by grading from point-to-point, but should have an engineer's stakes and profiles in cases of extensive cuts and fills, new locations, tile drains, or doubtful surface drainage.

Roads laid on an earth foundation should be given a higher crown when newly constructed than is desirable for perfect condition. Settlement will assuredly occur, and unless the road is too high to begin with, it will become too flat. A county road as commonly built, which in two or three years has settled to the desirable camber, will give the greatest degree of durability, with least expense for maintenance. One inch to the foot from centre to gutter or edge of shoulder, for a completed, rolled road, will meet ordinary conditions. With a circular cross-section, the greatest part of the fall is on the earth shoulders.

The cost of a road, unless earth-work and drainage is of an exceptional kind, will depend on the width and depth of broken stone used. Wide, flat roads are desirable, but narrow roads with a good camber cost less to build, and much less to maintain, unless a highly organized system of maintenance is created. We have, for this class of road, found an earth grade twenty-four feet wide, shoulder to shoulder, to meet most conditions, which may be reduced to eighteen or twenty feet for least traffic. With shoulders six feet wide, the stone is commonly put on from eight to twelve feet wide. The consolidated depth of metal on county roads is based on eight inches for a moderately strong clay or loam sub-soil. This is modified according to the anticipated amount of traffic and quality of stone to resist wear; the maximum concentrated wheel loads, local tire widths, and wheel diameters, bond of road metal and consequent distributing effect of the metal crust, the supporting strength of the sub-grade and opportunity for drainage.

Bituminous binders may be justified on heavily-traveled suburban roads of this class, but present practice in Canada tends to oiling as a preservative and dust preventive, owing to the less first cost of water-bound macadam.

Binder.—The durability of a road is largely dependent on the binder and the cementing qualities of the stone dust, in producing a waterproof surface—if tar or other bituminous binder is not used. We are strongly in favor of the use of stone screenings as opposed to sand, and have very rarely found gravel or sand sufficiently clean, coarse, and sharp to satisfactorily take the place of screenings as a binder. Wherever practicable, stone screenings are to be recommended, particularly the screenings of certain classes of limestone; the superior cementing qualities of which make it better road metal than its degree of toughness would justify. Limestone screenings are exceedingly useful with water-washed gravel, or with broken granite or trap.

Coursing Stone.—A uniform grade of stone, rather fine, is desirable in finishing the surface, and is necessary where a very hard stone such as trap is employed, but this may be sought at considerably increased cost, and is not always necessary to suitable results. It adds to the cost of a road to spread the stone in several layers. Municipalities using portable crushers will find a rotary screen with two sizes of mesh very satisfactory. This will produce (1) "tailings," or the stone too large to pass through the screen; (2) the middle course, a uniform grade to form the main body of the road, and (3) "screenings" to bond and finish the surface. The tailings should be spread in the bottom of the road, and covered to the required depth with the uniform grade; and this, after rolling, may be lightly coated with screenings and rolled. If a very tough stone, such as trap, the screenings may be such as will pass a one-inch mesh, or a one and one-half inch mesh if limestone, and the uniform grade of stone may be two-inch for trap, and three-inch for limestone, with the screenings removed. Crushing and handling are cheapened by this system, and, for water-bound roads, a smooth surface results.

Local Material.—Trap or other tough rock brought from a distance by rail in preference to the use of soft local material, may be justifiable for surfacing heavily-traveled main roads; but it is a safe rule, if applied with discretion, that local material, if it exists, should be used. Much will depend on the teaming required but for moderate wagon hauls up to two miles, on highways of the second and third classes, the writer has commonly found gravel roads being built for

$100 per mile for each foot in width of metal. If local broken stone is used, the cost is, all things equal, about doubled, or $200 to $300 per foot, and if imported by rail, about $300 to $400 per foot. Taking, then, a road not requiring much grading, and with eight feet of metal and eight inches in consolidated depth, the cost might be stated, for cheap construction, at $800 or $1,000 a mile for a gravel road; $1,600 to $2,400 a mile for a road built of local crushed stone, and $2,400 to $3,200 per mile if the stone is brought in by rail. These prices are for the cheapest class of road that can be built, and the main roads of the province should have a much heavier type of construction.

Gravel Roads.—Gravel in general is inferior to broken stone as a road material, but if of a reasonable quality, is suitable for roads of the third-class—township roads—and for many market roads of the second class, but unless of exceptional quality is deficient for heavy traffic. The rounded pebbles do not take the mechanical clasp that pertains to fragments of broken stone, while the sand which it usually contains is not equal to stone screenings as a binder. It may contain lime or iron, improving its bonding qualities, but as a rule it is not waterproof, and ruts readily in wet weather, especially if it contains sand, clay, or loam in excess.

The best quality of gravel is of varying sized grain up to two inches in greatest dimension, with only sufficient fine material to fill the voids between pebbles. It should be clean and made up largely of a uniform grade of pebbles—qualities rarely found in natural pit gravel. Gravel pits containing a mass of large stones and boulders should be treated as rock, and put through a crusher. Gravel which is not coarse, but which is "dirty," should be screened to remove the excess of sand or clay. A rotary screen may be used, operated by steam power. The gravel can be drawn in wagons to an elevated platform, dumped into a hopper from which it passes through the rotary screen, and from the screen to an elevated bin, from which the screened gravel is again loaded into wagons to be taken to the road. By means of the elevated bins the expense of shoveling into wagons is saved, the time of teams and teamsters is saved, and a well arranged plant will, under favorable circumstances, pay for crushing and screening. This is particularly the case if a pit near the work can be used rather than to team better material a long distance.

Methods.—The methods of construction will largely determine the cost. Machine work is cheaper than manual labor. The cross-section adopted should, therefore, permit the maximum amount of machine construction. Particularly for the cheaper class of roads, the grading machine, in treating with old locations, should do most of the earth work, supplemented with wheeled and drag scrapers. The cheapest and best plan, in our experience, has been to make the earth sub-grade, shoulder to shoulder between ditches, almost flat, or with a central rise of about three inches for a twenty-four foot grade. When this is rolled the stone is spread to the desired width in the centre, then with the grading machine, earth is drawn from the shoulders to support the stone, thus completing the camber. The stone is rolled dry to level the surface, the screenings are spread, sprinkled, and rolled till consolidated. To grade the road and then excavate a central channel to receive the metal is a more expensive method, and is apt, for roads without a foundation, to place the stone too low for good drainage, producing what may be termed a "water-logged" road. Instead of the camber and turnpike being high enough to allow for settlement, it is apt to be made too low and flat.

Rolling.—As distinguished from earlier road making, modern construction has been largely influenced by machinery, especially grading machines, rock crushers, and road rollers. The smaller municipalities of Canada commonly use graders and crushers, but the purchase of a steam roller is too often delayed. It is to be pointed out that the cost of a roller is by no means an additional expense, since rolling effects economy in several ways. Coarser stone can be used in a road that is rolled, so that the cost of crushing is reduced. With coarser stone, the road is stronger to resist wear, and is more securely bonded than if first rutted and mixed with mud. Less stone is required in a rolled road, as loose stone is largely forced down into the mud before the surface becomes waterproof, or is knocked to the ditches by traffic. Without rolling, roads demand attention for one or two years, to rake the stone to place from time to time; the earth shoulders have to be restored and leveled where cut up and destroyed by traffic, new material has to be added to fill hollows and ruts. By rolling the sub-grade, the wet or weak spots are developed, which can be drained or filled with earth and again rolled to produce a uniform foundation; thereby reducing the stone which the road would otherwise absorb. Long lines of loose stone left for traffic to consolidate are a most objectionable obstruction to travel, and bring road building into disrepute. On the other hand, a road built with a heavy roller is a complete work, in perfect condition when finished. Rolled roads are a revelation to those who have been accustomed to and who expect only old-time methods and results. For economy, service, and to popularize the work, rolling should be regarded as essential for every class of gravel and stone roads.

BUILDING FIGURES.

The past year was another one of active building operations and the fact that this condition was general is additional proof of national rather than sectional progress during 1911. The building of warehouses, factories, office blocks was a marked feature, while there was no slackening in the demand for residences. The current year will probably witness the construction of a considerable number of workmen's cottages in all parts of the country.

The following statistics show the value of building operations during the past two years, in 20 selected cities and towns:—

City or town.	1910.	1911.
Brandon	$1,224,385	$1,142,939
Calgary	5,589,594	12,907,638
Edmonton	2,161,356	4,328,960
Fort William	2,381,125	3,078,010
Halifax	471,140	548,734
Hamilton	2,604,605	4,255,730
Lethbridge	1,210,810	1,033,380
London	805,074	1,036,880
Montreal	15,815,859	14,657,210
Ottawa	3,040,350	2,997,610
Peterborough	517,958	345,372
Port Arthur	1,062,616	597,705
Regina	2,351,288	5,089,340
St. Thomas	286,650	285,515
Sydney	347,554	495,642
Toronto	21,127,783	24,250,000
Vancouver	13,150,365	17,652,642
Victoria	2,271,095	4,026,315
Windsor	392,040	739,515
Winnipeg	15,106,450	17,600,000

The value of the building permits issued last year as a rule exceeded the value of the previous year. The most remarkable increases were at Calgary and Regina, which more than doubled their figures. Large gains were also made at Hamilton, Toronto, Vancouver, Windsor, and Winnipeg.

PERMANENT STRUCTURES.*

By James S. Bell, C.E.

Permanent structures as applied to municipal public works are those structures which, when properly built, will remain and fulfil the requirements for which they were intended for the longest possible period. It is not possible to build structures that will stand forever. They are all subject to wear and decay. The whole object is to get a material at reasonable cost, that will, when placed in position, stand the ordinary wear and tear of vehicular or other traffic, and the action of the elements as long as possible without excessive repairs.

The rapid increase in the manufacture of Portland cement and reduction in cost, has made the use of concrete available for a multitude of purposes, and to no use is it more applicable than in building such structures as bridges, abutments, culverts, retaining walls, etc. Taken in combination with steel—the steel being properly imbedded in the concrete—the two materials combine and assist each other in resisting the stresses brought upon them, each material serving the purpose for which it is best adapted.

Brick and stone were formerly used for building abutments, and in some cases, arch bridges and culverts, but only to a limited extent, on account of the difficulty of procuring the material and the cost of placing it at the site of the proposed work. On the other hand, most of the ingredients entering into the composition of reinforced concrete are to be found in every township, and in many districts, in every concession. The cement and steel have only to be hauled from the nearest railway station; and as these ingredients in the mixture are by far the least portion, it is not expensive to haul them comparatively long distances.

Plain Concrete: Plain concrete is admirably adapted to the construction of works where it is only used in compression, such as abutments for bridges. Even for that purpose the use of a comparatively small amount of steel properly imbedded in the concrete will permit of a considerable reduction in the quantity of material used, and in most cases will also show a saving in cost. At the same time it will add materially to the strength and stability of the abutment, by uniting it more firmly together and making it less susceptible to cracks from expansion and contraction.

Concrete Pipe Culverts: Small culverts up to three or four feet in diameter can economically be built with concrete pipe—preferably reinforced—but these should always be protected at the ends with concrete abutments and wing walls, to prevent the water washing out the earth under them, and permit the free entrance and exit of the water.

The pipe should be made with hub and spigot ends, and be placed close together and cemented, so that there will be no chance of water leaking through the joints and making its way under the pipe. Should this occur, there is danger of the earth being washed out below and thus cause a failure of the culvert.

Short Spans: Culverts from four feet to eighteen feet can be more economically built with flat tops, when properly reinforced, than by arch construction. The side walls should be made about one foot in thickness up to sixteen feet in height, and the footings wide enough to suit the density of the ground on which they stand.

The wing walls should have a base of at least one-third the height and be supported by either counterforts or buttresses.

Beam Bridges: For spans over eighteen feet and up to forty feet beam bridges are the cheapest and give greater water-way than arch construction.

The side walls should be made heavier than for flat top culverts in order to safely carry the increased load and beams. Wing walls should be built the same as for flat top structures.

There are cases where beam construction has been used up to seventy-five feet, but generally they are not economical for a span over forty feet.

Arch Bridges: Concrete arch bridges will compare favorably in cost with steel construction in spans of forty feet to one hundred feet, and in cases where the material for concrete is easily obtainable, this length may be considerably increased. In the construction of arch bridges a perfect foundation is absolutely essential.

In flat top and beam bridges there is no longitudinal thrust. The whole weight of the structure and load is a downward pressure. But in arch construction there is an outward thrust pressure that has to be met with an increased weight of concrete supported by a perfect foundation. Should the foundations of an arch bridge give way, the result would likely be the destruction of the bridge. In the case of a flat top or beam bridge, the settlement of a foundation might not seriously affect the structure; although in every case it is advisable to secure a perfect foundation for any kind of a structure.

Steel Superstructures: For bridges over one hundred feet span it is generally considered more economical to build them of steel on concrete foundations, and in every case they should be made strong enough to support a solid floor. It is quite true that the life time of a steel bridge is not as great as that of concrete, but with proper care and attention, keeping the steel well painted, a bridge of this type should be safe for at least fifty years.

It is said that there is a cast iron bridge in France on the Seine River that was built in 1801 and is still in use.

Kind of Bridges to Build: The question of determining the kind of structure best suited to any particular crossing of a stream, can only be made after a careful examination of the site and its surroundings. No two sites are alike, and therefore a study of local conditions and requirements is necessary in every case before a recommendation can be made as to the best and most economical structure to build.

Great care should be taken to have the foundation built so that in future years there will be no danger of undermining by the scouring action of the water.

Size of Openings: Determining the length and height of openings is also an important matter. Freshets will undoubtedly be greater in future as the country becomes better drained. Ample room should, therefore, be provided for the water, for if confined in too narrow a space, scouring of the bed of the stream is sure to occur and consequently injury to the structure.

Design of Structure: In designing a structure, the first consideration should be the public safety. It is far better to provide in excess of the requirements than to have the structure too weak. Then loss of life would probably be the result Cheapness in construction should never be considered as against the security of the traveling public.

It is an undoubted fact that a large number of the steel and iron bridges that have been erected throughout the province are now inadequate for present traffic conditions. This is not all due to imperfect design or construction. Traffic conditions twenty years ago were quite different to what they are to-day. At that time the heaviest load to provide for would probably be a threshing engine or a drove of cattle. Now the law provides that bridges shall be safe for the

* Paper read at Ontario Good Roads Association meeting, Toronto, Tuesday, February 27th, 1912.

passage of a traction engine not exceeding in weight eight tons, and where roads are now being systematically improved, it is necessary that they be sufficiently strong to carry a fifteen ton steam roller in addition to the live load provided.

Bridge Floors: Very few of the bridges that have been erected with wooden floors are strong enough to carry a floor of concrete. In some pin connected bridges where the top chord and batter posts are strong enough, the other members can be strengthened sufficiently for this purpose, but in most cases it means the rebuilding of the superstructure.

All bridges where possible should be constructed with solid floors. Vehicular traffic on wooden floors causes a greater strain and vibration to the bridge than the same loads on a solid floor. This is caused by the irregularities of the plank when worn, and projecting knots. On a solid floor the surface is much smoother, and in consequence of it being a large slab, the stresses are distributed over a larger area.

Traction Engines: The cutting action of the lugs of traction engines is very destructive to wooden floors, particularly when they are soaked with water; and although the "Act" provides for planking to be laid under the drive wheels of the engine, this is rarely complied with.

Plans and Specifications: All plans and specifications of steel bridges should be submitted to and approved by a competent tribunal before erection. This is more necessary in the case of steel bridges than of concrete. If a reinforced concrete bridge, after the forms are removed, shows no defects, then after thirty days it is reasonable to suppose that it will stand the ordinary travel, and as its strength increases rapidly, there is little to fear for its safety. But in a steel bridge the reverse is the case. It is strongest the day it is completed, and from that day it decreases in strength.

The Legislature last session passed an Act providing that the specifications of all County Bridges should be submitted to the Provincial Engineer of Highways for approval before being built. As the majority of the bridges in the province—and in many cases those most traveled upon—are under control of the minor municipalities, this Act should apply to all bridges.

Inspection of Steel Bridges: Rigid inspection of steel bridges after erection, by a competent person, should be compulsory. The design and specifications of a bridge may be all that is desired, but if the erection is defectve, then the whole intention of the design is a failure. This inspection should be made immediately after erection and before any painting is done. All rivets, particularly those in tension members, should be carefully examined and each one tested with a light hammer to see if they are loose or do not fill the holes properly. All loose or imperfect rivets should be cut out and properly replaced.

The Provincial Engineer of Highways in his last report, has an amended specification for steel highway bridges, which if lived up to, will ensure the completion of better bridges in future. Proper inspection after erection is the only way to guarantee that those specifications are effective.

Inspection of Concrete: For concrete structures it is very important and necessary that a competent inspector should have charge of the work. He should be able to thoroughly understand the plans and specifications prepared for the work, and also have a knowledge of the different ingredients that make up the concrete, how to mix and place them in position. He should also know how the forms for holding the concrete should be made and placed, and see that they are strong enough to resist the pressure of the wet concrete. Good results can only be obtained by a thorough knowledge of materials and how to prepare and place them in position.

Painting: Keeping steel bridges well painted is a matter that should not be forgotten. Unpainted or imperfectly painted bridges deteriorate very rapidly in strength, and although a fair margin of safety is provided in the design, a failure to properly protect the steel will soon reduce the strength of the bridge to a point where it will be unsafe.

UTILIZATION OF WASTE STEAM AT THE MILWAUKEE REFUSE INCINERATOR.

At the November meeting of the Milwaukee Section of the American nstitute of Electrical Engineers, held in cooperation with the Engineers Society of Milwaukee, Mr. J. A. Neseroff, city engineer of Milwaukee, presented a paper on "The Utilization of Waste Steam at the Refuse Incinerator and the Electrification of Two River Flushing Stations."

The City of Milwaukee now operates a refuse incinerator in which all classes of refuse are burned in special furnaces under special boilers. At the present time the steam is blown off except a very small portion used to run the plant. Tests made showed that the steam available varied widely, depending on the grades of refuse, being lowest when green garbage was fed to the furnaces. Further tests showed that by adding a very small amount of coke dust to the charges of green garbage, enough steam could be raised to produce 600 kw. at all times, although at some times nearly three times this amount would be available.

Since it is undesirable to make a large investment in machinery at this time, it has been decided to install one 600 kw. steam turbine and proper auxiliary apparatus in a new engine house adjoining the incinerator. The nature of the steam supply and the absence of spare units made it inadvisable to utilize this power supply for service requiring great reliability, and street lighting would not be economical by reason of the absence of any day load. The city, however, now operates by steam two pumping plants taking water from the lake and forcing it through tunnels into the rivers running through the city, for the purpose of flushing them to carry off sewage. One plant is only two years old, with a capacity of about 200 horse-power, while the other is 24 years old, with a capacity of about 250 horse-power. Both run practically continuously, but a few hours shut-down would not be disasatrous. This load therefore seems ideal as an outlet for the power available at the refuse incinerator.

The plans contemplate 6,600-volt three-phase underground transmission to induction motors in the two pumping stations, about two miles in each case, and the removal of the present steam engines. The motors will be geared to the present shafts.

Figures were given of the cost of operation of the present steam pumping stations and it was shown that by an investment estimated at $80,000, a saving of approximately $28,000 a year could be made. This did not make any allowance for interest or depreciation on the new investment, nor did it include any value for the steam that will be used. As the steam is now a waste property of the city it is merely a matter of bookkeeping whether the economy is shown in the pumping plant by using waste steam, or whether the steam is charged against the pumping stations, and the economy shown in the operation of the incinerator.

The discussion which followed the reading of the paper was general, and involved criticisms of the present operation of the steam plants and suggestions that other more profitable markets be selected for the use of waste steam, but no practical suggestions were made that appeared better than the plan already adopted.

ENGINEERS' LIBRARY

Any book reviewed in these columns may be obtained through the Book Department of The Canadian Engineer.

BOOK REVIEWS.

Geodetic Surveying. By Edward L. Ingram. Published by The McGraw Hill Book Co., New York. Cloth; 289 pages, including index; size 6½ x 9¼ inches; 92 figures; 10 tables; price $3.00.

The author of this treatise is Professor of Railroad Engineering and Geodesy at the University of Pennsylvaia, and the full title of the volume is Geodetic Surveying and the adjustment of Observations (Method of Lease Squares). Up to the appearance of this treatise there has been a lack of a satisfactory text from which to teach civil engineering students the fundamental principles of geodetic surveying and the adjustment of observation. It was with the intention of filling this need that the volume was compiled. In order to make the book complete for the practising civil engineer a large amount of other matter has been included. A large number of illustrative examples are given and are worked out in detail, so that every process may be fully understood.

Strength of Materials. By James E. Boyd, M.S. Published by The McGraw Hill Book Co., New York. Cloth; size 6½ x 9¼ inches; 295 pages, including index; 200 figures and 15 tables; price $2.50.

Many treatises have been published recently on the subject of "Strength of Materials," and some of these have been very good. This new volume is a valuable addition to the subject and is intended to give the student a grasp of the physical and mathematical ideas underlying the mechanics of materials, together with enough of experimental facts and simple applications to sustain his interest, fix his theory, and prepare him for the technical subjects as given in works on machine design, reinforced concrete, or stresses in structures. It is assumed that the reader has completed the integral calculus, and has taken a course in the theoretical mechanics, which includes statics and the moment of inertia of plain areas. The book is a well-balanced, logical exposition of the subject, and will be found a valuable text for the student of the strength of materials.

The Law Relating to Engineering. By L. W. J. Costello. Published by the Society of Engineers and the Junior Institution of Engineers, London. Cloth; size 6 x 8¾ inches; 170 pages; including index; price $1.60.

This book is a course of six lectures delivered at Caxton Hall, Westminster, in 1910 and 1911, before the Society of Engineers and the Junior Institution of Engineers, by the author. There is also an introduction by Lord Justice Fletcher Moulton, past president of the Junior Institution of Engineers. The lectures comprise a judicious selection of the decided cases in law bearing on the matters with which the engineering profession have to deal, the cases being arranged in such manner that those that relate to each point come together. The perusal of them will benefit the most experienced, and will give invaluable training to the beginner. While the cases all came up in the English courts, still they are of great interest to the Canadian engineering profession.

Efficiency. By Harrington Emerson. Third edition, revised and enlarged. Published by The Engineering Magazine, New York. Cloth; size 5¼ x 7½ inches; 254 pages; price $2.00.

This volume forms one of the Works Management Library published by this company, and the full title is "Efficiency as a Basis for Operation and Wages." The rapid expansion of interest not only in the pursuit of efficiency, but in Mr. Emerson's interpretation of it as applied to industrial affairs, exhausted the first two editions in a very short time. In this third edition the author has made a thorough revision of his text, elucidating points upon which experience has shown added emphasis must be laid, adding sections to cover the development of thought and practice since the first draft was written and establishing points of connection between this volume and the following one on the twelve principles of Efficiency. The principal changes will be found in chapters 4, 5, 6 and 7.

The Twelve Principles of Efficiency. By Harrington Emerson. Published by The Engineering Magazine, New York. Size 5¼ x 7½ inches; 423 pages; price $2.00.

This is the latest work by Mr. Emerson and follows the volume entitled "Efficiency as a Basis for Operation and Wages," a review of the revised edition of which will be found in this issue of The Canadian Engineer. In this latest volume Mr. Emerson reduces the elements of efficiency to definite and clearly defined principles. These principles are so universal that they may be used to test the efficiency of an existing organization, or they may be made to serve as guides in directing the conduct of further enterprises. The method of treatment is simple and logical. An introductory chapter lays down the premise that the prime institutions for the attainment of efficiency are not men, materials, money, machines, methods, but theories of organization and principles, and that inefficiency prevails because the type of organization in general use does not lend itself to the application of efficiency principles. The second chapter discusses the type of organization under which efficiency principles can be successfully applied. The twelve following chapters take up each one a single principle: 1, Ideals; 2, Common-Sense and Judgment; 3, Competent Counsel; 4, Discipline; 5, The Fair Deal; 6, Reliable, Immediate and Accurate Records. 7, Planning and Despatching; 8, Standards and Schedules; 9, Standardized Conditions; 10, Standardized Operations; 11, Written Standard-Practice Instructions; 12, Efficiency Reward. The two concluding chapters show how the principles are applied as a means of diagnosis of industrial conditions and correction of existing inefficiencies.

Engineering as a Vocation. By Ernest McCullough, C.E., M. Am. Soc., C.E., etc. Published by David Williams Company, New York, N.Y. Cloth; 5¾ x 8 inches; 201 pages; 4 illustrations; 6 tables; price $1.00.

The book takes up first the definition of the word engineer and what is meant by engineering. Then is discussed the work and the education of the engineer, one chapter containing a full list of studies pursued at schools of civil, mechanical, electrical and mining engineering. The statement is made that the modern engineer should have a college education or its equivalent, the author mentioning that the

equivalent is very hard to obtain. To show what the self-tutored man is apt to encounter and to help him accomplish his purpose he gives a list of books to study, with the price of each book. Directions for home study are also given, the author being a man who is ready to admit that many first-class engineers never saw the inside of a technical School. There is a long chapter entitled "Does it Pay to Study Engineering?" which the reader cannot help but feel is largely autobiographical. An appendix containing reprints of editorials from prominent engineering papers is somewhat pessimistic in tone; more so than anything the author seemed to dare write. Contractors should be interested in this book, the author believing an engineering education the best, if contractors care for a college training. He refers to contracting as "migratory manufacturing" and calls attention to the great changes in methods since engineers entered the field. The author has a pleasing style, the pages being enlivened occasionally by quiet humor. The book will be useful to young engineers in setting before them the reasons for non-success and showing them how to advance. It will be interesting, because reminiscent, to older engineers, and if required to be read by every high school student and freshman in college will undoubtedly prevent many fine young fellows from making a mistake in selecting a vocation for which they may be totally unfit.

Tests on Reinforced Concrete Columns. By Morten Owen Withey. Has just been issued as Bulletin No. 466 of the University of Wisconsin. This bulletin is 116 pages in length; size 6 x 9; and records the tests on columns of the series of 1910. These tests were made in the laboratory for testing materials of the University of Wisconsin, and are a continuation of a branch of the work reported in Bulletin No. 300. The purpose of these experiments was to make a further study of the strength and elastic properties of columns reinforced with spirals and longitudinal rods. Copies of Bulletin No. 466 may be obtained by addressing the librarian of the University of Wisconsin.

Pipes and Tubes. By P. R. Björling. Published by Whittaker & Company, London. Size 5¼ x 7 inches; 244 pages, including index; price $1.00.

This little volume which forms one of the series of Whittaker's library of Arts, Sciences and Industries, deals with the construction and joining of pipes and tubes, together with many rules, formulae and tables. The chapters on Construction and Laying of Pipes are exceedingly good, and while they represent English practice, will be very useful to any engineer interested in this subject.

Mining Without Timber. By Robt. Bruce Brinsmade, B.S.E.M. Published by McGraw Hill Book Co., New York., 239 West 39th Street, New York, 1911. Size 6½ x 9½ inches; 309 pages, including index; 146 figures; price $3.00 net.

This book has been written to supplement many other valuable treatises on such work, such as Mayer's Mining Methods in Europe, Storm's Timbering in Mining, and those books also dealing with the financial side of mining, which include Ingall's Economics of Mining, Hoover's Principles of Mining, and Finlay's Cost of Mining. The mining industry is becoming alarmed as to its future supply of the big timber of which it has hitherto been such a prodigal consumer on account of the rapid depletion of the forests of America by fires and the axe in recent years.

The use of steel and masonry for the support of mine shafts and tunnels, the author states, has long been practised in Europe because most mines there are considered to be investments rather than temporary speculations; this system has been thoroughly covered by other writers, and has not been touched on in this treatise. The book deals with the various systems of excavation with such additional matter regarding exploring, blasting, explosives and the control of ground as is necessary for the elucidation of the main theme.

This book should be well received by both coal miner and metal miner, for they will find a great deal of interest in it.

Street Lighting. By J. M. Bryant and H. G. Hake, has just been issued as Bulletin No. 51 of the Engineering Experiment Station of the University of Illinois.

Efficient and economical street lighting is a subject on which little information of a definite and tangible character has been published. Bulletin No. 51 is designed to supply such information concerning electric street lighting. The subject has been treated in a simple, direct manner, and while of especial interest and value to the technically trained illuminating engineer, will appeal particularly to city councils and central station managers.

The general theory and construction of electric lamps, both incandescent and arc, are discussed, together with the standard systems of electric distribution for lighting, and accepted methods for the measurement and study of illumination, with and without shades and reflectors.

These principles are then applied to the study of street illumination, curves and calculations being given to show the candle-power distribution for the various lamps used, equipped with their proper glassware and reflectors, and others to show the illumination along the street for representative installations and conditions. Based upon these results, a discussion is given of the proper lighting of business streets, cross streets, boulevards, residence streets and outlying districts. The subject of economy for the several systems and lamps is thoroughly discussed—the initial cost, upkeep, interest and depreciation of various lamps and equipment are considered in tables and curves showing their relative economy at standard costs of power. Attention is given also to the economical selection of different lamps for certain classes of illumination.

Copies of Bulletin No. 51 may be obtained gratis upon application to W. F. M. Goss, Director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

An Investigation of the Strength of Rolled Zinc. By Herbert F. Moore, has just been issued as Bulletin No. 52 of the Engineering Experiment Station of the University of Illinois.

For many years engineers have been studying the strength of iron and steel, and though much remains to be learned about these, the commonest of metals, yet we have sufficient knowledge of their strength and stiffness to enable them to be used safely and economically. Very little attention has been given to the study of the strength of zinc, though that metal has had a wide use on account of its rust-resisting and electric properties. Zinc has, in fact, rarely been used in places where heavy loads were liable to be imposed. Recently, it was proposed to use loops of sheet zinc to suspend electric cables, and it became important to determine the strength of zinc so that such hangers could be designed to carry heavy cables with safety. The Engineering Experiment Station of the University of Illinois, at the suggestion of an Illinois zinc works, undertook the investigation of the strength of zinc, and the results of the investigation have just been published in this bulletin. The tests performed showed that thin sheet zinc is about one-third as strong as soft steel plate of the same thickness, and that a punch or shear which would punch or shear steel plate one-tenth of an inch thick would punch or shear zinc plate about one-quarter of an inch thick. Zinc plate was found to break under pull with much less stretching than steel, but a cylinder of zinc could be flattened out without cracking.

Copies of Bulletin No. 52 may be obtained gratis upon application to W. F. M. Goss, Director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

Retaining Walls for Earth. By Malverd A. Howe, C.E., Professor of Civil Engineering, Rose Polytechnic Institute. Published by John Wiley & Sons, New York. Canadian agents, Renouf & Co., Montreal. Fifth edition, revised and enlarged; size 5x7½ inches; 181 pages; price $1.25.

This little volume, now in its fifth edition, treats of the design of retaining walls for earth, including the theory of earth-pressure as developed from the ellipse of stress. It contains also a short treatise on foundations, illustrated with many examples from practice. The captions for the different parts of the book are: Theory of Earth Pressure; Formulas for Earth Pressure; Stability of Trapezoidal Walls; Formulas for Trapezoidal and Triangular Walls; Foundations for Walls Retaining Earth; Examples; Foundations; Foundations Under Water and Deep Foundations; Tables; Appendices. Not the least valuable part of the volume are the appendices, which are devoted to the analysis and design of reinforced concrete retaining walls, and the profiles of gravity walls retaining earth. This little volume should be in the library of every engineer engaged in the design of walls or foundations, for the theory and practice is closelv and concisely presented.

Concrete in Cold Weather is the title of a new booklet published by the Universal Portland Cement Co., of Chicago and Pittsburg. The subject matter of this very seasonable book is the mixing, handling and depositing of concrete in freezing weather. The booklet is particularly valuable at this time by reason of the increased use of cement during the winter months and on account of the demand for rapid building construction.

The necessity of a work of this character has long been felt by architects and cement users generally. This is perhaps the first time that any thorough study of the subject has been published in pamphlet form. The booklet contains much matter of great practical value to persons interested in doing concrete work properly in the winter months. The booklet may be had, free of charge, upon request to either the Chicago, Pittsburg or Minneapolis office of the Universal Portland Cement Co.

Economies of Contracting. By Daniel J. Hauer. Published by E. H. Baumgartner, Chicago. Cloth; 269 pages; size 5½ x 8½ inches; illustrated; price $2.50.

The author of this book is the eastern editor of The Contractor. Mr. Hauer has had an engineering training as well as practical experience as a contractor. Therefore his ideas will be calculated to command respect. He holds that contracting is a profession, and as such, may be studied as any of the other professions are. The volume is addressed to students of the subject as well as to the older men, who may feel that some advance in efficiency may be made in this work. The book contains ten chapters. The first deals with contracting as a profession, stating the way in which one may go into the business: first preliminary study, then by joining a partnership or corporation or acting as a subcontractor. General legal considerations regarding contracts are stated, such as matters of payment, breach of contract and ownership of materials of construction. The second chapter states the various forms of contracts, unit price, lump sum, percentage, cost plus a fixed sum, etc. Considerations regarding proposals, bonds, arbitration and other features, are discussed in the third chapter. The formal proceedings which a contractor must go through from the making out of his bid to the receipt of his final payment make up the subject matter. The chapter on the business end of contracting endeavors to outline in a general way the methods by which contracts may be obtained. The reputation of the contractor, his financial standing, as prerequisites to the obtaining of work, are emphasized. The relations of the engineer and contractor are also discussed. The fifth chapter deals with the clerical end of contracting. Herein are matters that should interest the older contractor. The office work, organization, execution and financial department are discussed. The subject of daily and other reports of progress and cost keeping and cost data are gone into. Chapter six deals with the labor question, obtaining workmen, transporting men, the welfare of laborers, wages and efficiency. The seventh is an interesting chapter on construction camps, covering the subject from the selection of a site to the supply of drinking water and lights. Under the caption "Management of Men" are laid down certain rules of management, which, however, will still require the intangible elements of leadership. The ninth chapter, on contractors' outfit and plant, is a long one, and outlines the chief classes of items in a contractor's equipment. The tenth chapter is entitled a personal chapter for the contractor dealing with the prevention of accidents, etc. An addenda gives a talk on specifications, and useful books for the contractor. Altogether this is a most valuable book for the contractor and engineer.

Highway Engineering. By Arthur H. Blanchard, C.E., and Henry B. Drowne, C.E. Published by J. Wiley & Sons. Renouf & Company, Montreal, Canadian Agents. Pages 299; price $2.

The object of the authors in writing this book appears to be to render available to those interested in the progress of highway engineering the large mass of information relative to the construction and maintenance of roads and pavements which was presented by the various reporters and contributors at Brussels in 1910.

The authors, appreciating the valuable knowledge which may be acquired by a close observance of the practice of highway engineering in the various countries of the world and believing that it is possible in many cases to profit by the successes and failures of others who have worked in similar fields and thus avoid costly duplication of experimental work and the waste of public and private funds through the adoption of methods which have resulted in unsaisfactory roads and pavements, wish to emphasize the fact that the subject of foreign practice has not received the attention it deserves by American engineers.

The main part of the book is devoted to the presentation of the fundamental facts and salient opinions submitted to the Congress and the discussions at many sessions of the Congress which occupied over two hundred pages of the "Report of the Proceedings of the Congress," recently published by the Association. It should be borne in mind that the reporters selected by the Executive Committee were instructed to cover in their reports the progress in the particular field assigned relative to the practice of the countries which they represented. The conclusions which were finally adopted by the Congress were the outcome of thorough consideration and ofttimes strenuous debates by highway engineering experts from all parts of the world. It is self-evident that through the medium of an International Road Congress a very comprehensive review of foreign practice is presented.

The plan adopted in the compilation of the book has been to collate the material under headings familiar to American engineers. Discussions in every case follow the reporter's name, hence quotation marks were not used although in some cases the words of the reporters were employed, but generally the object of the authors was attained by presenting the important ideas of the reporters in

abstract. The discussions on a given topic relative to the practice in a given country have been congregated while the groups thus formed have been arranged in alphabetical order in each chapter.

Modern methods of road building are improving so quickly that a discussion such as took place at this congress must be of exceptional value to road builders and this volume is an added advantage, in that the material has been selected and arranged by a prominent highway engineer, a man who has a clear appreciation of all that is required.

Steam Power Plants. By Henry C. Meyer, jr., M.E.; third edition, revised and enlarged. Published by McGraw-Hill Book Company, New York; 6 x 9¼ in.; 219 pages, including index; 67 illustrations. Cloth; price $2.

The first edition of the book appeared in 1902, and shortly after the author began to practise as a consulting engineer for power-plant design. This revision therefore entails many changes and additions, including the experience gained in actual work. The chapter on turbines is new, and a great deal of new matter is added on the subject of steam piping, condensers and chimneys. A good deal of space is devoted to the structural parts of installations, such as foundation design of chimneys, design of boilers, etc.; and here it is noticed that the author quotes empirical rules and formulae without going into the mathematical derivations. When an engineer uses a formula he desires to know on what basis it is founded. However, by doing this the author has brought the book to a reasonable size, while at the same time covering the subject well. The book is closely written and will be found very valuable to the mechanical engineer interested in the design of steam power plants.

Roofs and Bridges, Part III, Bridge Design. Fifth edition. By Mansfield Merriman and Henry S. Jacoby. Published by John Wiley & Sons, New York. Renouf & Co., Montreal, Canadian Agents. 6 in. x 9 in.; 414 pages; 185 illustrations; cloth. Price $2.50.

The first edition of Merriman and Jacoby's text book on Roofs and Bridges was published in 1894, and the fact that it has been standard in many institutions during the intervening years is evidence of its value. It has been revised four times—in 1896, in 1898, in 1902, and in 1912. The changes in bridge design and construction during the past ten years have been very important and the present revision was made necessary in order to include practices which have become standard. The principal change in the new edition is the complete rewriting of the chapters on Fabrication and Erection, Highway Bridges, Railroad Riveted Bridges, and several other articles. The subject of erection is added in the first chapter mentioned, the matter being well covered by Warren B. Keim, assistant engineer of the Pennsylvania Steel Company. The chapter on highway bridges is entirely new, being written by F. O. Dufour, assistant professor of structural engineering, University of Illinois. While the new volume gives latest details of bridge practice, the matter is presented especially for students and young engineers, the experience of the authors qualifying them well for presenting the subject to this class of readers.

PUBLICATIONS RECEIVED.

Annual Report of the Smithsonian Institution, 1910. Showing the operations, expenditures and conditions of the Institution for the year ending June 30th, 1910.

Report on the Geology and Mineral Resources of the Chibougamau Region, Quebec. A report by the Chibougamau Mining Commission, composed of Mr. E. R. Faribault, Mr. J. C. Gwillim, Mr. Alfred E. Barlow, for the Department of Colonization, Mines and Fisheries, Mines Branch, of the Province of Quebec.

Annual Report of the Department of Railways and Canals of the Dominion of Canada, for the year ending March 31st, 1911.

Steamboat Inspection Report. Supplement to the 44th annual report of the Department of Marine and Fisheries for the year 1911.

The Road Material Resources of Minnesota. By George W. Cooley, Bulletin No. 40, of the Office of Public Roads, United States Department of Agriculture.

Report of the Director of the Office of Public Roads for 1911. By Logan Waller Page, Director, United States Department of Agriculture.

Wood Distillation, 1910. Bulletin No. 7, Forest Products, Department of Commerce and Labor, Bureau of the Census, United States.

The Annual Report of Water and Lighting Department, City of Harrisburg, Pa., for the year 1911, being the 24th annual report of the Board of Commissions.

Reports of the Harbor Commissioners for Montreal, Quebec, etc. Supplement to the 44th Annual Report of the Department of Marine and Fisheries for the calendar year ending 31st of December, 1910.

Report of the Board of Governors of the University of Toronto, for the year ending 30th of June, 1911.

Railway Statistics of the Dominion of Canada for the year ending June 30th, 1911, compiled by A. W. Campbell, Deputy Minister of the Department of Railways and Canals.

New Hampshire Highways. Bulletin No. 42, Office of Public Roads, United States Department of Agriculture. A report of an inspection of Highways in the State of New Hampshire, August, 1911, by Charles H. Holt, superintendent of construction.

Technological Papers of the Bureau of Standards, United States. No. 5, the effect of high pressure of steam on the pressing strength of Portland cement mortar and concrete, issued by the Department of Commerce and Labor, United States.

Proceedings of the Fourth Annual Convention of the Indiana Sanitary and Water Supply Association, held at Indianapolis, February 9-10, 1911.

Directory of Portland Cement Manufacturers, 1912. Compiled and published by The Cement Era, 1207 Morton Building, Chicago. Price $1.

CATALOGUES RECEIVED.

Excavators. The F. C. Austin Drainage Excavating Company, Railway Exchange Building, Chicago, Ill., manufacturers of irrigation and drainage excavating machinery, forward catalogue showing different machines in operation.

The Tromanhauser System of Sub-Aqueuous Concrete Construction. By J. H. Tromanhauser, engineer and contractor, Temple Building, Toronto, describes his patented method of floating pontoon system of concrete construction in a pamphlet printed by the Canadian Engineer Press.

Compressors, Air and Gas. Catalogue issued by the Canadian Rand Company, Ltd., Montreal, Canada, describing their different types of compressors.

Ignition Appliances and Auto Accessories. Supply catalogue issued by the Canadian General Electric Company, Ltd., Toronto, Canada.

Steam Tables for Condenser Work. Issued by The Wheeler Condenser and Engineering Company, of Carteret, N.J.

Pneumatic Tools. A series of pamphlets issued by the Chicago Pneumatic Tool Company, of Chicago, describing their different types of pneumatic tools, air compressors, hoists, electrical drills, etc.

The Best Manufacturing Company, Pitttsburg, Pa., forward catalogue and hand-book of piping materials for steam, air, hydraulic, high-pressure piping systems.

Expanded Metal Constructiotn. Pamphlet No. 1, issued by the Northwestern Expanded Metal Company, Chicago, Ill.

Intermittent Flush Tanks. Pamphlet issued by the Pacific Flush Tank Company, Chicago and New York, describing their automotic, intermittent flush tank syphons.

Corrugated Bar Company, Buffalo, forward pamphlets describing the different materials fabricated by them and giving data useful in design.

Ferro Engines. Published by the Ferro Machine and Foundry Company, Cleveland, O.

Engineers' and Surveyors' Instruments. Catalogue L 112, of E. R. Watts & Sons, Ottawa and Winnipeg. Catalogue of engineers, surveyors, architects and draughtsmen's instruments and supplies.

Catalogue No. 50, The H. Shannon Company, Chicago, machinery and general supplies.

Description Leaflet No. 2298 of The Westinghouse Electric and Manufacturing Company, describing its well-known type CCL Inductor Motor.

Leaflet No. 2330 of the Westinghouse Electric and Manufacturing Company, covering a direct-current (type JL) vertical edgewise switchboard ammeter operating on the D'Arsonval principle with a single air-gap.

NATIONAL ASSOCIATION OF CEMENT USERS.

Eighth Annual Convention.

On March 11-16, 1912, the association will meet in its eighth annual convention, at Kansas City, Mo. The first Kansas City Cement Show will be held March 14-21, under the auspices of the Cement Products Exhibition Company.

The headquarters and convention will be at the Hotel Baltimore, where each member must go to register and secure information on all matters pertaining to the convention and Cement Show.

Tentative Program.—Monday, March 11.

10.30 a.m.—Meeting of the Executive Board, Hotel Baltimore.

2.00 p.m.—Meeting of Sectional Committees on: Building Blocks and Cement Products; Exhibition; Fireproofing; Insurance; Measuring Concrete; Nomenclature; Reinforced Concrete and Building Laws; Roadways, Sidewalks, and Floors; Specifications and Methods of Tests for Concrete Materials; Treatment of Concrete Surfaces; Education.

8.00 p.m.—Formal opening of the convention, Hotel Baltimore. Address of welcome to Kansas City. Response by the president, Richard L. Humphrey, consulting engineer, Philadelphia, Pa. Address. Address. Business session. Reinforced Concrete Water Purification Works, Dr. Walter M. Cross, city chemist, Kansas City, Mo.

Tuesday, March 12.

9.00 a.m.—Meeting of the Sections on Measuring Concrete, Nomenclature, and Specifications and Methods of Tests for Concrete Materials. Topical discussion on Methods of Measuring Concrete Construction, and on Materials Used for Concrete.

10.30 a.m.—Report of the Committee on Measuring Concrete, Robert A. Cummings, chairman. Report of the Committee on Nomenclature, Peter Gillespie, chairman. Report of Committee on Specifications and Methods of Tests for Concrete Materials, Sanford E. Thompson, chairman. Discussion on Aggregates for Concrete, Wm. M. Kinney, assistant inspecting engineer, Universal Portland Cement Co., Pittsburg, Pa. Discussion on the Use of Calcium Chloride as a Preventive of the Freezing of Concrete, Richard K. Meade, chief engineer, Tidewater Portland Cement Company, Baltimore, Md. Report of the Committee on Fireproofing, Rudolph P. Miller, chairman.

8.00 p.m.—Annual address by the president, Richard L. Humphrey, consulting engineer, Philadelphia, Pa., Construction of the Hollow Reinforced Concrete Dam of the Portland Railway Light and Power Company, Robert S. Edwards, consulting engineer, Portland, Oregon. Discussion of the Advantages and Comparative Cost of the Hollow Concrete Dam, W. L. Church, president, Ambursen Hydraulic Construction Company, Boston, Mass. The Design and Construction of the Keokuk Dam, Hugh L. Cooper, chief engineer, Mississippi River Power Company, Keokuk, Iowa. Report of the Committee on Insurance, W. H. Ham, chairman. Report of the Committee on Treatment of Concrete Surfaces, L. C. Wason, chairman.

Wednesday, March 13.

9.00 a.m.—Meeting of the Section on Reinforced Concrete and Building Laws. General discussion on Design, Methods of Construction, etc.

10.30 a.m.—Report of the Committee on Reinforced Concrete and Building Laws, A. E. Lindau, chairman. The Design of Concrete Flat Slabs, F. J. Trelease, Engineer, Corrugated Bar Company, Buffalo, N.Y. Business session: Report of the Executive Board; election of officers; place of next convention.

3.00 p.m.—The Control Beam as a Field Test for Concrete, Fritz E. von Emperger, consulting engineer, Vienna, Austria. Notes on the Deformation in the Webs of Rectangular Concrete Beams, H. C. Berry, assistant professor of materials of construction, University of Pennsylvania, Philadelphia, Pa. Continuous Concrete Beams, Dr. E. Probst, consulting engineer, professor, Royal Technical High School, Berlin. The Construction of the Fireproof Type of School House with Separately Molded Members, Theodore H. Skinner, architect, Oneida Community, Ltd., Oneida, N.Y. Unit Cost of Reinforced Concrete for Industrial Buildings, F. W. Reynolds, Lockwood, Greene and Company, Boston, Mass.

8.00 p.m.—Methods of Construction Used in the Arbuckle Building, Brooklyn, R. C. Wilson, assistant engineer, Turner Construction Company, New York, N.Y. The Design and Construction of a Reinforced Concrete Dome, 220-foot span, Dr. S. J. Trauer, chief engineer, Breslau, Germany. The Design of Reinforced Concrete Domes, H. Brussel, president, Reinforced Concrete Company, St. Louis, Mo. The Design of Concrete Grain Elevators, E. Lee Heidenreich, consulting engineer, Kansas City, Mo. The Construction of Concrete Grain Elevators, John S. Metcalf, consulting engineer, Chicago, Ill. Reinforced Concrete Grain Elevators and Silos, M. S. Ketchum, consulting engineer, Boulder, Col. The Use of Concrete in the Fourth Avenue Subway, Brooklyn, Frederick C. Noble, division engineer, Public Service Commission, Brooklyn, N.Y.

Thursday, March 14.

9.00 a.m.—Meeting of Section on Treatment of Concrete Surfaces. Topical discussion on the Artistic Treatment of Concrete Surfaces.

10.30 a.m.—Concrete Highway Bridges, Walter Scott Gearhart, State Highway Engineer, Extension Department, Agricultural College, Manhattan, Kansas. The Dallas Oak Cliffe Viaduct, Ira G. Hedrick, consulting engineer, Kansas City, Mo. Flat Slab Bridges, W. H. Finley, assistant chief engineer, Chicago and Northwestern Railroad, Chicago, Ill. The Use of Cement for Protecting the Steel Pipes Along the New York Aqueduct, Alfred D. Flinn, department engineer, Board of Water Supply, New York, N.Y.

8.00 p.m.—The Necessity for Good Roads, Logan Waller Page, director, Office of Public Roads, president, American Good Roads Association, Washington, D.C. Cement Paving as Constructed at Mason City, Iowa, F. P. Wilson, city engineer, Mason City, Iowa. An Improved Concrete Pavement, E. W. Groves, city engineer, Ann Arbor, Mich. Concrete and Highway Construction. Report of Committee on Roadways, Sidewalks and Floors, C. W. Boynton, chairman. Report of Committee on Education, Logan Waller Page, chairman.

Friday, March 15.

9.00 a.m.—Meeting of the Section on Roadways, Sidewalks and Floors. Topical discussion covering the Preparation of Materials, Laying, Finishing, Costs.

10.30 a.m.—Report of Committee on Building Blocks and Cement Products, P. S. Hudson, chairman. Advantages and Durability of Cement Sewer Pipe, Gustave Kaufman, engineer, The Wilson and Baillie Manufacturing Company, Brooklyn, N.Y. Cement Drain Tile, A. Marsten, Dean School of Engineering, Iowa State College, Ames, Iowa. The Manufacture and Use of Cement Drain Tile, Charles T. Sims, Worthington, Minn. Methods of Testing Cement Pipe, Duff A. Abrams, assistant professor, University of Illinois, Urbana, Ill.

8.00 p.m.—Reception and banquet, Hotel Baltimore.

Saturday, March 16.

9.00 a.m.—Meeting of the Section on Building Blocks and Cement Products. Topical discussion on the Manufacture, Curing, Cost, etc., of Cement Products.

10.30 a.m.—Concrete Fence Posts, W. J. Towne, engineer of maintenance, Chicago and Northwestern Railroad, Chicago, Ill. Some Notes on the Value and Comparative Cost of Reinforced Concrete Telegraph Poles, George Gibbs, chief engineer of construction, Pennsylvania Railroad, New York, N.Y. Concrete Piles and Harbor Work, Dmitri Alexeev, engineer, Russian Northern Railway, Moscow, Russia. Reinforced Concrete Piles, Robert A. Cummings, consulting engineer, Pittsburg, Pa. The Concrete Block Industry in Russia, Alexander Zuberbuhler, engineer, Moscow, Russia. Modern Methods of Manufacturing Concrete Products, Robert F. Havlik, engineer, Ideal Concrete Machinery Company, South Bend, Ind.

8.00 p.m.—The Use of Concrete in Irrigation Work, F. H. Newell, chief director, U.S. Reclamation Service, Washington, D.C. Reinforced Concrete in Agriculture, W. A. Collings, engineer, Builders' Material Supply Company, Kansas City, Mo. The Handling of Concrete in the Construction of the Panama Canal, S. B. Williamson, engineer, Pacific Division, Panama. Iron Portland Cement.

ENGINEERING NOTES.

Guelph, Ont.—Messrs. McArthur Bros., of New York, U.S.A., are contemplating the building of the Hamilton, Waterloo and Guelph Railway. They are waiting on certain engineering reports now being prepared.

Lethbridge, Alta.—The M. Rumley Co., of La Porte, Ind., will donate a 30 horse-power oil traction engine to the farmer exhibiting the best bushel of hard wheat at the Dry-Farmed Exhibition to be held at this point on October 21-26 next. The contest is open to farmers of every land.

Halifax, N.S.—Negotiations now in progress between the government and certain Canadian and English transportation companies operating trans-Atlantic steamship lines will result, if successful, in the establishment of a new fast service between Canada and England The proposal will make Halifax the Canadian terminal.

Glasgow, Scotland.—The street railway systems of the cities of Glasgow and Leeds are the two most successful municipally owned street railways in the old country, if not in the world. In each case the railway is the owner of its own power stations, distinct from whatever other electrical plants the city may own, and they manufacture only their own energy, no power being taken from them for any other purpose.

Vancouver, B.C.—In order to stimulate interest in good roads throughout Canada, W. J. Kerr, president of the Canadian Highway Association, is offering three medals for the best essay on "What Good Roads Mean to Canada." The competition for these medals is to be confined to boys and girls under 18 years of age, and no distinction is to be made between the sexes. Women have long since taken a place in literature equal to that occupied by men, Mr. Kerr believes, and a contest in which girls will compete against boys will be more interesting to all concerned than one in which separate prizes are given. The competition will be open to students in all parts of Canada, and there will be no hard and fast rules as to the length of the essay submitted, although articles of 800 to 1,000 words will be preferred. All essays must be in the hands of the secretary, P. W. Luce, 614 Columbia Street, New Westminster, B.C., on or before May 1st, 1912.

Magdalene Islands, Eastern Canada.—These islands, which lie directly south-east of the Gaspe peninsula, in the Gulf of St. Lawrence, and which in the past have been cut off from communication with the outside world during the winter months by the ice fields which bridge them from the main land, for a distance of more than 100 miles, will in the future be provided with a weekly news letter by wireless. For the sum of $450 the government has arranged with the Marconi Wireless Company whereby a wireless message of 1,000 words will be sent to the islands every Saturday evening, containing in brief the most important happenings of the world. Upon reaching the islands this news will be sent to the various clergymen, and will be read from the pulpits of the churches on Sunday.

PERSONAL.

Mr. Thomas H. Mawson has been appointed by the city of Vancouver to lay out Stanley Park, 900 acres in extent. Mr. Mawson is an English landscape artist.

Mr. Clifford Richardson, M.Am.Soc.C.E., Consulting Engineer, New York City, on February 16th, delivered a lecture on "Trinidad and Bermudez Asphalts and Their Use in Highway Construction," before the Graduate Students in Highway Engineering at Columbia University.

Mr. E. C. Hewson has been appointed to the position of resident engineer for the Grand Trunk Railway at Toronto. Mr. Hewson has been Mr. Power's assistant for nearly three years, and, before entering the service of the G.T.R. was engaged on various engineering works for the Dominion Government.

OBITUARY.

Francis H. Stillman, president of the Watson-Stillman Company, and a prominent figure in machine tool and engineering industries, died at his residence, 105 Rodney Street, Brooklyn, N.Y., in his sixty-second year.

MEETINGS.

Mr. H. H. Hagerman addressed the Engineering Society of the University of New Brunswick, on the "Bacteria and Their Relation to Water."

ONTARIO LAND SURVEYORS' RESULTS.

The following have been granted certificates as Ontario land surveyors by the Board of Examiners: Messrs. W. L. Malcolm, W. A. Sibbett, F. V. Siebert, W. C. Webster, W. J. Baird, G. Hogarth, J. M. McGregor, O. R. Blandy, F. C. Lane, R. M. Gourlay, M. C. Lloyd, W. S. Earle, M. M. Gibson, J. C. Street.

The following passed the preliminary examination: Messrs. V. H. Ramsden, A. L. Stanley Nash, C. J. Manser, N. J. Goebel, R. O. Sturdy.

COMING MEETINGS.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS — Toronto Section. Regular Meeting will be held at Engineers' Club, 96 King Street West, on Friday evening, March 1st, 1912, at 8 p.m. Illustrated paper on "The Shawinigan Water and Power Co.'s New Power House and 110,000 Volt Transmission to Montreal," by Mr. Julian C. Smith, Chief Engineer of the Shawinigan Water and Power Co. Secretary, Valentine Boyd.

THE CANADIAN MINING INSTITUTE.—Annual Meeting held in Toronto, March 6th, 7th, and 8th, 1912, the American Institute of Mining Engineers co-operating; also important delegates of the Institute of Mining and Metallurgy of Great Britain will be present. Secretary, H. Mortimer-Lamb.

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

ASSOCIATION OF ONTARIO LAND SURVEYORS.—Annual Meeting to be held in Lecture Room, Engineers' Club, 96 King Street West, Toronto, on Feb. 27, 28 and 29. Secretary, Killaly Gamble, 703 Temple Bldg., Toronto

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,

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

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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.

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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.

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

CONSTRUCTION NEWS SECTION

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

PLANS AND SPECIFICATIONS ON FILE.

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

Bids close		Noted in issue of
2-26	75,000 gallon water tank, Moose Jaw, Sask..(S.)	2- 8
3- 8	Water Tube Boilers; Automatic Stokers; Turbines; Saskatoon, Sask. .....(S.)	2-15
3-18	Concrete reservoir (2,000,000 gallons' capacity), Moose Jaw, Sask.....(P. & S.)	2-22
3-18	Centrifugal pumps, motors, etc., Moose Jaw, Sask. .....(P. & S.)	2-22
3-18	Valves and Fittings, Moose Jaw, Sask. .....(P. & S.)	2-22
3-18	96,000 ft. of 18-in. Steel Pipe, Moose Jaw, Sask. .....(S.)	2-22
3-15	Pavements, Welland, Ont. .....(P. & S.)	2-29

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.
Brantford, Ont., sewer pipe	Feb. 29.	Feb. 22.	72
Calgary, Alta., designs for aqueduct	May 1.	Feb. 22.	70
Calgary, Alta., electric machinery	Mar. 20.	Feb. 8.	68
Calgary, Alta., sluice gates....	Feb. 29.	Feb. 1.	68
Edmonds, B.C., steel pipes.....	Mar. 11.	Feb. 8.	68
Edmonton, Alta., steel highway Bridges	Mar. 15.	Feb. 22.	59
Edmonton, Alta., office building for C.P.R.	Mar. 1.	Feb. 22.	60
Hamilton, Ont., waterworks extensions	Feb. 28.	Feb. 15.	68
Keremos, B.C., quarantine station	Mar. 1.	Feb. 8.	59
Kingston, Ont., dormitory, R.M.C.	Mar. 6.	Feb. 22.	59
Milton, Ont., concrete arch and viaduct	Mar. 4.	Feb. 15.	70
Moose Jaw, Sask., reservoir ...	Mar. 18.	Feb. 22.	66
Moose Jaw, Sask., pumps, motors, etc.	Mar. 18.	Feb. 22.	66
Moose Jaw, Sask., valves and fittings	Mar. 18.	Feb. 22.	66
Moose Jaw, Sask., laying steel water pipe	Mar. 18.	Feb. 22.	66
New Westminster, B.C., dams and excavation work	Mar. 10.	Feb. 15.	59
Ottawa, Ont., steel hopper scows.	Mar. 11.	Feb. 22.	59
Saskatoon, Sask., waterworks materials	Mar. 1.	Feb. 15.	68
Saskatoon, Sask., electrical machinery	Mar. 8.	Feb. 15.	68
Sault Ste. Marie, Ont., approach to wharf	Feb. 28.	Feb. 15.	59
Swan River, Man., schoolhouse.	Feb. 29.	Feb. 15.	60
St. Andrew's, N.B., school house.	Mar. 11,	Feb. 22.	60
St. Catharines, Ont., church ..	Mar. 12.	Feb. 22.	60
St. Catharines, Ont., crushed stone	Feb. 28.	Feb. 22.	70
Toronto, Ont., bridges	Mar. 2.	Feb. 1.	59
Toronto, Ont., sewer, Toronto Junction	Feb. 27.	Feb. 8.	68
Toronto, Ont., annual supply of asphalt	Feb. 27.	Feb. 15.	70
Toronto, Ont., Coxwell Ave. subway	Mar. 7.	Feb. 15.	70
Toronto, Ont., Barton Ave., sewer	Mar. 12.	Feb. 22.	72
Vernon, B.C., vitrified pipe sewers	Mar. 11.	Feb. 22.	60
Victoria, B.C., St. John's Church edifice	Mar. 5.	Feb. 15.	60
Westmount, Que., sewer, paving.	Mar. 11.	Feb. 22.	70
Winnipeg, Man., gate valves ..	Mar. 7.	Feb. 22.	60
White Rock, B.C., quarantine station	Mar. 15.	Feb. 15.	59
Winnipeg, Man., drawings for Parliament Buildings	Mar. 31.	Jan. 25.	70
Winnipeg, Man., pumping machinery	Mar. 1.	Jan. 25.	72
Winnipeg, Man., steam shovel equipment	Mar. 1.	Feb. 15.	60
Winnipeg, Man., cables	Mar. 25.	Feb. 15.	60
Winnipeg, Man., waterworks materials	Mar. 1.	Feb. 15.	60

TENDERS.

Calgary, Alta.—The time for receiving tenders for electrical machinery has been extended to March 20th, 1912. J. M. Miller, City Clerk, Calgary. (See advertisement in Canadian Engineer).

Calgary, Alta.—Tenders will be received up to noon, March 6th, 1912, for the construction of various municipal works, such as concrete sidewalks, asphalt, bitulithics and block pavements, specifications of which may be obtained at the office of the City Commissioners or City Engineer, City Hall, Calgary. J. M. Miller, City Clerk.

Calgary, Alta.—The Calgary College will erect an Arts Building, costing about $500,000, and the Building Committee invites sketch plans. Full particulars, W. J. Tregillus, secretary, Calgary, Alta.

Calgary, Alta.—Tenders will be received by the Commissioners of the city of Calgary for one boiler feed pump and switchboards for the city of Calgary municipal electric light and power plant, until noon, March 15th, 1912. Specifications can be secured by application at the office of the city commissioners. J. M. Miller, City Clerk, Calgary.

Calgary, Alta.—Tenders will be received until March 14, 1912, for the supplying the city with sewer and conduit pipe, to be delivered at the city yards in carload lots as may be required. Specifications may be secured upon application at the office of the city engineer. J. M. Miller, City Clerk, Calgary.

Fort William, Ont.—Tenders will be received at the office of the City Clerk, until the 7th day of March, 1912, for the laying of an eighteen (18) cast iron main and the construction of a concrete culvert. Plans, etc., at the office of John Wilson, City Engineer.

Fredericton, N.B.—Tenders are being called for the construction of the concrete substructure and approaches of the Heine bridge, over Millstream, King's County; the Murchie bridge, over the Madawaska River, at Edmundston, and the Bocaguimac Mouth bridge, at Hartland. The plans and specifications can be seen at the office of Public Works Department, and tenders for the work will be received until April 1st.

High River, Alta.—Tenders will be received at the office of the Secretary of the High River school district No. 144, until March 15th, 1912, for the erection and completion of a four-roomed brick schoolhouse. Plans and specifications at office of Norman Young, Secretary, High River.

High River, Alta.—Tenders will be received until March 15th, 1912, for the heating, ventilating and plumbing of a four-roomed brick schoolhouse, as per plans and specifications on file at office of the Secretary, Norman Young, High River, Alta.

North Battleford, Sask.—Plans and specifications will be received for the erection of a Collegiate Institute in the town of North Battleford, Sask. The building to be erected is to cost from $50,000 to $80,000 complete, designs to be in the hands of the secretary by the 1st of March, 1912, or as soon after as possible. Hugh Moher, secretary-treasurer, North Battleford High School District, No. 12.

Oshawa, Ont.—Tenders will be received until March 11th, 1912, for the construction of a brick or asphalt block pavement, on a concrete base, together with a cement concrete curb and gutter, approximately 25,000 sq. yards. Plans and specifications obtained at the office of Frank Chappell, Town Engineer, Town Hall, Oshawa. (See advertisement in Canadian Engineer).

Ottawa, Ont.—Tenders will be received until the 15th of March, 1912, for the erection of a new brick veneer presbytery at South Gloucester. For plans and specifications apply to Rev. Geo. Prudhomme, South Gloucester, Ont.

Ottawa, Ont.—Tenders will be received until March 6th, 1912, for the supply of coal and fuel wood required to heat the Military Buildings at Halifax, Canning, N.S.; Fredericton, Woodstock, Sussex, Chatham, St. John, N.B.; Charlottetown, P.E.I.; for the year ending March 31st, 1913. Eugene Fiset, Col. Deputy-Minister of Militia and Defence, Ottawa.

Ottawa, Ont.—Tenders will be received until March 11, 1912, for the construction of two 150 cubic yards capacity steel hopper scows. R. C. Desrochers, Secretary, Dept. of Public Works, Ottawa. (See advt. in Can. Eng.)

Ottawa, Ont.—Tenders for the construction of a breakwater at Green Point, Gloucester County, N.B., will be received until March 18, 1912. Plans, etc., can be seen at the offices of Geoffrey Stead, Esq., Dist. Engineer, Chatham, N.B.; E. T. P. Shewen, Esq., Dist. Engineer, St. John, N.B.; on application to the Postmaster at Green Point, Gloucester County, N.B., and the office of R. C. Desrochers, Secretary Dept. of Public Works, Ottawa.

Prince Albert, Sask.—Tenders will be received until Friday, March 15th, 1912, for the supplying of sewer pipe required by the city during the year 1912. C. O. Davidson, Sec.-Treas., Prince Albert, Sask. (See advt. in Can. Eng.)

Prince Albert, Sask.—Tenders will be received by the City Commissioners, until March 8th, 1912, for the supplying of cast-iron water pipe required by the city during the year 1912. C. O. Davidson, secretary-treasurer, Prince Albert. (See advertisement in Canadian Engineer).

Regina, Sask.—Tenders will be received up to noon, March 4th, at the offices of F. Chapman Clemesha, architect, Regina, for the erection of a brick Presbyterian church at Swift Current, Sask.

Saskatoon, Sask.—Tenders for the supplying of approximately 5,000 barrels of Portland Cement will be received until Friday, March 15th, 1912. All information obtained on application to Geo. T. Clark, City Engineer, Saskatoon. (See advertisement in Canadian Engineer).

Saskatoon, Sask.—The time for receiving tenders for electrical machinery has been extended to March 22nd, 1912. City Commissioners, Saskatoon, Sask. (See advertisement in Canadian Engineer).

Saskatoon, Sask.—Tenders will be received until March 8th, 1912, for all trades required for the completion of the superstructure of the Y.M.C.A. Building, Saskatoon. Plumbing and heating to be separate, and will be received at the same time. Plans and specifications may be seen at the office of D. W. F. Nichols, Winnipeg, Thompson, Daniel & Colthurst, Associate Architects, Saskatoon.

Saskatoon, Sask.—Tenders will be received until March 29th, 1912, for the laying of approximately 8,990 lineal feet of storm sewers, and the construction of manholes, catch basins and appurtenances. All information may be obtained from Geo. T. Clark, City Engineer, Saskatoon. (See advt. in Canadian Engineer).

Saskatoon, Sask.—Tenders will be received by the City Commissioners until March 29th, 1912, for the laying of approximately 13 miles of sanitary sewer and water mains, and the construction of all necessary manholes and flush-tanks, setting of fire hydrants and gate valves, etc., as shown on plans and profiles, and according to specifications. Further information may be obtained at the office of Geo. T. Clark, City Engineer. (See advt. in Canadian Engineer).

Sydney Mines, C.B.—Tenders will be received until March 2nd, for the erection and completion of an annex to "Harbor View Hospital," Sydney Mines. Plans and specifications can be seen at the general office of the N.S.S. & C. Co., and at the Town Engineer's office, Sydney Mines. Edmund MacDonald, Secretary to Trustees, Harbor View Hospital, Sydney Mines, C.B.

Toronto, Ont.—Tenders will be received by the chairman of the Board of Control until March 19, 1912, for the supply of rails, ties and fastenings, specifications and forms of tender of which may be obtained on application to the Dept. of Railways and Bridges, City Engineer's Office, Toronto. (See advt. in Can. Eng.)

Toronto, Ont.—Tenders for the construction of the proposed branch of the Temiskaming Railway into the Elk Lake region, will be called for shortly.

Vancouver, B.C.—Tenders will be received for the supply of hydrants and water pipe, for the proposed extensions to the water works distribution system, during the current year. Tenders for hydrants will be received up to Wednesday, March 6th, 1912, and tenders for pipe will be received up to Wednesday, March 20th, 1912. Specifications may be seen at the City Engineer's Office, City Hall. Wm. McQueen, City Clerk, City Hall, Vancouver, B.C.

Welland, Ont.—Tenders are invited for the construction of approximately 37,000 square yards of pavement, in vitrified brick, bitulithic, asphalt block, or granitoid. Plans, etc., on file at the office of The Canadian Engineer, 62 Church Street, Toronto, or at the Town Engineer's office, Welland. (See advertisement in Canadian Engineer).

CONTRACTS AWARDED.

Calgary, Alta.—The contract for the building of the new Knox Presbyterian church is in the hands of Messrs. Fysche, Martin Co., Ltd. The contract, exclusive of value of lots, excavation, organ, pews or furnishings, will be $183,000.

Calgary, Alta.—Messrs. P. Lyall & Sons Construction Company, of Montreal, have secured the contract for the new big C.P.R. hotel here.

Calgary, Alta.—The Westinghouse Church, Keer & Company, of Pittsburg, Pa., will build for the Canadian Pacific Railway Company, additional railway shops at a cost of $2,750,000. Construction will start shortly. Contract includes the design and construction of locomotive, machine, boiler, blacksmith, pattern, coach and freight car repair and paint shops, foundry, planing mill, power house, dry kiln, scrap docks, material bins, store room and office buildings. In general the construction will be of concrete, steel, brick or hollow tile.

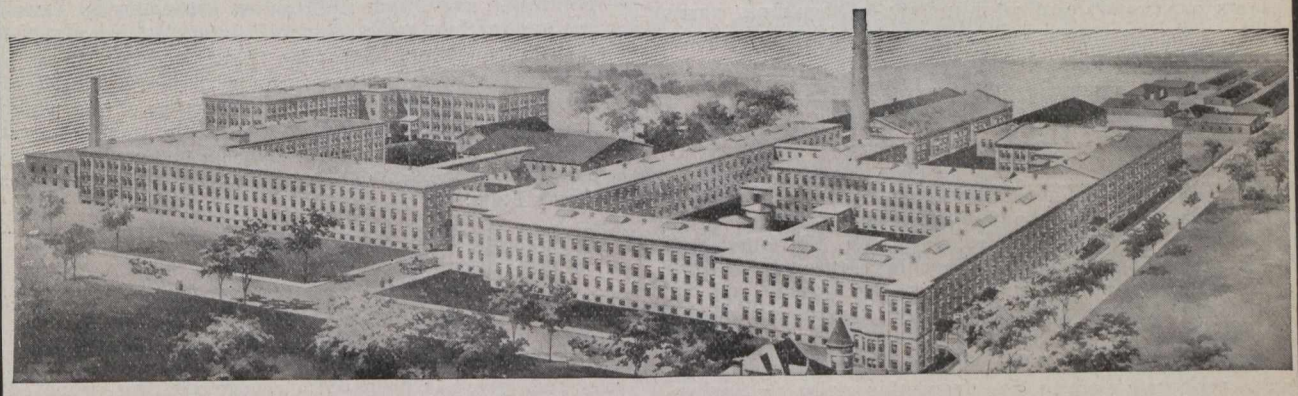
Hamilton, Ont.—The Hamilton Bridge Works, Hamilton, Ont., have awarded the contract for two overhead traveling cranes of 30 tons lifting capacity and approximately 60 ft. span, and for two overhead traveling cranes of 10 tons lifting capacity and approximately 90 ft. span, to Messrs. Royce, Limited, of Manchester, England. Mr. C. S. Mallett, of 207 Lumsden Building, Toronto, the Canadian manager for Messrs. Royce, Limited, also announces the award to his company of a contract for supplying the Jenckes Machine Company with an overhead traveling crane of 5 tons lifting capacity and 41 ft. span, for the Sherbrooke shops; and an overhead traveling crane of 10 tons lifting capacity and 48 ft. span, for the St. Catharines, Ont., shops.

Montreal.—The Foundation Company, Limited, of Montreal and Winnipeg, have been awarded the contract for the new substructure in connection with the double-tracking of the C.P.R. Red River bridge at Winnipeg. The work consists of five river piers and two abutments.

Moose Jaw, Sask.—The contract for the erection of the Boys' College building and the principal's residence in connection with Saskatchewan College, in this city, has been awarded to Claydon Bros., of Winnipeg, Man.

North Burnaby, B.C.—Messrs. Mussens, Ltd., have received the contract to supply a rock crushing plant at a cost of $2,568.20. It is being ordered by the council of Edmonds, Burnaby.

Barrett Specification Roofs



Warner Bros. Co., Corset Manufacturers, Bridgeport, Conn. Day & Zimmerman, Engineers, Philadelphia, Pa.

The Most Economical Roof

FOR half a century architects have known that slag and gravel roofs would *often* show marvelous durability.

The Barrett Specification defines the method by which these roofs may be built so that they will *always* show such durability.

It provides for the best materials manufactured, and prescribes the most approved methods of application.

A Barrett Specification Roof will cost less than any other permanent roof, will last upwards of twenty years and will need no painting or coating or care. Such roofs are fire-retardant and take the base rate of insurance.

That is why they are invariably used on large manufacturing plants where the roof areas are great and where, therefore, the unit costs are carefully studied.

Booklet giving the Barrett Specification in full mailed free on request. Address nearest office.

Special Note

We advise incorporating in plans the full wording of The Barrett Specification, in order to avoid any misunderstanding.

If an abbreviated form is desired however the following is suggested:

ROOFING—Shall be a Barrett Specification Roof laid as directed in printed Specification, revised August 15th, 1911, using the materials specified, and subject to the inspection requirement.

The Paterson Manufacturing Co., Limited

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

Saskatoon, Sask.—The Bithulithic Paving Company have been awarded the contract for 63,000 square yards of the 125,000 sq. yards of paving to be done this season. The tender of this company was for $2.95 per square yard.

Seven Falls, P.Q.—The Ambursen Hydraulic Company of Montreal, have been awarded the contract for the construction of a 10,000 horse-power development on the St. Anne River.

Suffield, Alta. — J. G. Hargrave & Company, Ltd., of Winnipeg, have received a contract from the C.P.R. for earthwork and embankments on the new branch from Suffield, Alta., from the main line in a south-westerly direction. The work will be started in April after the completion of similar work at Bassano.

Victoria, B.C.—Messrs. Moore & Whittington, builders and contractors, are building a three-story, brick apartment house at the junction of Fort and Pandora Streets. The expenditure contemplated is $25,000.

Vancouver, B.C.—A contract to the value of about $200,000 was awarded to the B.C. Equipment Company, of Vancouver, for combined gravel washing and rock crushing plants at Cragilacchie, Trail Creek and Old Man Creek. Each of these plants are capable of washing out a thousand yards daily. The gravel will be used for concrete culverts and the rock for ballast.

RAILWAYS—STEAM AND ELECTRIC.

British Columbia.—The promoters of the British Columbia and Alaska Railway announce their intention of renewing work in the spring of 1912. Mr. E. C. Harris, of New York, the new president of the company, was for some time assistant engineer of the Chicago, Milwaukee and St. Paul, and later having served as general manager of the Santa Fe road.

Fredericton, N.B.—Mr. Frank de L. Clements is interested in a proposed electric line from this point to Springhill, a distance of five miles. The proposition is to purchase a storage battery car and secure running rights over the St. John Valley Railway rails, giving a service at regular intervals throughout the day. A car such as proposed would cost about $12,000, and it is expected to have the service in operation by some time next summer.

Halifax, N.S.—Mr. C. C. Longard has prepared a sketch showing proposed improvements to the railway station in this city.

North Toronto, Ont.—A proposed electric line, known as the Forest Hill Electric Railway Company, contemplate building a line in these parts.

Ottawa, Ont.—City Engineer, Mr. N. J. Ker, has prepared plans for an extension of the street railway lines. The extension will total six and a half miles.

Prince Edward Island.—The Federal Government contemplate spending $450,000 on a car ferry, $400,000 on increasing the gauge of the P.E.I. Railway, and $490,000 on the construction of a third rail. This work is all for the benefit of the P.E.I. Railway.

Province of Saskatchewan.—The Grand Trunk Pacific Railway contemplate opening forty-seven new towns. A contract has been awarded to a Minnesota firm to construct twenty-five general stores throughout these towns.

Vancouver, B.C.—The work of filling in the Great Northern Railways right-of-way on False Creek is to be started in the course of the next few weeks. Three or four million yards of earth will be required.

Vernon, B.C. — A Canadian Northern Railway survey party of 12 men in charge of A. E. Ashcroft, C.E., will begin work on the location of the proposed branch line from Vernon to Kamloops. At the latter point connection will be made with the company's main line. The distance between Vernon and Kamloops is about eighty miles, and it is expected that an easy grade will be secured although there will be a short stretch of heavy work at the summit.

COPY OF ENGINEER WANTED.

A copy of our issue of August 10, 1911, is required. Parties sending in the same will have the expiration date of their subscription advanced one month.

LIGHT, HEAT AND POWER.

Acton, Ont.—The ratepayers voted in favor of adopting the hydro-electric policy and to issue debentures for $8,500 to equip the municipal line for hydro-power. A. J. Mackinnon, Town Clerk.

Brantford, Ont.—Certain improvements being made to the plant of the Waterous Engine Works will necessitate a new power plant installation.

Fredericton, N.B.—A survey of the Boccaguimaca stream has been made for power purposes.

Niagara Falls, Ont.—A report indicates that extensive additions to the plant of the Electrical Development Company will be made. The powerhouse is to be extended to the south, the addition to be erected costing over $200,000. Four more power units are to be installed, increasing the power development from 80,000 to 120,000 horsepower, and the transmission line to Toronto will likely be duplicated. Altogether a sum of about $1,000,000 will be spent by the company on the contemplated improvements.

Porcupine, Ont. — The management of the McIntyre, Hollinger and Dome mines are preparing to install electric motors in their mills.

Smith's Falls, Ont.—Mr. Acres and Mr. Gates have been in Smith's Falls in connection with the Hydro-Electric Commission, to make a thorough inspection of the water powers, the electric light and power plants, the pumping station, and the topography of the town and will make a report to the commission on their findings. The probable source of supply is Chats Falls.

GARBAGE, SEWAGE AND WATER.

Halifax, N.S.—Mr. F. W. W. Doane, municipal engineer of this city, has prepared a report covering proposed changes in the waterworks system. In this he recommends the construction of two reservoirs and other works costing $100,000.

Ottawa, Ont.—The municipal council have been asked to construct a septic tank for the treatment of sewage to cost $6,000. N. J. Ker, City Engineer.

Province of Ontario.—The Provincial Board of Health will shortly serve notice on municipalities to cease contaminating the navigable streams of the province by pouring sewage into them. At present, no municipality in Ontario is allowed to extend its sewage system without special permission from the provincial board.

Regina, Sask.—An extension programme of sewer extensions will be carried through to completion during the present year, if at all possible. To expedite the completion of the work it is proposed to divide the various undertakings into separate contracts.

Toronto, Ont.—The municipal council voted in favor of spending $100,000 on water meters.

Westmount, Montreal, P.Q.—The assessment of the city of Westmount is being sued before the courts, by the Montreal Water and Power Company. The allegation is that the assessors do not give to real estate its real value, being as a rule, about ten per cent. below the level. The contention is denied by the officials of the city, and the facts are being argued upon in the Circuit Court, before Mr. Justice Dorion. The argument of the Montreal Water and Power Company is that payment of the water rates in Westmount is based on the valuation of property and that by undervaluing real estate in their assessment, the assessors affect the income of the company.

Winnipeg, Man.—Acting City Engineer Wilson will prepare plans for a water supply to be obtained from Poplar Springs.

BUILDINGS AND INDUSTRIAL WORKS.

Berlin, Ont.—The municipal authorities are taking steps toward the erection of a tubercular sanitarium to cost $1,500. A. H. Miller, Town Clerk.

Brampton, Ont.—A report states that the Pease Foundry Company, now located at Toronto, will remove to this point. They intend erecting a large plant to employ 100 men.

Edson, Alta.—The Portland Cement Company have prepared plans for an industrial plant at Marlboro, 17 miles west of Edson, on the Grand Trunk Pacific, which will cover nine acres of ground.

Hull, Que.—The Hull Electric Railway Company are building new car shops. They will cost about $25,000.

Fort William, Ont.—Messrs. Park Blackwell, The Matthews Packing Company and the Laing Company will erect an $80,000 cold storage plant at this point.

Fredericton, N.B.—M. M. Haines of Cardigan, N.B. contemplates the erection of a sawmill at the mouth of the Nashwaaksis stream.

Fredericton, N.B.—The management of the John Palmer Company intend to erect a new factory. Chas. R. Palmer, president and general manager.

Lethbridge, Alta.—Among several building contracts recently let are a $40,000 structure known as the Hick-Sehl Block; Geo. Beaton, builder. The Sherlock building, cost $45,000; Smith Bros., contractors. Rukham Block, cost $40,000. Power plant extension, $33,500.

Moose Jaw Sask.—The Western Maufacturing Company intend to erect a modern wood working factory. Mr. T. H. Wilson is general manager of this company.

Naden Harbor, B.C.—Messrs. Wallace Bros., fisheries, are erecting a cannery at this point. J. E. Gilmore, of Prince Rupert, B.C., is contractor.

Ottawa, Ont.—It is reported that Messrs. W. W. & J. Wylie are interested in a $75,000 garage, to be of concrete consruction. It will be of three storeys, and so built that more storeys can be added at will. On the ground floor there will be accommodation for about 100 machines, and the two upper floors will be given up to repair shops and show rooms.

Pincher Creek, Alta.—The municipal council will erect a $15,000.00 town hall. Mr. McDonald architect, of Calagry has prepared the plans.

Port Arthur, Ont.—The Fitzimmons Fruit Co., will erect a new office and warehouse 50 feet by 80 feet, brick and mill construction at a cost of about $25,000.

Stratford, Ont.—The Traders Bank intend to remodel the Scott block for banking purposes. Mr. R. H. Smart is the local manager.

St. John, N.B.—Messrs. N. C. Scott and H. W. Johnston have decided to erect a piano factory near this city.

Toronto, Ont.—C. E. Proctor has obtained a permit for a $40,000 two-storey, brick apartment house at 31-33 Melbourne Avenue. Messrs. Weismuller and MacKenzie Bros. have been granted a permit for a three-storey apartment house on West Queen Street, to cost $75,000. W. R. Phillips & Co. have been granted a permit for a $20,000 warehouse, three-storeys and basement, at the north-west corner of Richmond and Duncan Streets.

Vancouver, B. C.—Work will shortly be started on the erection of a two-storey building which has been designed as an arcade. It will cost approximately $60,000.00. Mr. M. P. Thompson is interested.

Vancouver, B.C.—The North West Canadian Trust Company will proceed with the erection of an eight storey block at 507 Richard Street. The building will be of reinforced concrete construction and will cost $120,000. A six storey reinforced concrete building will be erected for Mr. F. W. Padmore, at 610 Cordova Street, at a cost of $50,000.

BRIDGES, ROADS AND PAVEMENTS.

Welland, Ont.—Tenders will soon be called for new pavement here. Plans and specifications will be on file at the office of The Canadian Engineer, 62 Church Street, Toronto, about March 3rd. D. T. Black, town engineer.

CURRENT NEWS.

Province of Alberta.—Two million dollars will be spent this year by the provincial government on telephone construction in Alberta. The programme includes the construction of over 3,000 miles of rural lines, 500 miles of long-distance lines over new routes, connecting towns along recently-constructed railways, and about 700 miles additional circuits on existing long-distance routes, also a number of new town exchanges as well as extensive additions to existing exchanges. Hon. A. L. Sifton, Provincial Minister of Railways and Telephones.

Calgary, Alta. — The convention of the Builders Exchange will meet in this city in 1913. Ald. Brockelbank has made the arrangements.

Montreal, P.Q.—Messrs. Lyall & Sons have reorganized their company, taking the name of P. Lyall Construction Company, Ltd., with a capital of $4,300,000.

Regina, Sask.—The Educational Committee will recommend to the council that an architect be retained for one year at a fixed salary. This committee contemplate erecting two or more new school buildings.

Saskatoon, Sask.—Twenty firms have tendered to supply the various electrical equipment required by the municipality. The cost of these will be $50,000.

St. Catharines, Ont.—The municipal educational committee intend to spend $400 on the equipment of a physical laboratory for the Collegiate Institute.

Sydney, C.B., N.S.—The new nail mill under construction at the steel plant was somewhat damaged, as the result of a collapse of a portion of it, from a heavy weight of snow on the roof.

Toronto, Ont.—The municipal board of works have made application for the sum of $2,721,000, to carry out their proposed programme of 1912.

Winnipeg, Man.—The Manitoba Government Telephone Commission have purchased a motor truck with a loading capacity of four tons. It is fitted with a special winch, at the rear end of the platform, by means of which a load can be hoisted either to or from the truck, or the winch can be utilized for pulling cable through mains, or in jobs that necessitate power.

TRADE ENQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., during the week ended February 12th, 1912. Fuller information may be obtained by communicating with the Department of Trade and Commerce, Ottawa.

A Birmingham firm of general silversmiths and manufacturers of electro plate wish to appoint agents in every province of Canada.

A London firm of filter manufacturers desire to appoint an agent in every province of Canada. Enquiry is made for the names of Canadian manufacturers of leather cloth.

A Glasgow firm of consulting, inspecting and contracting engineers desire to get into touch with Canadian importers of machinery requiring such services as they can render.

A London firm for filter manufacturers desire to appoint supplies of all kinds desire to do business in Canada.

A West of England firm make enquiry for the names of Canadian manufacturers of wood turnings, such as dowels, spindles, legs for chair work and wooden wheels for toys.

A Birmingham firm of mechanical and electrical engineers manufacturing steam, air, and electrically-driven hauling and winding gears and three throw pumps, electric capstans, etc., wish to be placed in communication with Canadian importers.

A London firm of manufacturing electrical engineers desire to appoint an agent at Vancouver.,

A London firm of mechanical engineers manufacturing air compressors, vacuum pumps, lifting tackle, runways, power transmission, etc., desire to arrange for the sale of their machinery in Canada.

Enquiry is made on behalf of a number of important newspaper publishers in Italy for the names of Canadian manufacturers of news paper.

A London engineer who is proceeding to Canada in April next wishes to obtain agencies for electrical apparatus of every description, electric cranes and other heavy engineering specialties, also hardware lines.

From the branch for City Trade Enquiries, 73 Basinghall Street, E.C.:—

A firm in Southern India wish to get into touch with Canadian importers of tanned sheep and goat skins, and also of tanned cow, calf and buffalo hides.

A London company manufacturing a lamp for exterior and interior lighting, burning methylated spirit, wish to arrange for its sale in Canada.

PATENTS.

Below will be found a list of patents recently granted to inventors in Canada. This list is furnished by Messrs. Fetherstonhaugh & Company, Royal Bank Building, Toronto: C. A. R. Roy, file protectors; J. W. Mowbray, hydrocarbon vaporizers for internal combustion engines; S. Aikins, door knobs; J. Andron and G. F. Hickmott, ash sifters; R. L. Gardner and S. S. Holden, portable stable tents; S. Ashdown, hooks; W. P. Cahoe, methods of producing a glucose like product from cellulose and ligneous materials; A. G. Hunter, Churns; J. W. Lucas, lantern handles; A. J. McDonald, barrels; T. A. Murray, sewage sedimentation tanks; J. A. Ray, stove lids; J. Samuels, cinder sifters; F. G. Hunt, disc harrows.

The following is a list of Canadian patents recently issued through the agency of Messrs. Ridout & Maybee, Manning Chambers, Toronto: I. S., I. & S. McDougall, insectides and the like; E. D. Gouk, veneer box; C. B. Redrup, Fluid pressure engines or pumps; J. B.Beadman and H. J. Macklin, axle boxes and other bearings; I. H. Storey, flying machine; F. M. Field and D. A. Skene, railway control system; F. Orbell, elevating mechanism; A. H. Reid, concrete; A. W. Cooper and S. H. Watts, cultivator shares; A. C. Thompson, filling spring for mattresses.

H. J. Daniels, potato harvester; Weedon Grossmith, collar for personal wear; Kilgour Bros., paper drinking cup; R. W. Bateman and L. H. Bateman, driving and reversing gear; Bain Wagon Company, Limited, wagon.

The following list of Canadian patents is supplied by Messrs. Fethersonhaugh & Co., 10 King St. E., Toronto:—

C. E. O. Langlois, self couplers for fluid train lines; W. P. Stephenson, display boxes; A. E. McKenzie, seed show cases; M. Filion and H. L. Dumouchel, automatic cattle guards for railroads; W. Topp and F. Topp, automatic fire alarms; L. E. Beaulieu, fish plate bolts; T. H. Elliott, fire escapes; A. Hackett, combined throttle and reversing valves for motors; A. Horwitz, gas water heaters; J. J. Noon, pipe couplers.

MACHINERY FOR RUSSIA.

Mr. A. L. C. Taylor, 629 Corydon Ave., Winnipeg, Man., has asked us to put him in touch with firms in Canada who are prepared to tender for the supplying of the following equipment for works in Russia:—

(a) Electric furnace for scrap iron, 16-25 tons per diem.

(b) A rolling mill of smallest possible size (round) up to 3-inch diameter. (b) Rectangular 1⅞-inch by 1¼-inch and 1½-inch by 1⅝-inch.

(c) Bending and electric welding machines for chains from ⅛-inch to ½-inch.

(d) Stamp and forging machines for scythes, sickles and horse shoes.

(e) Lamps for giving about 200 candle-power from crude naphtha.

(f) Machine lathes for turning pick and axe handles (taper).

(g) Machines for making long boots of thick felt and similar materials.

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.

15947—February 12—General Order re Rules and Regulations for Inspection of Locomotive Boilers, etc.

15948—February 5—Approving location of G.T.P. Ry. station site at Stony Plains, Alta.

15949—February 12—Authorizing Geo. H. Shaw, G.T.M., N.St. C. & T. Ry. to prepare and issue tariffs of tolls.

15959—February 8—Directing C.P.R. to, before July 1, 1912, install electric bells at crossing in village of Coldwater, Ont., 20 per cent. from Railway Grade Crossing Fund.

15951—February 12—Authorizing C.N.O. Ry. to cross Ford St., Toronto, by overhead structure over highway and across tracks of Toronto Suburban Ry. Co.

15952—February 12—Authorizing C.N.O. Ry. to cross seven highways in Twp. of Etobicoke.

15953—February 12—Directing Bell Tel. Co. to amend Supp. No. 42, C.R.C. No. 1708 and providing for certain changes in rates to telephone subscribers between Island and city of Toronto. (See Order 12625, December 14, 1910.)

15954—February 9—Authorizing C.P.R. (G.B. & S. Ry.) to cross St. Patrick and Dermot Sts. at mileage 72.21 and to take certain lands for road diversion belonging to W. B. Fee, Twp. of Ops, County of Victoria, Ont.

15955—February 6—Approving location of C.N.O. Ry. station at Brockville Junction.

15956—February 12—Directing Grand Valley Ry. Co. to pay to T.H. & B. Ry. $200 for old diamond at crossing on South Market St., Brantford, Ont.

15957—February 9—Authorizing C.P.R. to cross with second main line track (double track) McTavish St., Fort William, Ont.

15958—February 9—Authorizing C.N.O. Ry. to connect with G.T.R. at Cobourg, Ont.

15959—February 9—Authorizing C.N.O. Ry. to cross Russell Road, at Junction Gore, County of Carleton, Ont.

15960—February 14—Directing that crossing of G.T.R. near Kettle Creek Bridge, St. Thomas, Ont., be protected by day and night watchmen, 15 per cent. to be paid by Twp. of Yarmouth, 15 per cent. by city of St. Thomas.

15961—February 15—General Order re freight rates in Canada, west of Port Arthur, adding Province of British Columbia to enquiry.

15962—February 15—Directing G.T.R. to install within ninety days electric bell at crossing of Grand Ile Ave., Valleyfield, Que.

15963-64—February 14—Issuing certificate of correction to G.T.P.B.L. Co. correcting errors in plan of location Biggar-Calgary Branch and Biggar-Calgary Branch.

15965—February 12—Relieving C.P.R. from erecting and maintaining fences, gates and cattle guards on portions of Atlantic, Eastern, Ontario and Lake Superior Divisions.

15966—February 15—Authorizing C.P.R. (G.B. & S. Ry.) to use and operate bridges at mileages 20.64, 23.4 and 24.3 at Couchiching Narrows.

15967—February 3—Authorizing C.P.R. to construct spur for A. Bowerman in city of Saskatoon, Sask.

15968—January 31—Authorizing C.N.R. to cross with its Grosse Isle Branch twelve highways in municipality of Woodlands, Man.

15969—February 13—Amending Order No. 15667, December 15, 1911, by substituting plan "B" for plan "A" filed.

15970—February 15—Extending until July 1, 1912, time for construction of spur by C.N.R. in city of Edmonton, in H. B. Reserve.

15971—February 15—Approving coal chute clearances of G.T.P. Ry.

15972—February 14—Authorizing Edmonton, Dunvegan & B.C. Ry. Co. to cross highways from mileage 0 to 30, Alberta.

15973—February 15—Adding Twp. of Bentinch to application re protection of crossing by Walkerton & Lucknow Ry. (C.P.R.), County Grey, Ont.

15974—February 14—Approving plan "A" and rescinding Order 14066 of June 24, 1911, in so far as it approves the plans of said automatic signal on T.H. & B. Ry. between Hamilton and Vinemount.

15975—February 15—Certificate of correction to G.T.P.B.L. Co. re errors in plan of location of Biggar-Calgary Branch.

15976—February 16—Re Brockville train connection between G.T.R. and C.P.R. when passengers for Ottawa on G.T.R. train.

15977—February 15—Approving location of C.N.O. Ry. station grounds at St. Joseph, Parish of St. Eustache, County Two Mountains, Que.

15978—February 14—Authorizing C.N.O. Ry. to cross C.P.R. by overhead structure on Lot 11, Con. 2, Twp. of Nepean, County of Carleton, Ont.

15979—February 16—Certificate of correction to G.T.P.B.L. Co. correcting errors in location Biggar-Calgary Branch.

15980—February 15—Authorizing C.N.R. to construct spur to Round Hill Collieries, Ltd., Province of Alberta.

15981—February 16—Approving by-law of T.H. & B. Ry. authorizing F. D. Backus, G.F.A. and P.A., and Geo. C. Martin, A.G.F. and P.A., to prepare and issue tariffs of tolls.

15982—February 14—Authorizing Twp. of York to construct bridge over old belt line, so-called, of G.T.R. east of Yonge St., and to open up a new highway.

15983—February 15—Authorizing G.T.P. Ry. Co. to operate industrial spur to serve P. Burns & Co., Ltd., Edmonton, Alta.

15984-85—February 16—Approving revised location of C.P.R. Virden to McAuley Branch from mileage 14 to mileage 36.27, Manitoba and Saskatchewan, and revised location of Kerrobert Northeasterly Branch from mileage 0 to mileage 20.2, Saskatchewan.

15986—February 16—Authorizing C.N.O. Ry. to cross three highways in Twp. of Nepean, County of Carleton, Ont.

15987—February 16—Rescinding Order No. 14379, July 22, 1911, and authorizing C.P.R. to divert public road between Cons. 7 and 8, Twp. of Eldon, County of Victoria, and to cross diversion at mileage 56.4 by overhead bridge, company to also compensate John McArthur by reason of any damages sustained by closing highway.

15988—February 17—General Order re Ash Pans on Locomotives.

15989—February 16—Authorizing G.T.P. Ry. to cross with its second track of C.N.R. on Empire Ave., Fort William, Ont.

15990—February 15—Authorizing C.P.R. to construct spur for Manitoba Bridge & Iron Works, Ltd., on Higgins Ave., Winnipeg, Man.

15991—February 16—Approving revised location of James Bay & Eastern (C.N.R.) through Twp. of Demeules, County of Lake St. John, Que.

15992—February 16—Directing C.N.R. under penalty of $10 per day to, before May 15, 1912, provide suitable farm crossing for E. K. Glidden, of Vermilion, Alta.

15993—February 15—Dismissing application of Dominion Sugar Co., Ltd., Wallaceburg, Ont., re re-adjustment of rates on sugar in carloads from Wallaceburg to Winnipeg and western points.

(Continued on Page 74.)