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The Canadian Engineer

An Engineering Weekly

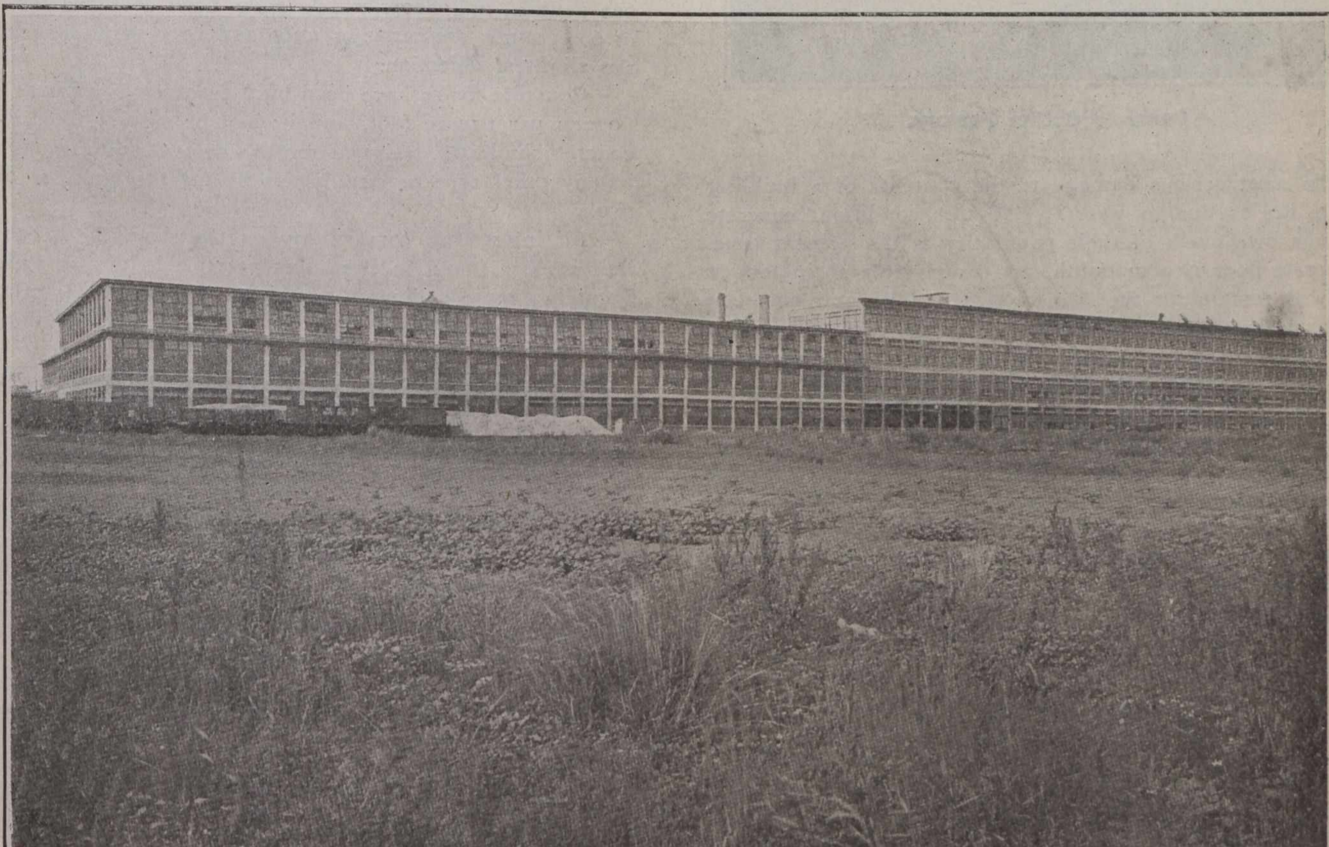
CONCRETE FACTORIES.

The varied uses of cement in industrial constructions grow apace with increased manufacture and decreased cost of the staple. The American Association of Portland Cement Manufacturers have gathered data together which shows the possibility of all steel and cement construction as applied to factories, warehouses and other buildings necessitating commodious floor space.

To an engineer about to assume the responsibility of the erection of an industrial structure, the employment of concrete would have to be considered in the specific case. It is very interesting, however, to examine the points brought forward by the cement association mentioned above.

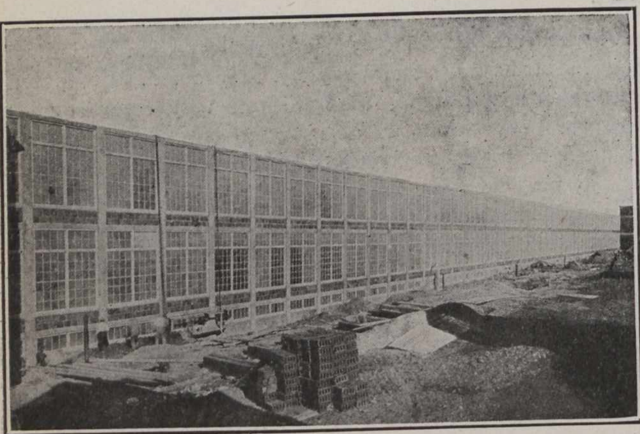
From an industrial point of view, the advantages of a reinforced concrete building are its fireproofness, waterproofness, verminproofness, sanitary qualities, maximum light available, load-carrying capacity, vibration, resistance, permanence, adapability, speed of construction, low heating charge, low initial cost and its fire protection value.

Compared to any other fireproof type of building, reinforced concrete for industrial buildings is the lowest in initial cost. It is generally found that on a four or more storey factory or warehouse, with live loads of 150 pounds or more, reinforced concrete buildings cost from 10 per cent. to 20 per cent. or even 25 per cent. less than a similar design in structural steel properly fireproofed. Compared to non-fireproof buildings, concrete will vary from equal cost on large propositions to possibly 30 per cent. greater cost on medium sized propositions, and sometimes 40 per cent. and 50 per cent. on the smaller buildings when the comparison is made with the cheapest form of brick and frame construction. These percentages will, of course, vary for different sections of the country, but are in a measure fair statements for general usage. These costs are exclusive of building equipment such as plumbing, heating, lighting, elevators and sprinklers, as these items run about the same on any type of building. What these costs really mean is that a prospective builder can obtain a fireproof structure, if he uses reinforced concrete, at a cost little in excess of the non-fireproof or at best slow-burning form of construction. Before the introduction of reinforced concrete construction the only fireproof form of building was structural steel fireprofed.



Concrete Motor Car Factory.

A reinforced concrete building gives very nearly full protection from fire. Even though the building is in a conflagration district, if it is properly protected with wire glass windows, fire doors, etc., it will, as far as it is possible to judge, come through a conflagration uninjured. If the fire is a local one, it would be confined to the floor or room where it started. The underwriters' records of the United States show that there are forty fires causing loss in excess of $25,000 per fire every week among industrial buildings in that country, and that the annual per capita loss for the United States is something in excess of $2.30 as compared to an average loss per capita of seven European cities of 30 cents. The cost of a reinforced concrete fireproof building under most conditions would not exceed a non-fireproof type of building by over 10 or 15 per cent.



Concrete Cotton Factory.

The most serious damage to the contents of a building after a fire is due to water. To this condition, concrete buildings owe much of their popularity at the present time. A concrete floor is a monolith, and water from sprinklers or hose will remain on the floor where it falls and does not run down through several storeys as in the case of ordinary types of construction. The best practice of the day in the design of concrete industrial buildings provides a small curb, generally not over three inches high, at all stair and elevator wells, lowerator shafts, and other openings through floors, so that there is no possibility of water from a flooded floor flowing into the lower story. To make this certain scuppers are usually placed in the walls. Furthermore, the waterproofness of a reinforced concrete building is of great service where industries using wet processes have to be housed, or where industries requiring frequent cleaning of rooms or floors are the tenants. A concrete building may be washed down with a hose and no damage results. The new York Board of Fire Underwriters are accepting concrete floors with a granolithic finish placed on two inches of rich cinder concrete as waterproof and give the same rating as other types of floors which have three- or five-ply tar and felt waterproofing laid between the structural part of the floor and the floor surface.

A building where there is no dry rot, no dampness, no vermin, and where cement, which is a lime product and naturally sanitary, is the chief material of construction, is very nearly ideal from a hygienic viewpoint.

The sanitary qualities of a building and efficiency of employees vary almost directly with the amount of light obtainable in a building. Concrete factories are noted for the ease with which abundant light is obtainable in them. The ordinary brick and mill construction and brick or frame building has rarely over 20 or 30 per cent. of its wall area in windows, whereas the normal window area for a reinforced concrete factory is 50 per cent. and in many cases runs as high as 85 per cent.

Owners of concrete buildings have shown that they can increase the efficiency of their employees 5 to 10 per cent., and often even more, by having well-lighted, clean rooms. Concrete buildings possess an advantage over most other types of construction along this same line, not merely from the extra amount of light available, but also from the extra ventilation which the large window area gives. This is of importance, especially through the summer months.

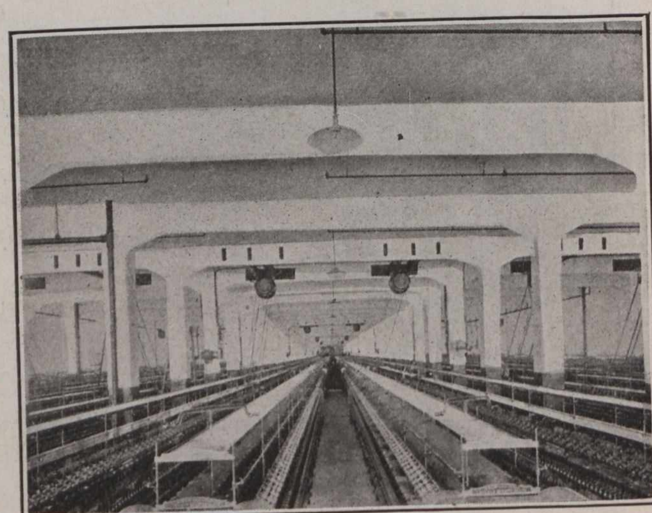
The great window area which is obtainable in reinforced concrete factories reduces the lighting charges materially and in many cases makes artificial light almost unnecessary. Light courts or very narrow buildings often become unnecessary when reinforced concrete is used. By allowing the windows to extend to the ceiling line the light from these windows will reach 40 or 50 feet into the building in an efficient manner.

Reinforced concrete increases in strength with age. There are many tests of cement and concrete briquets and cubes which demonstrate beyond controversy the increase in strength with time.

Poor workmanship and unusual conditions have sometimes occurred on buildings, but the material after once in position has always responded without a single sign of weakness. Concrete floors which have been designed for a strength of 200 pounds have been known to carry 500 and 600 pounds, and floors which have been designed for loads of 600 pounds are carrying 1,200 and 1,500 without incurring the slightest defection.

Concrete floors have been built to carry as high as 5,000 pounds per square foot, and it may be safely stated that a concrete building designed for the same loading as is used in any other type of building is by far the stronger of the two.

An interesting commentary on the strength of concrete buildings is found in the latest practice in design which is becoming more and more prevalent. Advantage is taken of the increase in strength with time of a concrete building. If an owner desires a building to be four stories high, but to be so built as to later carry a fifth story, the columns are designed to carry the loads which will be brought on them if the building were to be ultimately only four stories high. At the end of a year or two these columns will have increased in strength to such an extent that a fifth story can be safely added, and the resulting loads on the columns will not produce stresses above the factor of safety used in the original design.

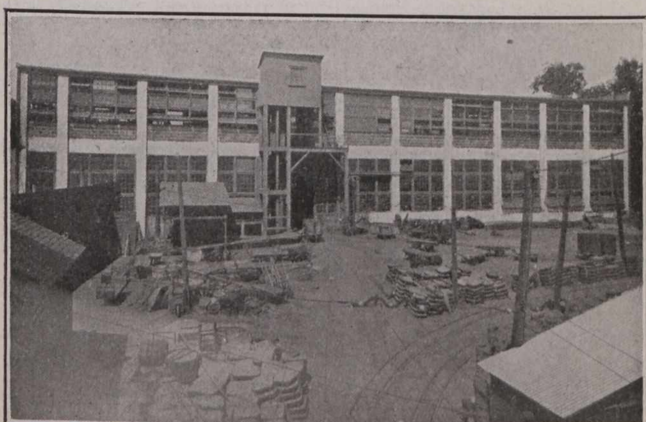


Interior of Concrete Cotton Factory.

A reinforced concrete factory or warehouse, properly designed and erected, may be said to be the most rigid building which can be put up. The reason for this is almost self-evident. The floors and columns of a concrete building are cast or poured at one time, and become a homogeneous mass, that might have been carved out of a solid block of stone. Rapidly moving machines, heavy embossing presses, electric motors, milling machines, high velocity engines, and, in fact, any heavy equipment can be installed in a reinforced concrete building and run at highest speed and in the story below its presence is scarcely discernible. It has been found that machinery can be operated at higher speeds and at greater efficiency in concrete buildings, owing to the rigidity of these buildings, than in any other type of construction. While it is true that there are some concrete buildings where vibration is noticeable, the conditions in these buildings are such as to create vibration in any kind of a structure, and the amount existing in the concrete building is certainly less than would otherwise be obtained. Concrete was early selected for the housing of the publishing and printing industry because it permitted the placing of large presses in upper floors of the building, without danger to the safety of the structure.

One type of vibration which concerns many manufacturers is due to a very slight lack of balance in parts rotating at high speed. This is in distinction to the vibration that might be caused by machinery of a heavier type due possibly to the reciprocation of heavy weights or to the shock, as in punch press work and the like, or vibration of a machine due to "chatter." It has been found that in reinforced concrete factories the usual difficulty of installing machinery so that high frequency vibration would not in a short time loosen the fastenings, as well as cause loss of adjustment to the machines, has been almost enirely overcome. It has further been found that machines standing high from the floor and subject to more or less horizontal shock can be held rigidly in place. This is a condition which in mill construction, at least, is almost impossible to bring about.

The effect of this property on the tenant of a factory is great. If machinery or shafting can be set or bolted to a



Iron Company Concrete Core Room and Carpenter Shop.

concrete floor, or hung from the ceiling without the possibility of its getting out of line or level, the repairs to the machines in new bearings, the amount of attendance, the quantity of oil used, and the general up-keep are greatly reduced. Many owners of concrete industrial buildings have found that they save considerable money by having their machinery in this type of building, as compared with any other type of structure.

In many light manufacturing buildings consideration has to be given to the position of heavy stock piles or machines, it being necessary either to place extra heavy loads over a beam or girder or make provision to distribute the load. In concrete buildings this rarely occurs. Furthermore, in the ordinary type of building the movement of an unusually heavy load across the floor often disturbs the shafting or other machinery hung from the ceiling below. In concrete buildings the foreman of a department seldom has to think of such a contingency.

The speed of construction of reinforced concrete buildings has been misrepresented many times, and a number of buildings have been designed in mill construction because their owners were afraid that if they elected to use reinforced concrete there would be such delays as to make the use of concrete prohibitive. There have been, it is true, many concrete buildings put up where the time of completion has dragged along to an unreasonable extent, and the owners

Concrete Meter Factory.

have had every reason for complaint. Most of such cases, however, have been due chiefly to inexperience on the part of the contractor or unreasonable requirements on the part of the engineer or owner.

With an experienced contractor, and ordinarily fair working conditions, reinforced concrete factories or warehouses can be, and in innumerable instances have been, erected in a time which compares favorably with any other type of construction. Speed in concrete work means essentially a well organized and experienced contractor.

A few instances of quick concrete construction would include:—

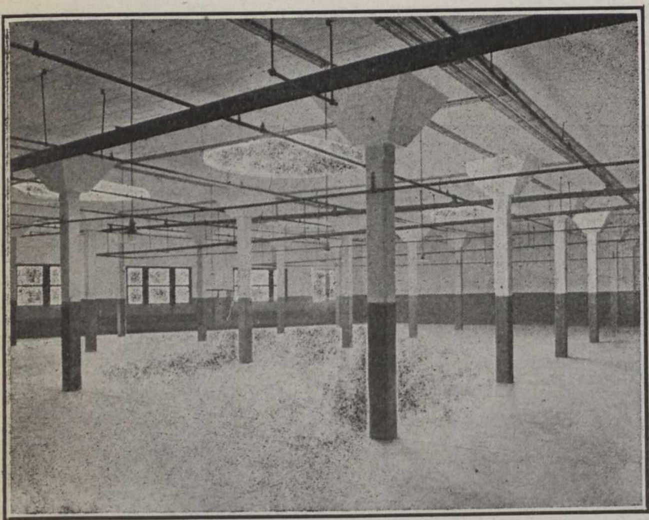
The Mason Warehouse at 134 Johnson Street, Brooklyn, New York, is 40 by 80 feet in plan, seven stories and basement in height. After the completion of the excavation but forty-eight working days were used to the completion of the roof, and the building was turned over ready for occupancy, including plumbing, heating, lighting, and elevators, in three months and one-half after the signing of the contract.

The Rogers-Pyatt shellac factory at 34 Fletcher Street, New York City, is ten stories and basement in height, and about 60 by 70 feet in plan. After the completion of the foundations, which were special, forty-seven working days were consumed to the concreting of the roof and three and one-half months elapsed from the signing of the contract to the delivery of the building ready for occupancy.

The Robert Gair warehouse, on Front and Washington Streets, Brooklyn, New York, a twelve-story building with twenty thousand square feet to the floor, was constructed, twelve floors in eleven weeks, and the building turned over ready for occupancy in seven months after the signing of the contract.

It is the general practice of reputable concrete construction companies to carry their buildings up at the rate of a story per week after the first floor is concreted. A seven-story building, about ten thousand square feet to a floor, can be guaranteed completed in from four to five months after the contract is signed.

An investigation of over 200 reinforced concrete industrial buildings showed that in none of them was any dampproofing placed. All the buildings have given perfect satisfaction on this score. Concrete walls 8 inches in thickness, properly built, are practically impervious to weather. In cases where the temperatures are high there may be a tendency towards condensation, but this would be true with any character of wall which was not furred to provide a dead air space. The prevalence of the idea that concrete buildings are damp probably is founded on the old-fashioned concrete cellar or rubble wall cellar, which was under a static head of water, and, therefore, very liable to dampness. Plastering may be applied direct to the inside of concrete walls 8 inches or more in thickness without danger of the plastering coming off. The fact that piano factories, which require about as dry a building as any other type of industry, have been built of reinforced concrete most satisfactorily, furnishes an interesting example of the lack of dampness in concrete buildings.



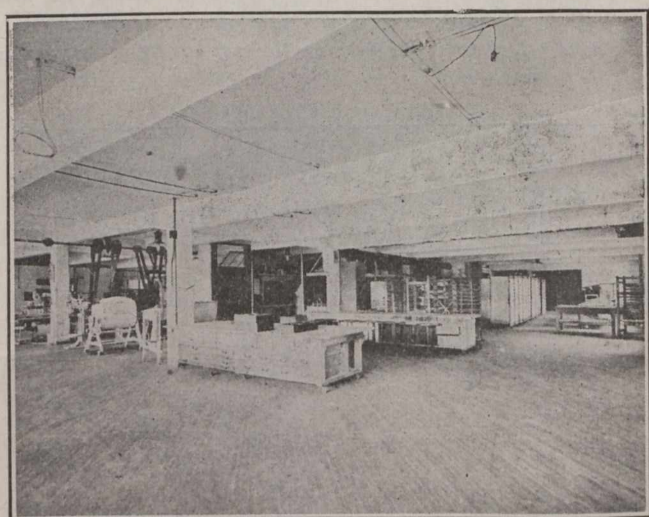
Interior of Concrete Embossing Factory.

In exterior appearance a concrete building, as illustrated, will compare in appearance favorably with any other type of building when designed accordingly. The old prejudice on the part of the general public against concrete from the esthetic point of view is due to the psychological fact that what the eye has not seen the brain cannot conceive. The man in the street has come to know brick, stone, and older types of exterior construction and to accept them for what they are and to distinguish between good work and bad work in the various classes. Until there has been enough concrete work for the public to become used to it and to learn to distinguish between good concrete and bad concrete, there is bound to be somewhat of a feeling against it. Admitting this condition, it is not necessary for the prospective builder to turn down concrete as a structural material. Rather, he should use brick, stone or whatever material suits his whim as a veneer or as bearing walls and let the structural part of his building be of concrete. In other words, reinforced concrete may be used for the frame of a building in the same way that structural steel is used for skyscrapers the country over.

Difficulty of Installing Mechanical Equipment.—Perhaps the most common prejudice against reinforced concrete for industrial buildings is the supposed difficulty of installing in a satisfactory and economical manner, piping, machinery, motors, and other mechanical equipment. While it is undoubtedly true that it is harder to cut into a concrete ceiling or beam than into wood or brick, the extra amount of labor and time involved is much less than those inexperienced in such work would imagine. As a matter of fact, in the majority of industrial concrete buildings erected to-day provision is made during the course of construction so that equipment of every character can be readily installed without any cutting whatsoever. This is generally accomplished by leaving holes sufficiently large to take a ¾-inch bolt through the beams and girders just underneath the floor slab. These holes are spaced generally from 24 to 36 inches on centres. By use of hanger bolts or sockets, any kind of equipment can be supported rigidly from the concrete ceilings. In construction where there are no beams or girders, cast-iron spool sockets are set at regular intervals in the ceiling. These sockets are tapped for bolts of any size and provide a very simple means of attaching machinery. In fact, these cast-iron spool sockets are not infrequently set in the bottoms of beams or girders or in the floor slabs between same. Shafting is ordinarily supported on 3-inch by 6-inch wooden stringers which are bolted to the concrete ceiling. As previously noted, machinery or shafting thus attached to concrete construction remains rigidly in place without any of it getting out of line or level which is so common in other types of buildings.

The installing of plumbing, heating, and sprinkler pipes is handled usually in a different manner from other mechanical equipment, in that it is customary to write contracts and specifications for concrete buildings with the provision that the sub-contractors for these different classes of work have to set sleeves or indicate where they wish holes left in the concrete construction before the floors or walls are concreted. It is then up to the concrete contractor to meet their requirements.

Most machinery is set on the floors and not supported from the ceiling. Two problems are then presented: First, where the machinery is sufficiently heavy so that it may rest without bolting upon the concrete floors or be grouted in place; and, second, light machines which have to be secured to the floors. The first class of work is obviously simple and needs but little attention except to note that concrete floors lend themselves very readily to grouting, and, in their stiffness, prevent any tendency towards movement of machines. The second class of machinery is provided for generally in two ways: First, by drilling holes from two inches to three inches deep in the concrete floor and either driving wooden plugs into these holes and then attaching the machine by use of ordinary bolts or screws or by setting expansion bolts in the holes direct and holding them in place with lead or sulphur. The drilling of these holes may, in the eyes of the uninitiated, form a problem. As a matter of fact, it has been found in actual practice that these holes can be tapped in the con-



Interior of Concrete Bakery.

crete floors very easily. The second class of machinery, which the drilling of the holes and the setting of anchor or expansion bolts does not take care of, consists of very light machines or machines which have to be moved frequently. Here it is generally good practice to install over the concrete structural slab a wooden floor to which the machines may be bolted as in an ordinary building. Most reputable concrete engineers and contractors, although very enthusiastic over their form of construction, are not blind to certain conditions which something other than concrete had best be specified.

If provision is made beforehand, such as above noted, equipment can satisfactorily be installed in concrete buildings. Assuming that no provision has been made during the construction of the building for attaching any mechanical equipment. The general practice among the occupants of concrete buildings is to use expansion bolts set in holes tapped in the concrete. In a large building where there is a great amount of such work to be done or where changes are constantly occurring, the most economical way to meet this problem is to purchase a small portable air compressor, generally operated by electricity, and use a pneumatic drill. The cost of such a compressor is low and the economies which it effects soon more than equal the initial outlay. But even in a building where such a machine is not available, it has been found that holes can be cut into concrete at an almost negligible cost. The results of an investigation of some fifty concrete buildings in the Metropolitan district of New York City about a year ago showed that the mechanical engineers or factory superintendents, after the first few weeks of occupancy of their new buildings, got to regard cutting holes in concrete beams, for the setting of expansion bolts or other devices, about as they did cutting into wooden beams. This may at first seem to apply wholly to machinery or shafting. Alterations in piping layouts require, of course, cutting holes through floors or walls or partitions. This is somewhat more difficult than the tapping of expansion bolt holes, but if a little discretion is exercised it will be found that alterations of this kind are not really burdensome. It is sometimes objected that additions may be necessary to buildings which require removal of walls, or departments may have to be moved from one part of the building to another, which may require removal of partitions. In cases such as this concrete should not be used for walls or partitions. Exterior walls should be built of a material which can be readily removed. Partitions should be made of concrete blocks or hollow tile or lath and plaster, which brings this problem to the same footing as in other types of construction.

Coal pockets above 3,000-ton capacity cost from $6.00 to $7.50 per ton. Reinforced concrete stand pipes above the foundations cost from 2½ to 3 cents per gallon.

It is difficult to give a comparative insurance rate on industrial buildings in Canada owing to each one being rated specifically, local circumstances having entire control over the schedule. A concrete building reinforced with steel, and provided with metal window sashes supporting wire glass, and containing little or no interior woodwork, is rated by fire underwriters as "fireproof." The insurance rate on such a building in Ontario runs from 0.20 cent per $100.00 per twelve months upwards.

The estimated approximate unit costs of reinforced concrete buildings of various types are shown in the table below:—

Type of building. Dimensions.	Live load. per sq. ft.	Cost above foundation. sq. ft.	cu. ft.	Cost includ'g foundation, sq. ft.	cu. ft.
Machine shop, 120x50', 4 stories	150	$1.05	$0.08	$1.17	$0.09
Machine shop, 220x100', 1 story, sawtooth skylights		1.65	0.09	1.75	0.10
Cartridge factory, 223x56', 2 stories	300	1.40	0.09	1.55	0.10
Cotton mill, 550x129', 2 stories	75	0.99	0.07	1.06	0.075
Weave shed, 341x231', 1 story, sawtooth skylights	125	1.66	0.064	1.79	0.07
Power-house, 90x62',		2.53	0.115	2.67	0.12
Storehouse, 181x56', 4 stories	150	1.08	0.065	1.15	0.07
Storehouse, 256x100', 12 stories	150	0.90	0.09	0.98	0.105
Storehouse, 223x56', 2 stories	300 and 1,000	1.20	0.08	1.35	0.09

LIGHTNING RODS.

In arranging aerial and ground connections in a system of lightning rods, the different rods are connected together on the roofs of the house. The rods situated on the gables, and on this account more exposed to the action of lightning, are always each provided with a separate conductor, one conductor to every two rods being sufficient in the case of those lower down. A conductor consists either of a copper wire 8 to 10 millimeters thick, or of copper wire rope containing seven wires 3.3 millimeters each in diameter. Only electrolytically pure copper should be used. Galvanized-iron wire cable, 15 millimeters thick, composed of twelve single wires 3.3 millimeters in diameter, is also employed. Large metallic bodies in the interior of the building, such as iron girders, iron pillars, rain, gas, and water pipes, metal roofs, etc., should be brought into good conducting connection with the conducting rods by screws and soldering. The object of the ground connection is to conduct the lightning to the earth with the least possible resistance. For this purpose copper plates 2 millimeters thick and from 0.5 to 1 square meter in area are generally employed. If there are more than two ground plates to one conductor, the size of the plates can be reduced to 33 by 100 centimeters. Galvanized-iron plates 1 square meter in area and 5 millimeters thick, iron rails, water mains (when allowed by law) can also be used for ground connection. The plates should be fixed in underground water, and far enough to remain covered when the water is at its lowest. If there is no ground water available, the electrode should be fixed in the moistest soil possible, e.g., in the neighborhood of rain spouts, kitchen drains, etc. In this case the surface of the electrodes must be doubled. Instead of solid ground plates, copper or iron wire netting may be used, but in selecting the size, care must be taken that they present the same conducting surface as the solid plates, i.e., one square meter. If the ground plate has to be placed in a well from which drinking water is taken, a galvanized-iron plate or galvanized-iron wire rope must be used, or the copper plate and connecting wires well tinned, on account of the poisonous character of the salts formed on the copper conductors.

COST OF GARBAGE REDUCTION.

The engineer in charge of the design and construction of the garbage reduction plant built for the city of Columbus, Ohio, has just issued his report for the first year of operation. An abstract of the report is published hereafter:

A review of the history of the plant and a brief description of it is given, which states, among other things, that the city advertised early in 1908 for bids for the construction of a reduction plant to be built in accordance with specifications issued by the city, but no bids were received. The specifications were at once revised and two bids were received, but both rejected, because the lowest, $230,000, was considered too high. The Board of Public Service then decided that better results could be obtained by employing an engineer to design and construct the plant so they could award contracts on separate parts of the work, and Mr. Osborn was employed for this work in July, 1908.

A reduction plant was designed with a capacity of disposing of 80 tons of garbage in 12 hours; this capacity being considered sufficient to take care of the future growth of the city for a number of years and at the same time provide for any emergency in case of breakdown. Contracts for machinery were awarded in November, 1908, and this and the buildings were nearly completed by the latter part of 1909, when winter shut down the work. The plant was completed and placed in operation on July 20 of the following year and has been in continuous operation ever since.

At the same time the plant was being constructed, collection equipment and various buildings were being provided. On a six-acre plot in a comparatively central location were built a garbage loading station, garbage collection stable, railroad sidings, dog pound, night soil station, street repair yards, wagon sheds and blacksmith and repair shop; while work is now under way for the erection of a stable for the street cleaning department.

The dog pound consists of a small one-story frame building with an office in front and stalls for keeping dogs until released or otherwise disposed of. The nightsoil station consists of a small one-story brick building containing a concrete basin in which the wagon tanks discharge their contents, which is then diluted with water and flushed into the sewer. The stable is a two-story building 60 feet wide by 200 feet long. Stalls are arranged in rows across the building, with a ten-foot passage aisle at the rear and a four-foot feeding aisle at the front. A centre aisle 8 feet wide runs the entire length of the building. The stable has a capacity of 160 horses, and the ground room also contains harness rooms and the office of the stableman. The second floor is used for storage of feed and also contains the office of the superintendent of collection and a locker and bathroom for the men.

The garbage loading station consists of a two-story brick building 40 feet wide by 90 feet long, with railway tracks extending through it. The wagons are driven up an incline driveway onto the second or loading floor which is about 15 feet above the railway track. The wagon is backed up to a bumping rail and the front end of the wagon body elevated with power hoist, thus discharging the garbage into the car below. The building houses two cars at one time when the large double track doors are closed, so that all work of loading is done inside the building. Four garbage cars were purchased for transporting the garbage to the disposal plant. These cars were especially made, having a steel semi-circular body set on trunnions so that they can be turned to discharge the load. The cars have a capacity of 80,000 pounds or 1,400 cubic feet of garbage.

Thirty-four garbage wagons were purchased for use in collection. These wagons were built according to the city's specifications and consist of rectangular steel bodies mounted on heavy running gears. The wagons are provided with spring seat, and canvas covering put on in sections. The sectional canvas cover makes it necessary to uncover only a part of the wagon at a time and at the same time does away with the noise caused by metal covers. The wagons have a capacity of 2½ cubic yards and the net weight of the loads varies from 1½ to 2 tons.

The loading station and other buildings described above are placed at a comparatively central point in the city, on the Scioto River. The reduction plant is located about 1½ miles south of the city limits, also on the bank of the river. The plant consists of four buildings—the green garbage or unloading building, the main or reduction building, the office and a small stable. A car of garbage, when delivered at the plant, is weighed on railway track scales and then run into the green garbage building on a railway siding which extends through it. The body of the car is then turned on trunnions by means of power hoists and the contents of the car discharged onto the floor below. Here the free water is drained off through a gutter covered with perforated plates which extends the full length of the building. The water so flowing off is drained into a catch basin from which it is discharged into grease separating tanks. The garbage is sorted and shoveled into a 24-inch scraper conveyer which extends the full length of the green garbage building.

Connecting the green garbage building with the main building is an inclined truss which carries the conveyer to the top of the latter building, where it discharges the garbage through swivel spouts directly into the digestors. When the garbage has been cooked in the digestors it is discharged through a large valve into a receiving hopper and from this to a roller press. The vapors which arise from the mass when dropped into the hopper are conducted to a condenser which in turn is connected to a vapor-tight steel hot well. The time required in cooking varies with the quality of garbage, but averages from 6 to 8 hours with the steam at from 60 to 70 pounds gauge pressure as it enters the digestor.

After passing through the presses the compressed material is carried to the drying department, where it is fed into a revolving cylindrical dryer. After being thus dried the material is passed through a revolving screen and the screened tankage is placed in vacuum mixing driers, together with the concentrated syrup from the evaporator. The dry fibrous material acts as a filler and enables the moisture in the syrup to be driven off. The addition of the syrup to the fibrous tankage provides a higher grade of tankage from a mechanical and fertilizing standpoint. When this mixture has been dried it is conveyed by a spiral conveyer and an elevator to the third floor where it is stored until shipment.

The water and grease from the press flow through a conduit to the grease separating room. The grease drained off from the separating tanks is heated in the treating tanks in order to separate out the impurities, and is then pumped into storage tanks ready for shipment.

The tank water drawn off from the grease separators is evaporated so as to recover the five to seven per cent. of solids in solution. An evaporator is used consisting of three pans, capable of concentrating 1,500 gallons of tank water per hour from 7 degrees Be. to 22 degrees Be., using exhaust steam at five pounds pressure and a vacuum of 25 inches on the third pan. The concentrated syrup is drawn off by a magma pump and discharged into a storage tank, to be added to the tankage as previously described. The feed pump to the evaporator is provided with a neutralizing gear and connected to a tank containing a neutralizing solution; thus securing the mixture with the tank water of the amount of solution required to neutralize the acid so as to prevent its attacking the metal.

The city now has under construction a percolating plant to be used in extracting grease from the dry tankage, as only about one-half of the available grease is recovered by means of the press. The percolating plant will consist of an extractor, vaporizers, condensers and storage tanks.

The electric current for both lighting and power is furnished by the municipal lighting plant at 1½ cts. per kw.h. An independent motor is connected with each power-driven unit and operated with 440-volt, 60-cycle, two-phase current. The boiler plant consists of three horizontal tubular boilers 78 inches in diameter by 20 feet long. Two of the boilers are in regular service and the third is in reserve.

The cost of the collection equipment and of the reduction plant was as follows:

Collection Department.		
Loading Station site	$10,136.40	
Loading Station	14,101.64	
Collection Stable	41,796.55	
Trestle and driveway	2,153.10	
Grading, fill, electric wiring	2,379.54	
Garbage cars	7,564.00	
Garbage wagons	7,151.10	
Railway siding	3,161.60	
		$ 88,443.93
Reduction Plant.		
Levee	$ 9,711.72	
Buildings, grading, etc.	81,267.05	
Reduction machinery	59,866.00	
Power equipment	21,356.70	
Railway tracks	3,342.80	
Conveying machinery	9,316.22	
Electric wiring	3,670.99	
Non-conducting covering	1,010.75	
		$189,542.23
Miscellaneous.		
Office and advertising	$ 1,401.18	
Engineering	16,143.48	
		$ 17,544.66
Total		$295,530.82

As during the first six months of operation, that is the last six months of the year 1910, the works were new and the men unacquainted with operating them, Mr. Osborn has taken the first six months of 1911 as more representative of what results can be obtained. During this period accurate records were kept of the operation and the cost computed for each part of the operation. During the first half of 1911 the amounts of garbage disposed of each month were as follows:

January	1,063.08 tons
February	977.64 tons
March	1,114.75 tons
April	1,175.22 tons
May	1,364.05 tons
June	1,371.39 tons
Total	7,066.13 tons

The above includes 94 dead horses and 9 cows.

The plant was operated 153 days, and the average tonnage per day was 45.59.

As the plant has a capacity of 160 tons of garbage in 24 hours, the disposing of 45.59 tons per day was done ordinarily during one eight-hour shift. During the second shift only such work was done as required more than eight hours. If the tonnage of garbage was sufficient to operate the plant at full capacity the cost per ton would be decreased, as the same number of men are required to operate the machinery irrespective of the tankage to be disposed of.

The receipts of the works from the products were as follows:—

206.48 tons of grease	$21,413.92
1,132.03 tons of tankage	10,338.42
62 hides	253.90
Miscellaneous	1.50
Total	$32,007.74

In addition to this there was on hand June 30, 1911:

43 tons of grease @ $100.00	$4,300.00
156.34 tons tankage @ $10.00	1,563.40
34 hides @ $4.00	136.00
Total	$5,999.40

The inventory of January 1, 1911, was:

68.44 tons grease @ $108.00	$7,391.52
100 tons tankage @ $10.00	1,000.00
Total	$8,391.52

This makes the net receipts from by-products recovered from 7,066.13 tons of garbage to be $29,615.62.

Each carload was analyzed for determining both the fertilizing elements (on which the price per ton is based) and also the percentage of grease left in the material, these analyses showing this percentage of grease to be approximately ten. It is believed that if the percolating plant which is now under construction had been in operation, a recovery of 8 per cent. of grease would have been made, which would have amounted to 95 tons, valued at $9,500. The operation of the percolating plant would have required an additional expense of $2,000, leaving a net revenue from this plant of $7,500. The total cost for the collection of garbage for the first six months of 1911 amounted to $17,794.99; so that, with the percolating plant operating, the receipts from garbage would have been $4,313.44 over and above the cost of collection and disposal.

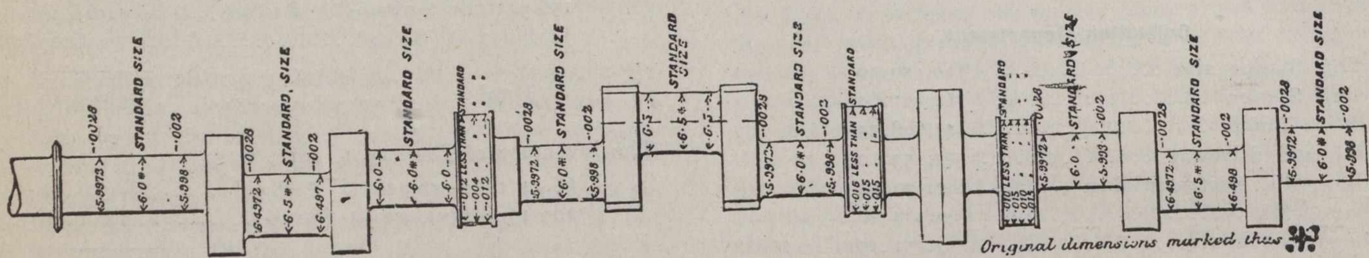
The total expenditures for the six months were as follows:—

Supervision and payrolls	$9,724.03	
Coal	2,349.75	
Electric power	843.90	
Repairs and renewals	849.24	
Supplies	548.13	
Office expense	185.78	
Miscellaneous	191.84	
Unpaid bills July 1st, 1911	839.52	
		$15,532.19
Inventory coal and supplies, July 1, 1911:		
250 tons coal @ $1.30	$ 325.00	
Pipe, fittings, supplies, etc	200.00	
		525.00
Total net cost of disposal		$15,007.19

This leaves a difference between receipts and expenditures of $14,608.43. As 7,066.13 tons of garbage were disposed of, this shows a net revenue per ton of garbage of $4.19, a net cost per ton for disposal of $2.12 and a profit per ton of $2.07.

THE WEAR OF MACHINERY.

How nearly forced lubrication can produce and maintain the ideal condition of confining all the wear to the oil is shown by the engraving on this page, which records the original and present dimensions of a three-throw crank-shaft, which had been at work for seven years. We are indebted for this information to A. L. Mieville, resident engineer for Canada, of Messrs. W. H. Allen, Son & Company, Limited, of Bedford, England, who designed and built the engine, and which firm is represented in Canada by Chapman & Walker, Toronto. It was intended to develop not more than 500 horse-power, with an occasional overload; but for seven years it has run for 12 hours a day and 300 days a year at considerable overload, the rate of revolution being 300 per minute. After all this long and arduous work the wear in many places is not capable of being measured, and in all other parts is merely microscopic, it being a noteworthy feature that all the bearings remained cylindrical.



Sketch of Shaft, Showing Original and Present Dimensions.

The crank-pins are all 6.5 in. in diameter, and all journals are perfectly round, and in all three cases this diameter has suffered no diminution in the centre. The ends, however, in two cases have been reduced a little, the smallest figure being 6.4972, a wear of $\frac{28}{10000}$ in. The bearings were originally 6 in. in diameter, and in one case there is no measurable diminution. In all cases the bearings have kept their original dimensions in the centre, there being in most of them a slight wear towards the ends, the smallest diameter in the six bearings being 5.9972 in., a reduction of $\frac{28}{10000}$ in. The eccentric sheaves, with their rapid surface motion, have suffered more, but in these cases the largest reduction is $\frac{15}{1000}$ in.

One lesson taught by these measurements is that lubrication only fulfils its ideal purpose of absolutely preventing wear when it is perfect. The oil is led to the centre of the bearings, and at that point it absolutely keeps the metals apart. But towards the ends the film falls off slightly, with the result that there is some wear, although it is so small that it is of no account, being nowhere over $\frac{5}{1000}$ in.

Here we have a crank-shaft 13 ft. long, with three crank-pins and six bearings, and conforming so closely to its designed dimensions that instruments measuring to the ten-thousandth part of an inch cannot detect a difference at any part. And, thanks to the care and skill applied to the lubrication, many of these dimensions have suffered no change after seven years of hard and constant work. Such results can only be attained by the modern tools, coupled with splendid management and organization.

Over 19,000,000 square yards of bitulithic paving have been laid during the last decade in Canada and the United States.

LOCH LEVEN HYDRO-ELECTRIC INSTALLATION.

In the course of his paper before the Institution of Civil Engineers of Great Britain, on the Loch Leven Water Power Works, Mr. A. H. Roberts, M.I.C.E., said the Loch Leven Water Power Acts were obtained in 1901 and 1904, authorizing the construction of works to utilize the rainfall of the western slope of Rannoch Moor for power for industrial purposes. The scheme possesses a number of advantages, including large catchment-area, heavy rainfall and high head, all in proximity to the seaboard. The author refers to the usual waterworks practice of reckoning only upon the mean rainfall of the driest three consecutive years, and suggests that in power-schemes of this character it might often be possible to obtain a greater output of power with the same expenditure. This could be effected by installing extra units of power plant (turbines, etc.), making a reduction in the height (and therefore in the cost) of the storage dam, and arranging to work the extra power in wet seasons.

The catchment-area for the Loch Leven Works is the basin of the River Blackwater, and is 55 square miles in extent, lying between Lochs Treig, Ossian and Rannoch and Glen Coe. Rain-gauges established in 1905 and 1906 have given average readings of over 70 in. for Blackwater basin and 80 in. for Kinlochleven. No compensation-water had to be supplied, this feature greatly increasing the available power. The site of the reservoir is favorably contoured for storage purposes, and the full reservoir is about 7½ miles in length and ½ mile in breadth. Its greatest depth is 75 ft., and it impounds over 20,000 million gallons of water. The Blackwater dam is 3,112 ft. in length, with a maximum height of 86 ft., its top surface being 1,068 ft. above Ordnance datum. About half its length is formed as a waste-weir in six horizontal steps of 6 in. each. The foundation is of an exceptionally sound character; only a few feet of the surface beds had to be removed to obtain a satisfactory foundation. The plant and materials required for the construction were brought by sea to the wharf and carried thence to the dam, etc., by an overhead cableway and an overland railway of 3 ft. gauge, which latter included two rope inclines. The cableway was driven by a Pelton wheel at the foot of the Falls of Leven. The dam is built of large blocks of stone embedded in a matrix of ordinary concrete, with fine concrete facework. The bulk of the cement was of rotary-kiln manufacture, and exhibited certain characteristics, which are described. Cracks due to the contraction of the concrete appeared after the dam was built, traversing it vertically from top to bottom. Reference is made to the question of inserting contraction-joints in large dams. The valve-tower contains the six valves of the three draw-off pipes, the spindles being carried up to the valve-house above top water level. The draw-off pipes lead to the upper penstock-chamber, whence the water is delivered over a measuring-weir into the conduit.

Water is conveyed to the pipe-track by this conduit, which is 3½ miles in length; it is of square section, 8 ft. by 8 ft., and is laid to a general gradient of 1 in 1,000. The construction consists for the lower part of a channel excavated in the rock and lined with concrete; while the work above rock level is of concrete reinforced with expanded metal and round bars. Expansion joints are inserted in the walls at intervals of 64 ft. Contraction cracks, however, appeared midway between these joints until the conduit was brought into use, after which they closed up entirely. The arrangements for the maintenance of the natural surface drainage are described, and also the methods of shuttering and concreting the work. Along the route of the conduit and above the same lies a catchment-area of 3½ square miles, with a rainfall of about 75 in., the greater part of which is drained by three streams. These have been laid under contribution by collecting their water and turning it into the the conduit. A description is given of their intake works and of the automatic valves for throwing off superfluous water. Electrical transmitters and recorders indicate to the valve-keepers at the lower penstock-chamber the changes taking place in the contribution of the side streams, enabling them to take advantage of the extra water and reduce the draw-off from the reservoir, thus storing an equivalent quantity of water in the reservoir. The conduit discharges its water into the lower penstock-chamber of about 300,000 gallons capacity, where it is measured and delivered to the pipes as required.

From the penstock-chamber water is conveyed to the power-house in six welded steel pipes of 39 in. diameter. The track is 1¼ miles in length, and the fall of 935 ft. yields a normal static pressure of 406 lbs. per sq. in. Pipes are supported upon concrete pedestals, and at the bends there are heavy concrete anchorages to resist the thrusts of the water and pipes. The pipes are made from one plate welded longitudinally, and vary in thickness from 10 millimetres (0.394 in.) at the top of the hill to 22 millimetres (0.866 in.) at the foot. With the exception of flange-joints in special positions the whole line is jointed with a special "muff" joint, a form of spigot and socket with joint rings for securing the packing material. Expansion is thus accommodated at every joint. The pipes were brought to the site by an overland railway laid up the hill alongside the track, and were lifted into position by specially-adapted derrick-cranes. Water is distributed from the six main pipes to the various turbines by a system of pipes comprising two omnibus pipes and six feeders, all of 39 in. diameter. Each "bus" pipe with its three feeders forms one complete system, the two systems being at different levels to enable branches to cross. One branch from each bus pipe feeds each turbine. The main valves which control the supply of water to the distributing pipes are of ordinary sluice-valve type, but specially designed to meet the combination of large diameter and high pressure. They are hydraulically worked, and are fitted with operating gear and automatic closing appliance, together with a mechanical device for controlling the speed of closing. At the top of the pipe-track, immediately below the penstock-chamber, automatic cut-off valves have been installed, of the usual "butterfly" pattern, to stop the flow of water in the event of a burst occurring on the main pipe-lines. At the summit of a slight elevation in the main line air-valves have been fixed of a special design to allow large quantities of air to pass in or out, as required, when filling or emptying pipes. The tail race is of concrete, the channel leading to an outfall in the River Leven.

The company have constructed a wharf and a jetty, both of timber, in Loch Leven; and have dredged a channel through the Loch Leven Narrows. A domestic water supply has been installed for the village and factories of Kinlochleven. It comprises a storage-reservoir with concrete dam in a neighboring valley, pipe-line, a service reservoir of reinforced concrete, and distributing mains. The dam at present is only carried up to half its ultimate height; this when completed will be 55 ft., and its length will be 440 ft. Contraction-joints are provided, and have proved efficient in preventing the occurrence of cracks.

The works have cost about $3,000,000, and are now the property of the British Aluminium Company. The construction was begun in August, 1905, and the factory commenced working in February, 1909. The engineers were Messrs. Thomas Meik & Sons, and Messrs. Kennedy & Jenkin in collaboration with Mr. W. Murray Morrison, the manager and technical adviser of the company. The principal contractors were Sir John Jackson, Ltd., and there were other subsidiary contracts. Mr. A. H. Roberts was resident engineer.

RETROGRESSION IN TENSILE STRENGTHS OF CEMENT.

At a meeting of the American Society of Civil Engineers, held in New York on November 15th, J. M. O'Hara, Assoc. M. Am. Soc. C.E., read a paper on the above subject. After taking up the specification for Portland cement adopted by the American Society for Testing Materials, which require no retrogression in strength between 7 and 28 days, the writer goes into an examination of the question as to whether or not retrogression is an indication of poor quality. Summarizing the principal ingredients of Portland cement and the action of the various chemical ingredients, he gives tables to show the action of American and European Portland cements at various periods between 7 days and 12 months, as well as the action of gypsum upon cement, and comes to the conclusion that the retrogression is probably due to calcium aluminates. He goes on to say: "The first strength is obtained from the calcium aluminates, as they hydrate quickly but the permanent strength is due to the calcium silicates, which are much slower in hydrating. The full tensile strength of the calcium aluminates is reached at one month, when they become more or less inert; at this age the calcium silicates are acting slowly, but are not strong enough to maintain the strain already reached by the calcium aluminates, hence retrogression takes place. The calcium silicates are constantly increasing in strength for an indefinite period, and gradually pick up the lost strength."

From the above he concludes that "if the action of the calcium silicates can be accelerated, so that the final strength is reached sooner, it is an advantage, and that this can be done in the case of American Portland cement by grinding the materials much finer and carrying a higher calcium silicate factor. The fine grinding accelerates the hydration of the calcium aluminates and silicates so that great strength is likely to occur at the 7-day period, and little or no gain, or even retrogression, at the 28-day period."

From this the writer proceeds to a table showing retrogression between the 7 and 28-day periods at intermediate dates at 10 and 20 days, and from this he argues that as this retrogression in many cases escapes detection by reason of the fact that the cement briquettes are only broken at 7 and 28 days, it is difficult to say that a cement giving these results is fit for use if one showing retrogression should be rejected.

The paper was discussed by a party of engineers who took the opposite side of the question, claiming that retrogression was an indication of defective manufacture and of inherent defects in the cement itself.

WIND PRESSURE AGAINST INCLINED ROOFS.

Experiments to determine intensity of wind pressure against inclined roofs were conducted during 1910 and 1911 by Mr. H. P. Boardman, of the faculty of the University of Nevada at Reno. He has compiled the results of his investigations in a paper presented on December 6 before the Western Society of Engineers, from which the following notes have been taken:

In these tests it was desired to approximate as closely as possible the conditions that exist in an ordinary building. To do this the model house as shown in diagram in Fig. 1 was built. The house was 10 ft. long with hinged roof and no projecting eaves, and was open on the leeward side. Shrinkage had developed some cracks in the walls, but an anemometer, held inside the house while the wind velocity was considerable, showed very little motion and no definite

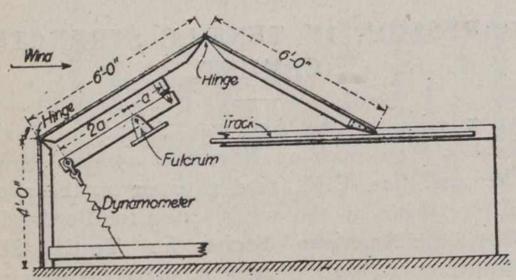


Fig. 1.—Diagram of Testing House.

direction to the air within. The two roof surfaces were covered with prepared waterproof roofing, and the gable ends closed with galvanized iron sheets, so hung as not to interfere with adjusting the roof. The adjusting was accomplished as shown in Fig. 1 by means of small grooved wheels supporting leeward roof and traveling on tracks as indicated. Small canvas curtains weighted with iron rods at the lower edge covered the opening along the windward eaves and ridge. The house was so mounted as to rotate through an arc of 60° in order to face the direction of wind. This was achieved by means of the centre post of the windward face acting as centre of rotation and three other posts toward the rear of the house with small wheels traveling on a wooden track. The prevailing winds are from the west, and the house was so placed as to command an unbroken western exposure to them.

The method of measuring the wind pressure against the roof was by means of a lever and spring dynamometer as shown on the diagram in Fig. 1. Standardizing the spring dynamometer gave a result of 144 lb. per inch of compression of spring, on dynamometer scale. Assuming the pressure normal to the roof to be uniformly distributed over its 60 sq. ft. of area, the value per square foot is found by the formula

$$Pn = (s - d) \times 144 \times 2 \times 4) \ / \ (60 \times 3)$$
$$= 6.4 \ (s - d)$$

where

Pn = normal component of wind pressure in pounds per square foot against an inclined surface.

s = dynamometer reading in inches at time of wind load.

d = dynamometer reading in inches due to dead load alone. An anemometer was used for measuring velocity of wind.

The method of taking observations was as follows: An observer stationed about 20 ft. to windward of the centre of the house held the anemometer at an elevation approximately equal to that of the centre of the roof surface. The inside observer watching the dynamometer signaled to the outside observer the time for starting the test, at the same time starting a stop watch; when dynamometer reading materially changed he signaled the outside man and stopped his watch. The outside observer had meanwhile automatically recorded the speed of the wind during the time interval of test, by means of a stop catch lever controlling the dial pointer of the anemometer without influencing the vanes. The estimated reading of the dynamometer, the duration of test and anemometer reading are then recorded.

Testing the anemometer used for possible inaccuracies it was found that the readings were too low for velocities below 12.8 ft. per second, and too high for those above that speed. The diagram, Fig 2, gives a graphical method of applying this correction and expresses the corrected velocities in miles per hour.

Individual velocities were first reduced by the formulas $V = 15 v / 22$ and $Pn = 6.4 (s - d)$ to get values of V and Pn. The values for V were further corrected by means of the diagram in Fig. 2, and such values as fell within the range of 1 mile per hour, e.g., between V = 10 and V = 11. were averaged and plotted as abscissæ, with corresponding averages of Pn as ordinates. In some cases individual observations were plotted, and for higher velocities than about 18 miles per hour values of V showing a range of 2 miles an hour or even higher were averaged. It was observed that all high velocities came in gusts, lasting from a fraction of a second to 10 seconds, but few recorded tests were for less than 2 or 3 seconds.

A series of observations by Mr. Sears and Mr. Miller with velocities not exceeding 20 miles per hour, when plotted, showed, for small angles of slope, the points grouped closely along straight lines, the slope of the lines increasing as the angle of inclination increased. This, according to the author, would indicate less pressure at high velocities than expected. Mr. Boardman's personal observations covered a range of roof inclinations from 40 to 70 deg. with velocities as high as 50 miles per hour. Several observations were taken at 70 deg. as pressure at that inclination should closely approximate that against a vertical surface. Negative pressures were obtained at low inclinations and

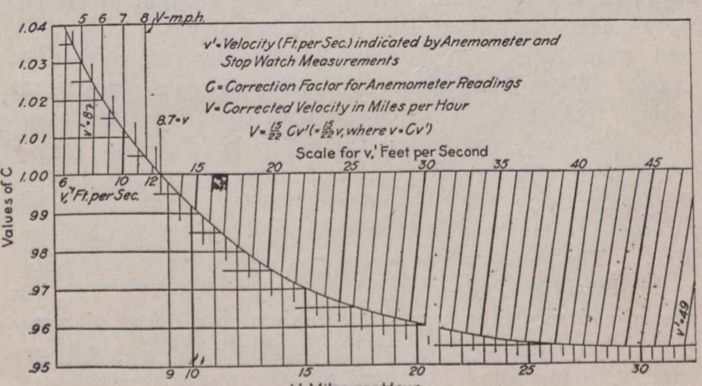


Fig 2.—Diagram of Anemometer Corrections.

explained as follows: The wind deflected upward by the windward surface of the roof tends to draw with it, and thus rarefy, the air over the leeward surface, thus permitting the air within the building to press upward sufficiently to produce a negative pressure.

In his discussion of results Mr Boardman states: The results of tests by Mr. Sears and Mr. Miller seem to indicate a straight line formula, as the relation between Pn and V for each inclination of the roof, and this appears to be further justified by those of later tests, notably at inclinations of 40 deg. and 70 deg., the positions at which maximum velocity was recorded. Hence a series of empirical formulas of the form $Pn = a V + b$ were deduced from plotted observations at inclinations of 15 deg. and from 20 deg. to 70 deg. inclusive, at 10 deg. intervals, by the selection of average lines through the points plotted.

In order to determine the relation at any given velocity between Pn and the inclination of the roof surface, the values of Pn were computed for velocities of 10, 30, 50 and 100 miles per hour, and for inclinations ranging from 15 deg. to 70 deg. by the straight line formulas above mentioned and plotted in Fig. 3. In the selection of average lines, consideration was given to the resultant effect on curves of Fig. 3, as it appears there should be some regular law of increase in pressure with increase in angle of slope. It is to be noted that results of tests at 40-deg. slope when plotted would not give consistent points in Fig. 3, for the respective velocities, but fell below. No explanation is offered for this discrepancy, especially as results of the last tests made at 40 deg. inclination gave the most definite location of any, to the average straight line.

Since the pressure produced when $V = 100$ miles per hour is the commonly accepted maximum used in designing, a formula was computed on the basis of $V = 100$ to fit the points plotted in Fig. 3. In deriving this formula it was assumed from the appearance of the curves that the equation would be parabolic with its vertex on the vertical, through 90 deg. inclination. The general equation of the parabola

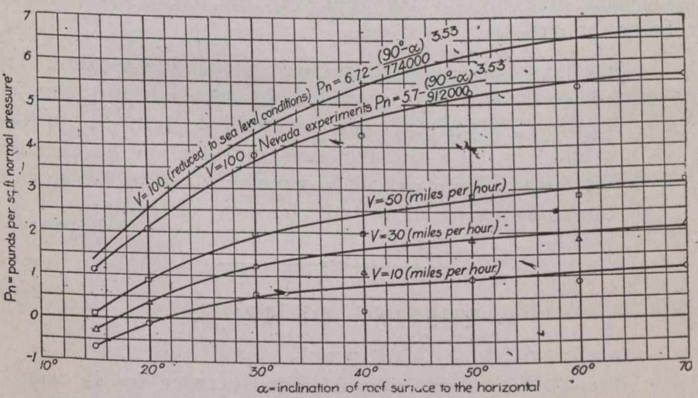


Fig. 3.—Relation Between Wind Pressure and Slope of Roof.

with its origin at the vertex is $Xn = Ky$ where n is an unknown exponent, and K an unknown coefficient. Hence n log x = log y + log K or log y = n log x—log K, which are typical equations of the straight line.

Assuming a value of Pn as the vertex of the parabola and passing this curve through two other points, we have two values of x and two of y, with corresponding values of log x and log y. From these either graphically or analytically the constants n and log K may be obtained. By trial we select $Pn = 5.7$ as the vertex, and expressing x and y with reference to the origin at the vertex we have: $x = (90$ deg. $\alpha)$ and $y = (5.7 - Pn)$ where $\alpha = 9\ \alpha$ deg. For other points, assigning values to x of 40 deg. and 70 deg., and $y = 0.5$ and 3.6; we have $\alpha = 50$ deg. and 20 deg. and $Pn = 5.2$ and 2.1. Passing a curve through these points and the vertex we obtain the following equation: $x^{3.53} = 912{,}000$ y or (90 deg. $- \alpha)^{3.53} = 912{,}000\ (5.7 - Pn)$. Solving for Pn gives $Pn = (5.7 - y)$ or $Pn = 5.7 - (90$ deg. $- \alpha)^{3.53}/912{,}000$. This equation plotted is shown in Fig. 3. Since the atmospheric pressure at sea level is about 18 per cent. greater than at Reno it was assumed that wind pressure would be correspondingly greater and the equation $Pn = 6.72 - (90$ deg. $- \alpha)^{3.53}/774{,}000$ was derived on that basis. This equation, plotted, is shown in Fig. 3 as adapted for general use.

NOTES ON THE THEORY AND PRACTICE OF PERCOLATING FILTERS.*

By J. E. Farmer, F.C.I., Sewage Works Manager, Croydon.

Before anything new can be put into practical form, the mind must have been at work, and worked out certain details, also the expected results.

How and when the idea entered the mind of the first one to put into practice the percolating method of sewage purification I cannot say, as I have not seen any definite record of the event. It was probably brought about by the action of rain falling on porous soil, and the purification effected by this means. The means of imitating the dropping of rain for the spraying of the sewage on the surface of the filters I do not intend going into in this paper, as they are well known. The theory of the percolating method of filtration is that when a foul liquid is passed over a surface, such surface becomes coated with the purifying agent necessary for the purification expected. In practice it is known that by this means purification is effected, but the simple theory as mentioned is only a portion of that required to explain the whole working of a filter. By allowing the foul liquid to flow over a surface one obtains certain results: it is quite natural the mind would work on the questions of the cause and also on probable improvements.

One factor that comes to one's mind on considering the theory is that of surface area. It would be expected that if the area were increased, greater purification would be effected. This is proved by the greater purification given by a clinker filter than one of gravel, the grade and quantities being equal.

On comparing the surface area of a material of different sizes, it is seen that with the same mass the surface area can be increased considerably.

Taking a 1 ft. cube measure, which would hold one sphere of 1 ft. diameter, containing 904.78 cub. in., it would have a surface area of 452.39 sq. in., but the same measure would hold 1,728 spheres of 1 in. diameter, the total area being 5,428.6 sq. in., and the mass 904.78 cub. in., the same mass as the sphere of 1 ft. diameter, but with twelve times the surface area.

Another factor that must be taken into consideration is the size of the space left between one particle and another forming the body of the filter. If the size is too small, the friction is too great for the proper passage, in the downward direction, of the solid matter, also for the movement of the air.

Taking the same measure and spheres as above, the size of the spaces, with 1 ft. diameter sphere, would be 205.8 cub. in. each, and with 1 in. diameter 0.48 cub. in.

These calculations being made from mathematical figures, the results are more correct than those which can possibly be obtained in practice, but they are useful in giving an impetus to the mind to work out an ideal filter.

In the theory as mentioned the following conclusions are arrived at:—

(1) The smaller the particles comprising the filter, the greater the surface area.

(2) The smaller the particles comprising the filter, the smaller the individual space between the particles.

In my opinion, these two conclusions have a great bearing on the construction of a filter, when the work expected to be done is taken into consideration—namely, the

* Paper submitted at a meeting of the Association of Managers of Sewage Disposal Works at Croydon.

oxidation of the matter in suspension and the purification of the liquid. If the space between the individual particles is of such a fineness that the resistance to the passage of the solid matter is greater than the accumulation rate, choking is the result, also ponding of the surface.

The capacity of the interstices can be decreased, not only by using smaller material, assuming it is all one grade, but by mixing a small grade and a large together. This is apparent when the capacity of the interstices of any given grade of spheres is taken; for instance, 1-in. sphere—a cube foot would take 1,728 spheres of at least ⅜-in. diameter, and reduce the total capacity of the interstices from 832.22 to 775.5 cub. in., would but increase the surface area from 5,428.6 to 6,191.8 sq. in. The remaining interstices would still take a sphere of about 1/16 in. diameter, and still further increase the surface area, but with a lessened interstical capacity.

It is obvious that to increase the surface area by so mixing the grades, the resistance to the passage of the solid matter and air is increased.

A general conclusion of the foregoing is that the following are factors that must be taken into consideration before determining the grade of material to use:—

(1) Quality of the sewage liquid required to be treated.
(2) Quantity required to be treated on any given area.
(3) The degree of purification required.

In practice many materials are used, because of their cheapness or proved suitability. Clinker is the material mostly used, as in thickly-populated districts it is a by-product from the manufacture of products that have become necessitous with the rise of civilization. In other places gravel, waste from potteries, and so on, is cheaper, but cheapness should not altogether be taken as the main reason for the use of any particular material, as it may not have the properties required to produce the desired purification. Clinker has the advantage over many materials in having a large surface area for its mass, and so is very suitable, giving a greater degree of purification than smoother-surfaced material.

A material may be composed of such different-sized particles that when not graded the interstices may conform to that which is required for the filter; but care must be used, as the obtaining of a solid mass, as in the mixing of materials for concrete, is to be avoided, that which is to be kept in mind being maximum surface area with the maximum interstical volume. To obtain these maxima, clinker is generally used, and the filter built up in grades, the larger size at the bottom decreasing in size to the top.

By having the small-sized material at the top, the surface area per cube unit is greater than the lower depth, thereby arresting the solids on the surface layer of the filter, where it can obtain a greater amount of oxygen than lower down the filter.

The advantage of having the larger material at the bottom of the filter is the increased drainage effected, as the resistance through friction is much less than it is with the top layer of small material.

Experience has proved that good drainage of the lower portion of a percolating filter is absolutely necessary, and to obtain the best results a smooth-surfaced material, such as gravel, is found to be the most efficacious.

There are many things connected with sewage purification that require elucidation before it can be said to be on a strictly scientific basis; but with the combination of the labors of all those working on the subject, and patient investigation by those working every day on the purification of sewage, this subject may in the future be on as much a scientific basis as many of the industries are to-day.

One who sees a filter every day notices that there are many changes taking place during a year. For instance, at times the surface is covered with a dirty, greyish-colored growth. After a time this gives place to a greenish-colored growth; at another period there is no growth perceivable; sometimes the various growths are in varying-sized patches; also, the amount of humus matter being discharged increases suddenly, and the degree of purification at times is unaccountably affected.

To find out the cause and effect of these changes will no doubt help forward the solving of the problem of sewage purification, and assist in placing it on a scientific basis, so that any sewage works manager who has the courage to tackle the investigation of any one of the changes that goes on in a percolating filter will have his patience well tried, and if successful will be rewarded with the pleasure of having attained something towards building up the science of sewage purification.

Where, as in most instances is the case, the expenditure in the construction of the filters is limited, it is much better to spend money on that portion necessary for the purification, such as the distribution, filtering media, and drainage, than on having artistic walls, as, no matter how pleasant to the eye a set of filters may look, if they do not do the work expected of them, the manager does not derive much benefit from the artistic appearance.

Sewage purification, as regards the liquid portion, has got to such a pitch that, provided the money is forthcoming, any degree of purification can be attained; but the question in my mind is, Can the the same purification be obtained with less expenditure or can a greater quantity be purified with the same purification and the same expenditure?

RUSTING OF IRON.

Wrought-iron work, if not properly cared for in respect to painting, or under conditions otherwise bad, may be expected to rust at a rate which corresponds to the loss of ⅛-inch on each surface for from fifteen to thirty years; but with proper care as to painting, and exclusive of exceptionally bad conditions, it does not appear to waste at any measurable rate. In some instances, upon scraping the paint from girders which had been in use for thirty years, the writer has found, beneath the original red lead, the metallic surface, brigh and clean, showing no trace of rust. Of ordinary steel work the same cannot be said, the common experience being that mild steel is very liable to be attacked by rust. With common care in the bridge-yard during manufacture, such that with wrought iron no after trouble would be noticeable, steel is very liable to show, within a year of being built up, numerous little blisters on the painted surface; any one of these being broken away discloses a small rust-pit. This is more often seen on the flange surfaces (horizontal) than on web surfaces (vertical), but it is probable the position has little to do with the matter, and that it is rather due to the fact that rust has been earlier started on the flange-plates, upon being put through the drilling machines and inundated with slurry, which occurs only to a more limited extent with webs having fewer holes. The heads of steel rivets do not show this tendency to "pit" or to early development of rust. The riveting is about the last operation in making a girder, each rivet being freed of all rust by heating, and quickly coming under the protection of oil or paint.

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ENGINEERING OUTLOOK FOR 1912.

The past year has been an active one for the construction engineer and the contractor. Never before in the history of Canada has there been so much money spent in one year on the extension of railways, installation of water plants, construction of sewerage systems, the erection of bridges, large factories and office buildings as was expended during 1911.

In the Annual Statistical Review of The Monetary Times Mr. E. A. James in a comprehensive manner analyzes the prospects for 1912.

The business activity and expansion have not yet reached in Canada their greatest activities, and, as 1911 exceeded 1910 in this regard, so will 1912 exceed 1911. In the past we have been an agricultural country. Our energy has been directed to the opening of the new lands, and, although this has been expensive, yet the returns have been immediate. To-day we are acquiring the solidity of an older community. We are opening high office buildings, developing rapid transportation routes, highly efficient sanitary schemes, large factories and manufacturing establishments, and extending into the urban, suburban and rural communities the telephone wire and electric circuit.

During 1911 the expenditure of public money on construction work in Canada exceeded $300,000,000, and, with the work not yet completed and the prospective work which will probably be carried out, the figures for 1912 will exceed these by at least $50,000,000.

The city of Toronto, for instance, for extension of railways, bridges and electric light system requires $9,000,000, a third of which will be spent in 1912, or on this item alone $7 per person. The Ontario cities and towns generally are but little behind this high average. Berlin will spend $100,000 on a waterworks system; Chatham will spend $40,000 on pavements; St. Thomas will spend $45,000 on waterworks extension; Hamilton will spend $550,000 on waterworks extension, $500,000 on Hydro-Electric distribution system and $180,000 on pavements; Welland will spend $60,000 on pavements and $20,000 on the water system.

In Western Canada the activity is even greater. Saskatoon will spend on pavements $400,000, sewerage system and extension $300,000. Prince Albert is likely to spend on the power scheme $750,000, while the sewerage system will take $200,000 for its extension. Moose Jaw is planning for extension of the municipal work, the figures being $1,000,000.

Winnipeg, which has spent many millions in municipal improvements, requires $1,500,000 for 1912 for: Pavements, $500,000; sewers, $150,000; waterworks, $100,000; walks, $100,000; subways, $600,000. This expenditure is not required for municipal frills and luxuries, but for absolute necessities in a growing city.

The activities of the West are not confined to the prairie provinces alone. The growth of railway mileage in British Columbia, the extension of the Grand Trunk highways, the development of Pacific ports, all require an expenditure of large sums and compel municipalities to press forward improvements.

Cranbrook will complete the sewerage systems at a cost of $100,000. New Westminster, having completed a $1,000,000 water scheme, have now before the public by-laws aggregating $100,000 covering garbage disposal and sanitary measures, and will likely expend this year on pavements at least $100,000.

Eastern Canada showed unusual activity last year, and the prospect for the present year is even better. The increase in the population in Quebec has been followed by a general demand for improvements, sewerage and lighting schemes, quicker transportation. The opening of new territories by the Grand Trunk Pacific is creating new activity on the both sides of the St. Lawrence.

In the Maritime provinces the activity has not been so great, but the possibilities of these provinces are being more fully recognized, and the development of water power and the opening of new territories by railways is causing unprecedented activity in construction work. In St. John, N.B., the Government and railways will commence spending $1,000,000 on harbor and docks; Halifax, N.S., will spend on sewers $100,000 and on a standpipe for water $50,000. At this port the Intercolonial Railway will commence in 1912 the $1,000,000 deep water terminal.

With these special cases of municipal expenditure and with the knowledge we have of the probable expenditure of the provinces and by the Dominion on capital account we can arrive at a close approximation of the amount of money that Canada will have to borrow during 1912, in addition to the amount of money that will be spent out of current account.

For Dominion purposes	$35,000,000
For railways, electric and steam...	10,000,000
For municipal improvements	64,000,000
For provincial expenditure	60,000,000

To this large total must be added the amount of money that will be spent out of current revenue, an amount equal, if not in excess of the figures given above. Canada is expanding and developing to-day as is no other nation. Her requirements are great, and it is fortunate that her borrowing power has not yet reached anything like its limit, and the Canadian debentures and bonds, whether municipal, provincial or Dominion, are quickly absorbed in the money markets. So long as this is true, the Canadian engineers and contractors will be the important men in the growing community.

AN EXISTING DANGER.

Fire Commissioner Latulippe and Fire Chief Tremblay, of Montreal, have expressed definite opinions repecting fire precautions and regulations in that city. These, they say, are extremely lax, and will bring home the responsibility for fires in cases where buildings are used for purposes for which they are not designed. The fire commissioner says that if the city were more watchful the number of fires in Montreal could be halved. The fire chief describes the present by-laws as farcical. These points were brought out at the investigation into the fire which occurred at the premises of a garage.

Chief Tremblay stated that the building was in no way adapted for a garage, and was not intended when erected to be put to that use. If such a fire had occurred in any of the great cities of Europe under circumstances of this kind, the parties connected with it would have been amenable before the law. The chief also expressed the opinion that the city by-laws in regard to motor garages were useless, and further, that the system of enforcement of the existing by-laws was not sufficient.

At the conclusion of the taking of evidence, Fire Commissioner Latulippe expressed the opinion that a fire of this kind made it clear that if the city authorities were a little more strict in regard to fire rules and regulations, one-half the fires that occurred might be eliminated. He was in favor of a by-law being passed which would render it a penal offence to provide a building that might prove a fire-trap, or to use a building in such a way as was obviously dangerous in view of the fact that it was put to a use for which it was not intended when built. Such a by-law, suggested Mr. Latulippe, should be made to hold liable all concerned in its construction and use, the architect, contractor and the owner, a provision which would result in enhanced care and greater scruples on the part of all concerned, and would thereby materially diminish the heavy fire bill of the city.

These are matters which cannot be left for innumerable adjourned discussions. It is the duty of the Montreal civic authorities to deal immediately with such a serious phase of the fire waste.

EDITORIAL COMMENT.

Motion pictures were used to illustrate work on placing underground conduits and construction work incidental to this in a recent lecture to the Canadian Society of Civil Engineers. This is the first time to our knowledge that motion pictures have been used for such purposes. There is, no doubt, a wide field for their use along these lines, for they afford a most excellent means of showing methods of construction and design.

* * * *

We draw attention in this issue to an address by Mr. D. H. Browne, which was delivered at the School of Mines dinner, Queen's University, recently. In this address Mr. Browne takes issue with the thoughts expressed by Mr. Crane, who has created such a discussion by his attacks on college education. We must congratulate Mr. Browne on his eloquent and closely-reasoned defense, and we publish it with the hope that it will be widely read.

* * * *

Mayor Geary, of Toronto, has received an answer from Mayor Gaynor, of New York, in response to a letter asking Mayor Gaynor to recommend a competent man for the Park Commissionership for Toronto. In it Mayor Gaynor suggests that he has sufficient to do himself to appoint his own Park Commissioners. We would suggest to Mayor Geary that he endeavor to locate a Canadian for this position. The late Park Commissioner Wilson was a Canadian, and received his training in the Queen Victoria Niagara Falls Park. If Mayor Geary will use a reasonable amount of energy in looking around, he will find competent men to fill this position without advertising in another country.

* * * *

The Dominion Power and Transmission Company, which supplies power to Hamilton, Ontario, is again having trouble with anchor ice at their intake. The city of Hamilton was in darkness a couple of nights last week, all traffic on the street railway and suburban lines being tied up also. Similar trouble last year caused heavy losses to the manufacturers and laboring men there. Where hydraulic power companies are so located that there is liability of interruption of such a nature, means should be taken to have a standby in the shape of auxiliary steam power. Power companies with extensive transmission systems supplying widely-spread territories, with many industries and public utilities dependent on them for power, must of necessity take every precaution to prevent interruption of service. And in many cases the auxiliary steam plant is the only sure way.

THE IDOL OF QUICK RETURNS.*

By David H. Browne.†

There are here at Queen's University some 1,200 students, who have come here to spend from four to six years of their life in the pursuit of some definite object. These students will each spend, perhaps five hundred dollars a year, in railway fares, college fees and living expenses, which means that about $600,000 a year is expended by these young men and women. In addition to this they have during this time surrendered their earning power and become non-producers. We will assume that during eight months of the year these young people are idle, and that their earning capacity is $50 a month. This amounts to a monetary loss of at least $400,000 a year. So that I am quite within the bounds of reason when I say that it costs these students at least one million dollars a year to maintain their attendance at this university.

Now, why do they do this? No one pays out money, none devotes his time, his labor, his ambition in this way without hope of recompense. Ask these boys and girls, and they will answer that they do this in order to be successful in life.

Success in life. This means two things, greater earning ability and greater enjoyment capability. The end of life is happiness.

Happiness is not mere Hedonism, not the simple pursuit of pleasure for the sake of pleasure. Happiness means the attainment of man's best, highest, noblest desires. We seek for riches, not for the sake of money alone, but for what we can do therewith to further our physical, mental and spiritual welfare. I take it that these students are here at Queen's in order to gain two things, first the ability to attain a higher position in life, and second the capability to enjoy that position when they have attained it.

The first proposition is then that these students came here with the idea that when they leave college they will be able to earn more and to fill higher positions than if they had never attended college.

Is this correct?

I have here in my hand a pamphlet written by R. T. Crane, President of the Crane Company, of Chicago, which is entitled, "The Futility of Technical Schools in Connection with Mechanics and Manufacturing or Electrical and Civil Engineering." This pamphlet and several others along the same line have been widely circulated. They contain a very violent attack upon the technical schools of the United States, and while the Canadian schools are not mentioned, Mr. Crane's arguments are perfectly applicable on this side of the border. It seems to me that these ideas are false, illogical, and dangerous, but in order to show why I thus deny them, it is necessary first to state Mr. Crane's ideas in order.

Quote Mr. Crane's pamphlet on "Futility of Technical Schools" from page 4 "Importance of starting out in life" to page 7 "However as you cannot."

Mr Crane then goes on to show that a graduate of a technical school will go to work for the General Electric Company for two years in the testing department at 20c. an hour, and will then spend two years more in the engineering department at 27½c. an hour, brings the boys to 27 years of age, at which time, as he says, they will be very lucky if they can go out and secure a job at $3 a day.

Mr. Crane's remedy for this is given in his pamphlet, under the caption. Mr. Crane concludes by accusing the college authorities of sharp practice.

Now, Mr. Crane's attack is directed against American technical schools, but it is reasonable to suppose that his arguments are equally applicable to those on this side of the border.

There are, however, some important points upon which our Canadian schools differ from the American. It is customary in the States to carry a course of nine months, even in some cases of eleven months work. On this side our custom is to limit the class work to a period of five or six months, and to allow the boys to spend three or four months of each year at practical work, in the mine, smelter or shop, according to whatever branch of scientific work the boys intend to make a specialty of. It has been my privilege at the smelter at Copper Cliff, to hire a large number of Canadian students during the summer months. The majority of these are hard-working, diligent, intelligent men, keen to grasp a new situation, and manly enough to accept the discomforts incident to the work, in a cheerful way. We are glad to have them there. Those who make good are always welcome again. Of course, as in any other body of men, there are a few goats. I have had a student come to me after a week's work around the furnace and ask for his time, giving as his reason that he wanted to get away, as he had learned all there was about the work, except the details. He got his time.

But the vast majority of Canadian boys are manly and self-reliant. My only regret is that more of them do not stay with us. Like all other commercial enterprises I know of, we are always hard pushed, to find among our men some men of intelligence and experience to make foremen. I can assure you that such men are hard to find. Many times we have had to put in responsible positions men who were none too well qualified for these positions, simply because no other was available. What we and many other firms need is bright young men who will remain in our employment, even if their present positions are not exactly to their liking, until we have had time to move them from one department to another in order that they may get a broad experience in this work. But very frequently the very man we have talked over and planned to move into some more responsible position, gets another opportunity offered him elsewhere, and when we want him, he is gone. This fact which I wish to emphasize, shows very clearly that the demand for such intelligent work as these boys give is greater than the supply. This fact disposes in very large measure of Mr. Crane's argument that the technical schools turn out a lot of young men who are worthless to their employers, and who can not obtain responsible positions. But Mr. Crane goes on: These technical school men are not fully trained craftsmen, they are not competent along any one line. They come out of college and have to compete with the uneducated laborer, who, by sheer dint of sticking to one line of work, has mastered that line, and is receiving good wages. This is very true. Take a college boy who has studied, say electrical engineering, goes into the shops at Peterboro'. He finds there men who can do the work he is put at far better than he can, men who know nothing but this particular work.

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*Address delivered at dinner of School of Mines, Queen's University, Dec. 12th, 1911.

†Superintendent Lake Superior Corporation.

These are his competitors. He has to accept their wage rate, and pit his brains against their experience. He is at a disadvantage for a time. If he considers his present condition only, he may regret that he had not followed Crane's advice, which, you will remember, was to omit the technical school course, go directly into a shop, and spend four years of practical training at one line of work.

Now, all I say to this is that if a boy desires to become a highly efficient machine, this is certainly the best way to go about it. The modern shop is always in advance of the technical school, the surrounding influences are all in one direction, and a young man thus spending six years of his life is undoubtedly a better craftsman, and can immediately earn higher wages than one who has spent four or six years in a university.

We will admit once for all that there are some subjects which a university or technical school cannot teach, does not attempt to teach, and should not be expected to teach. A university does not aim to make machines, but to make men. It does not take a boy and perfect him along one narrow line. It aims to lay broad foundations, to inculcate principles, to train in culture, to foster a taste for all that makes life liveable and men and women lovable.

Take this technical school here for example. If a boy wishes to become a mine foreman, or a smelter man, or an expert winder of commutators, he will never get that training here. Any of your professors would advise to go into the mines at Granby, or the smelter at Copper Cliff, or into the General Electric Works at Peterboro'. In four or five years he would be a skilled craftsman, he would earn three or four dollars a day, he might even be in charge of some commercial enterprise—but that is all. He would be successful as he measures success—but what a price to pay for such a limited success. Like Selkirk on Juan Fernandez, he is monarch of all he surveys, but how far can he survey; how limited his horizon?

Many, many generations have gone by since the preacher said: "Where there is no vision the people perish." Where there is no vision, no broad outlook on life, no scope for larger ambitions. What phrase could better describe the condition of one who spends his best years in mere striving to learn a craft whereby to earn his daily bread.

This is all the training, such as Mr. Crane proposes, can give, the certainty of daily employment. Is this, then, all we are to strive for? Is the training we get here simply a meal ticket?

I claim that life is more than this. Man cannot live by bread alone. Remember that happiness arises not merely from greater earning power, but from greater capacity for enjoyment.

There are schools, exactly such as Mr. Crane describes, where a man can learn to be a telegraph operator, or a stenographer, a watch-maker, or a barber, and at the end of his training course he comes out a brisk, useful craftsman, needing only practice to make him perfect.

But what profiteth it a man if he gain the whole world and lose his capacity for enjoyment? Wherein is he a gainer if he can earn a living, and his life is not worth living? He can wind a commutator, but he has never heard of Franklin or Faraday. He can cut stone or mix paints, but is blind to the smile of the Venus of Milo or the grace of the Sistine Madonna. He can tune a piano, but is deaf to the pathos of Beethoven and the pious exaltation of Handel. He can survey a wilderness into town lots, but has never lifted his thoughts to the Pleiades and the flashing belt of Orion. He has mastered the books of the Scranton Correspondence School, and has never heard of the madness of Hamlet, or the troubles of Tristram Shandy. He can work for a party victory in his own riding, and knows not that his liberty to vote was won by Pyne and Hampden and William the Silent and Stephen Langton. He is living by bread alone. He has no vision, he cannot see the world as a whole, he has bartered his birthright for a mess of pottage, and sold his manhood for a meal ticket.

You are taught here many things which may appear to you dry, tedious, irrelevant, uninteresting. Never mind that. You will forget more than you will remember. But always remember this: it isn't the water that stays in the fleece that scours it, it's the water that goes through the fleece. It isn't always what you remember that does you most good, it is the act of grasping new ideas, of fixing the attention, of facing novel problems, of training your brain to act quickly in emergencies. These studies you grind out here are useful, not solely for what you remember of them, but for what they suggest to you.

Mathematics is not, as the Beloved Vagabond says, a lot of damned facts about triangles, it is the plan on which the Creator fashioned the universe.

Chemistry and biology are not the mere study of reactions and adaptations, they are the keys to all life, past and present. Mining and metallurgy are not hand-crafts, they are the factors that open new continents and change the map of the world. French and English are not simply languages in which to call for another wheel-barrow of concrete, they are the open doors to the literature and history, the wisdom and pathos, the wit and humor of a thousand years.

All this broad outlook on life is summed up in one word —culture. No one can give you this, but every college gives you an excellent opportunity to attain it. Culture, friendship, inspiration—these are the three things that make life worth living, three things which are here for you to grasp and take with you.

Culture, as I have said, comes from the study of broad principles, and can never be attained by undivided attention to one narrow subject. Here in these halls, among these libraries and museums, you have the chance to attain it.

Friendship, the good-will and affection of your fellows is here also for you. You cannot dig this out of dead books. Here around you are young men who may be leaders of the future. Learn to know them, find out the best that is in them, be loyal to them, for as the Norse proverb says: "Back is bare without brother behind it." The loyalty you give to the captain on the campus is the same loyalty that has made Canada a great country, and some day will make it, in name as well as in fact, a great self-governed, self-centered nation.

Inspiration meant the inbreathing of a great spirit, the breath of life in man's nostrils. We cannot define it, we cannot analyze it, we can only feel it, as we feel a chord in music. It comes from the consciousness of the presence of the mighty dead who have moulded the nation, it comes from the companionship of noble men and women living around us, from the memories with which the college halls are hallowed. You know the feeling that comes over you in a close-packed crowd when the leader rises and you see the tense upturned faces around you and hear the quick intake of breath, as the truth he speaks sinks home. You picture the gaunt figure of Lincoln at the National cemetery and the hushed audience that hangs on his words as he gives them the greatest speech ever made in the English language, the matchless Gettysburg address. They turn away, too deeply moved to applaud, too much uplifted to cheer, because they have received the inspiration, they have seen the vision.

There has been in every college some man around whom the highest and noblest ideas have crystallized, men who have moulded the nation, such men are our greatest inspirations. Such men as Arnold of Rugby, Elliot of Harvard, Wilson of Princeton, Angell of Michigan, are fit companions of the greatest Grant of Queen's. These are the men who have made us men. Can any narrow course of training such as Mr. Crane desires, give us anything for which we would exchange these memories? Never. Man cannot live by bread alone.

You will go from here in a few years less skilled perhaps in the profession you enter than many a trained apprentice, you may earn less for a few years than if you had never come here, you will have your struggles as we have all had, but if you have learned how to be thorough and manly and self-reliant, to be honest and kindly and clean, in a word, if you are true to the tradition of Queen's you cannot fail of success; but when you do attain your ideals you will have brought with you a greater capacity for enjoyment, a broader outlook on life, a nobler patriotism, and a higher ideal than if you had never spent these years at Queen's, for you will take with you somewhat of these three, culture, friendship, inspiration, to broaden and brighten your life, and you will have glimpsed the vision without which the people perish.

CONCRETE SIDEWALKS.

By S. B. Code, O.L.S.

Owing to the superior qualities of cement concrete, as well as to its low cost in comparison with that of other materials formerly used, concrete sidewalks are now almost universally used in every city, town and village. All the requirements necessary in a walk are met with by this material, the chief of which are (1) an even surface, (2) solidity, (3) durability.

Specifications for sidewalk construction are not new, and it is not the intention of the writer in this short paper to give a list of specifications, but rather to deal with the question of what is the best mehod of carrying them into effect.

Some municipalities adopt a system of building their walks by day labor, others the system by contract. In the former case a foreman being employed, in the latter case an inspector looking after the work. The responsibility of the whole work devolves upon either of these men. When the work is done by contract and an inspector is appointed, it has been the experience of the writer that municipal councils are not careful enough about the selection of the inspector. Either they look to the side of cheapness and give the position to the lowest bidder, or else through sympathy or influence on the part of the members engage an incapable. The inspector should be a man of integrity, ability, and beyond suspicion, also possessing some energy, and not one who on a hot afternoon will sit down on a doorstep and go asleep while the contractor is at the same time "making hay while the sun shines."

The possibilities of cement-concrete are probably not fully appreciated, while it is also a fact that defects are to be found in concrete construction, and especially in walks, but these defects may in most cases be traced to lack of knowledge of the materials used in construction, to inexperience in such construction, and to neglect and failure on the part of the builder or inspector, to appreciate the importance of the minor details. Cracks in walks are not always caused by an improperly prepared foundation. A fractional part of a block should not be left over even for suspension of work at the noon hour. This often occurs, and when work is resumed fresh concrete is placed against that laid in the forenoon and a top coat placed over all. The concrete in the separate parts will not properly bond, and the result is invariably a crack in the walk at this place.

To obtain best results only first-class materials should be used. The labor is the largest item and costs as much for laying the walk with poor materials as with good materials. First-class materials, skilled labor, complete specifications, a capable and efficient inspector who will see that the specifications are enforced, should give good results. Very often the inspector is too lax, and carelessness of one kind is encouraged by another. The selection of materials is the first consideration and is an important matter. Portland cement of high grade should be used, the same subjected to a close test, as it is well to take nothing for granted. As more reliance can be placed upon a reputable brand of cement than upon a natural deposit of sand, gravel or stone, it is thus important that the quality of the aggregate should receive careful attention. The surfaces presented by the particles composing the aggregate should be hard and permanent. A covering of any fine superfluous material will interfere with the cement or mortar getting into contact with the surface of the aggregate and thereby reduce the strength proportionately. The aggregates should be well graded and should not contain an excess of one size particles and a small amount of fine particles. The crushed stone should be hard and durable, clean and free from a covering of dust or other matter. In sand and gravel one is dealing with entirely different materials, and materials that should be selected with great care. Shaly particles are undesirable because they are both weak and unstable, and a concrete can never be stronger than the material making up the aggregate. The size of the sand grains and the relative proportion of grains of different size have a very marked effect upon the value of the sand. At least 75 per cent. of a sand should be retained on a 40-mesh sieve with the particles well distributed between that size and the size passing a 4-mesh sieve, with an increasing proportion on the coarser sieves. Such a sand will have much less total surface than one sand made up entirely of fine particles will present a very much larger surface which must be covered with cement than either of the sands above mentioned. The total superficial surface of a given volume of spheres one-eighth of an inch in diameter is four times the surface of the same volume of spheres one-half an inch in diameter. To obtain first-class concrete it is necessary to perfectly cover every particle of sand with cement, and every particle of the coarser aggregate with the cement sand mortar. It is therefore essential that materials with an excess of fine particles should not be used. Compressive strength is in favor of the coarser material. To give the maximum strength and use at the same time the least cement, the aggregates should be so graded as to have each successive size material fill the interstices left by the preceding larger size. It has been found by experiment that aggregates exceeding one and one-fourth inches in diameter should not be used. The lower limit, one quarter of an inch, which is also the upper limit for sand and stone screenings, is almost universally accepted.

The foundation should provide a permanent bed for the walk, and serve as a means for disposing of water which would otherwise accumulate under the walk. It is very important that the foundation should be so constructed that neither time nor the elements can change its ability to support the walk. It is usually necessary to prepare the sub-grade, upon which the foundation is established. If the soil at the excavated grade is firm and solid there is no necessity for further preparation, but if it contains any soft, boggy or spongy places, these should be removed and the holes filled with firm material and thoroughly consolidated by ramming or rolling as the filling progresses. The preparation of a fill for the sub-grade requires care. The upper portion of the fill should be tamped in layers not to exceed six inches in thickness. The sides of the fill should be given a slope of not less than 1½ to 1, so that it will not slip away, and when granular materials are used the sides should be banked on the slope with sod or clay.

Any piece of work is large enough to justify a study of the aggregates for the purpose of determining the correct proportions. It has been stated that the ordinary mixture for water-tight concrete is about 1 part cement, 2½ parts sand and 4½ parts coarser aggregate, which requires 1.37 barrels cement per cubic yard of concrete. The most practical way of arriving at the proper proportions is by the determination of voids, or space that is occupied by air. In order to eliminate the error which might arise from absorption of water in the process of determination of voids, the material, if dry, of porous, should be wetted slightly and afterwards dried so as to remove this moisture from the surface. In the actual process of determining the voids, a cylindrical vessel of metal of 1 cubic foot capacity may be used. The vessel is first weighed and then filled level full of water and weighed again. Call the net weight of the water C. Empty and dry the vessel and fill level full with the aggregate. Call the net weight of the aggregate B. Pour water slowly into the aggregate until the vessel is again level full of water. Call the net weight of the aggregate and water A. The formula then is per cent. voids equals $\frac{A-B}{C}$ 100. To determine voids in sand and stone screenings, the sand should be poured into a vessel containing water. The object in doing this is to eliminate the air, which is impossible if the order is reversed. When the vessel is level full of sand and water, the weight is determined and the formula given for the coarser aggregate applied.

Proper mixing of the materials composing the concrete is very important. Machine mixing has its advantages and its disadvantages. The sand and cement should be first mixed dry and then mixed wet into a homogeneous mortar. The coarse aggregate previously mixed should be added to this mortar, and all thoroughly mixed together. Hand mixing, if carefully done, is entirely satisfactory. Oftentimes mixing is sadly neglected, or is entrusted to unskilled laborers who have little or no appreciation of what is really necessary and less interests in final results. Machine mixing with the batch type of mixer is reliable.

About every fifty feet a good expansion joint should be made. This may be accomplished by replacing one of the wooden cross forms by a metal parting strip, which should be left in the walk until it is open to traffic, when it will be removed and the opening thus produced filled with pitch or other suitable material.

Care should be exercised in adding water to a concrete mixture, because, as is often the case, the water is thrown on a bucket full at a time, and the cement is thereby washed from the mixture. The water should never be added faster than it can be taken up by the materials. When additional water is required in a mixture it is a good practice to add it in a spray.

Concrete or mortar which shows preceptible hardening or drying out should not be re-mixed nor used. Any disturbance of concrete after hardening has begun will weaken it.

Where hand-mixing is made use of the concrete is usually mixed on a water-tight platform, and the size of the batch may be governed by the speed of mixing and depositing in place. Before placing the sub-base should be previously wet and tamped and the concrete deposited immediately after being made, having regard for the preservation of the proper proportions. As the concrete is usually deposited with wheelbarrows, there is a tendency for the cement, being fine, to be carried in suspension with the surplus water away from the other materials. On hot drying days the loss of water by evaporation from the mixture should be prevented, as it forms an essential constituent part of the concrete.

The top finish, when put on separate from the concrete, should be a mixture of one part of cement to one and a half parts of screenings or coarse, clean sand. This should be put on immediately after the concrete has been consolidated. Any time which elapses between the laying of the concrete course and the laying of the finishing course, will seriously interfere with the bonding of the two. The longer the interval the more drying out will take place in the concrete, and there is no assurance that a perfect bond can be attained, except by special treatment, such as cleaning off any dust, sand or foreign matter and applying a wash of neat cement and water.

A very important point in sidewalk construction, and one which is very much neglected, is the making of proper expansion joints. Usually the place for the joint is marked on the edge of each form and an attempt is made at making a sort of indifferent joint by forcing a thin piece of iron or a trowel through the base. This is filled with dry sand. Afterwards the top finish is floated and trowelled and before setting the same tool is driven through the finish in an endeavor to strike the opening in the base. Often, through carelessness, this top mark is not made directly over the bottom mark, but the two marks are some distance apart and the result is invariably a break in the top above the joint in the base. A good joint can easily be made, as stated in the foregoing part of this paper.

After the walk has been completed care should be exercised to protect it from the action of the elements. A covering of canvas or other material is usually used, as too rapid drying in a hot sun is apt to result in checking. After the cement has thoroughly set it is a good idea to keep the walk moist for a time.

STATISTICS OF WATER POWER DEVELOPMENT.

A brief prepared by the public policy committee of the American Institute of Electrical Engineers and presented at the public hearing before the United States National Waterways Commission, Washington, November 21, contains among other statistics the following interesting data:—

"The statistics of water power collected under the direction of Congress several years ago and embodied in the report of the National Conservation Commission of 1909 show that there is at present developed in the United States about 5,000,000 horse-power of water power.

"The amount of power produced by steam from coal is difficult to estimate, but is considered to be about 27,000,000 horse-power, and is rapidly increasing, with attendant depletion of coal reserves. A large part of this it is not only possible but easy for water power to replace if it were made freely available through development. Within range of development at a cost of investment that would make the cost of such power about equal to that of steam power, there is still undeveloped in the streams of the United States about 35,000,000 horse-power.

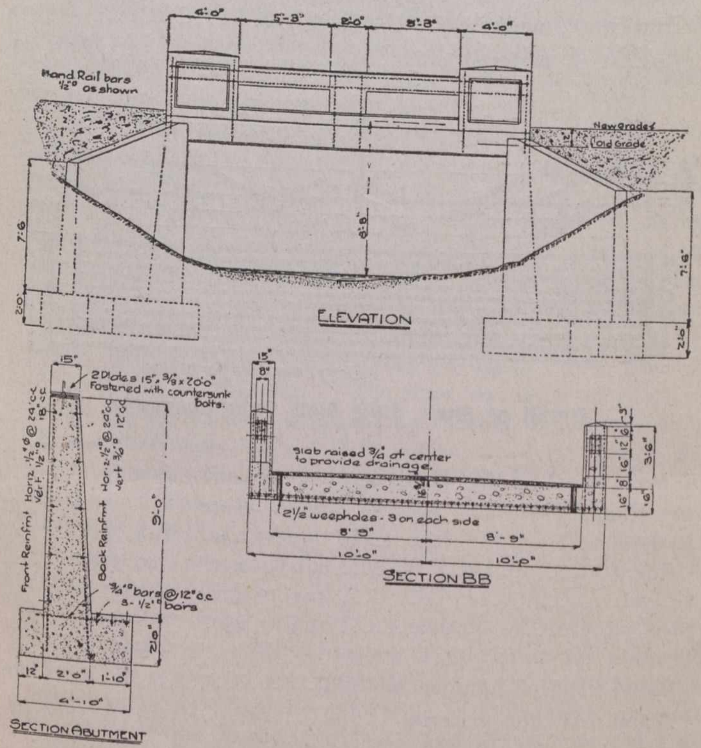
"Any acion by Congress that would accelerate the release of this power would conserve enormous supplies of coal for such domestic and industrial purposes as only coal can supply."

THE CONSTRUCTION OF A MODEL BRIDGE IN IOWA.

The construction of a model bridge is described by Mr. C. B. McCullough, assistant engineer of the Iowa State Highway Commission, in a recent issue of Good Roads. The following is abstracted from the description as being of interest:—

During the past few years, the State Highway Commission of Iowa has devoted considerable attention to the construction of model reinforced concrete culverts and short span bridges throughout the various counties of the State. While the cost of any one of these structures, considered as a unit, is rarely as low as could be desired, their value to the counties from an educational standpoint, and to the concrete industry, is sufficient to warrant a much greater expenditure if necessary.

The construction work has just been completed on a bridge of this kind crossing Wolf creek, in Clay township, Grundy county. The bridge is a reinforced concrete slab of 18 ft. clear span, and a clear roadway of 17 ft. 6 ins. The construction work was done by the county bridge crew under the general direction of the writer, who attempted to keep an itemized and accurate account of the cost of each operation. Because of the fact that very little data of this kind on structures so small as this, has been published, and because the design of the bridge embodies several features such as the use of shop built reinforcement, which should interest every county bridge official, a brief description of the design and an account of the construction is here submitted.



..Elevation, Slab and Abutment Sections, Bridge No. 1301, Wolf Creek.

Abutments.—The abutments were designed as simple retaining walls to withstand a horizontal pressure equal to one-third the vertical, including a surcharge of 2 ft. above the bridge seat. The reinforcing in the back and top of footing was made of sufficiently great cross sectional area to withstand the tendency to crack at base of stem, while the bars in the front face were simply a precaution against frost and other action which would operate to crack the abutment horizontally in front, should the expansion joint at the bridge seat become defective. While this latter precaution is perhaps not absolutely necessary, it seemed warranted by the number of abutments throughout the state which have developed horizontal cracks for seemingly no other reason. An analysis of the abutment, account being taken of the dead weight of that portion of the slab resting upon it, shows the resultant line of pressure to pierce the base a little outside of the middle third, resulting in a maximum toe pressure of about 4,200 lbs. per sq. ft., and a factor of safety against sliding along the base of about two. In the design, no account was taken of the increased stability due to the action of the wings, although these were positively connected to the body of the abutment by means of the hooking of the reinforcing bars.

Slab.—The slab was designed for its own dead weight plus 6 ins. of earth fill, together with a live load consisting of a 12-ton traction engine, two-thirds of the weight of which was considered concentrated on two rear wheels, 5 ft., centre to centre, and 11 ft. from the front trucks, on which the remaining one-third of the weight is concentrated. The weight on each of these wheels was considered as being distributed transversely over 4 ft.

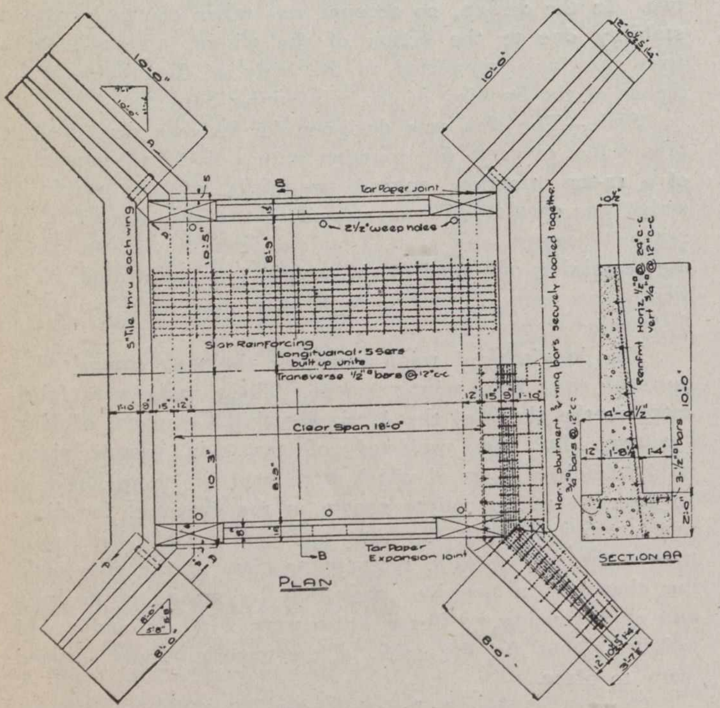
The longitudinal reinforcing for the slab comprised 5 units of shop built reinforcement. These units were fabricated in the shops of the A. E. Shorthill Company, of Marshalltown, Ia., and consisted of ten ¾-in. square, plain, mild steel bars, part of which were bent up at an angle of 30 degrees, at the points shown in the drawing, for diagonal tension. Both the bent and the straight bars were passed through a ⅜-in. rectangular plate at the end, making therewith a positive connection by means of hooking and cold riveting. These units were 4 ft. in width and weighed about 565 lbs. each. They were built and shipped ready to place.

The use of shop built reinforcing eliminates the uncertainty as to whether the bars in the structure really occupy their computed positions, and also rendered the placing of the slab steel comparatively easy, while the use of the plate at the end secured the bars against any slipping due to lack of bond strength at the ends and consequent diagonal tension or shearing failure. The transverse reinforcing was of high carbon twisted square rods, as was practically all of the other reinforcing steel. Provision for drainage of the slab was made by the insertion of six 2½-in. gas pipes through the slab at points indicated on the drawing.

Expansion Joints.—Provision for expansion was made on both ends of the slab by means of two steel plates, 15 ins. by 20 ft. by ⅜-in., placed on top of each abutment with countersunk bolts, bonding them to the concrete. The wings were separated from the slab by means of an ordinary tar paper joint, as shown in the drawing.

The form lumber used was practically all new. Number 1 ship lap, 1 in. by 8 ins., being used for the casing and lagging, while 2 by 12's and 2 by 6's were largely used in the hand rail form work. The studding was of 2 by 4's, spaced 16 ins. centre to centre, and two-ply caps of 6-in. by 8-in. material placed over an existing bent of piling constituted the centreing over which joists of 3-in. by 12-in. county bridge plank, spaced about 14 ins. in the clear, were placed. The lumber was in fairly good condition upon removal, and with reasonable care should be good for the construction of four more bridges. A depreciation of 33⅓ per cent. of the first cost was figured as the cost of the lumber. The tables of cost data give the actual cost of the bridge, no allowance being made for contractor's profit, superintendence, engineering or overhead charges, such as depreciation of mixing plant, etc.

Inspection of the cost data will show that the material items make up by far the larger portion of the cost of the structure, about 77 per cent., in fact, while further examination will show the hauling charge as being about 35 per cent. of the total material charge. In other words, the same structure could be erected at the site of the material for $850.39. The hauling was all done by teams over an exceptionally long haul, and the large amount to which this hauling expense runs seems to emphasize the desirability of utilizing some form of tractor for hauling of this kind in places which are situated very far from a railway station.



Plan and Wing Section, Bridge No. 1301 ("King" Bridge), Grundy County, Iowa.

Due to the fact that the footings were carried down somewhat deeper than shown on plans, and to other slight changes, the total yardage was somewhat greater, being about 92.5 cu. yds. Based on this figure, the total cost per cubic yard was about $12.60, which was exceptionally high because of the unfavorable conditions.

Some unit costs, based on the actual quantities used, are as follows:—

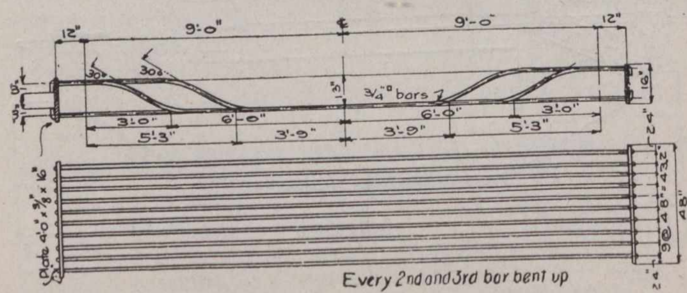
Placing form lumber, per 1,000 B.M.	$7.660
Removing form lumber, per 1,000 B.M.	2.220
Placing concrete, per cu. yd.	.650
Placing steel, per cwt.	.095
Wet excavation, per cu. yd.	.850
Dry excavation, per cu. yd.	.370
Labor on hand rail, per lin. ft.	.620
Placing foundation cribbing, per lin. ft. (perimeter of opening)	.060

Table Showing Labor Costs.

Account	Hours	Rate	Amount
Removing old bridge	6	25c.	$ 1.50
Temporary bridge	43	25c.	10.75
Dry excavation	22	40c.	8.80
Channel change	10	25c.	2.50
Dry excavation	37	25c.	9.25
Wet excavation	14	40c.	5.60
Wet excavation	154	25c.	38.50
Building foundation cribbing	33	25c.	8.25
Building forms (not including hand rail)	182	25c.	45.50
Placing and wiring steel (not including slab)	14	25c.	3.50
Mixing and placing concrete (not including hand rail)	231	25c.	57.75
Runaways and platforms	16	25c.	4.00
Placing slab reinforcing	16	25c.	4.00
Painting forms	5	25c.	1.25
Hand rail, building forms	57	25c.	14.25
Hand rail, placing concrete	45	25c.	11.25
Removing forms	56	25c.	14.00
Removing forms	6	50c.	3.00
Miscellaneous (trips to town for equipment)	26	40c.	10.40
Moving plant	30	25c.	7.50
Moving plant	10	40c.	4.00
Total			$265.55

Table Showing Cost for Material.

Item	Amount	Rate	Cost
Lumber (casing and lagging)	3,200 ft. B.M.	$10.00	$32.00
Lumber studding and centreing	4,500 ft. B.M.	10.00	45.00
Cement	163 bbls.	1.68	273.84
Gravel	105 cu. yd.	.50	52.50
Steel	78.7 cwt.	2.16	170.00
Miscellaneous:			
Drain pipes			.50
Form oil			6.00
Hardware, nails, etc			5.00
Cost of material only			$584.84



Detail of Shop Built Slab Reinforcement.

Hauling Material.

Item	Hours	Rate	
Lumber	35	45c.	$15.75
Cement	110	45c.	49.50
Gravel	525	45c.	236.25
Steel	25	45c.	11.25
Total cost of hauling material			$312.00
Total cost for material			897.00

CABLE CONVEYERS.

The Jeffrey Manufacturing Company, Canadian Works, Montreal, Quebec, have recently received orders for four cable conveyers for the Lake Superior Pulp & Paper Co., at Sault Ste. Marie, Ontario. Geo. F. Hardy, mill architect and consulting engineer, is furnishing the designs and specifications.

DIFFICULTIES OF RECORDING CONSTRUCTION COSTS BY USUAL METHODS.*

The statement has been made that the ordinary methods of cost determinations are almost valueless. This applies both to cost keeping as carried out by the builder and to the force account of the supervising engineer. The fundamental reason is that guess work methods have been used in place of accurate scientific methods.

To obtain cost records that are of value to the builder or to the engineer, several essential elements must be recognized, even if methods of unit times are not used. These essentials may be outlined as follows:

(1) Accurate subdivision of the work into distinct operations.

(2) Accurate records of time.

(3) Knowledge of exact quantities.

(4) Proper apportionment of cost of plant.

(5) Proper apportionment of general expense.

(6) Proper apportionment of cost of materials.

(7) Full description of each item of work.

(1) Accurate subdivision of each section of the work into its distinctive operations is of prime importance. The methods described afford the means of dividing the work into its proper elements with great accuracy. The same general scheme of division, however, carried to a lesser degree may be followed in ordinary cost keeping with far better results than have usually been attained.

In the construction of a concrete conduit, for example, the cost records at least should separate the labor into such operations as: Lay invert, place and remove centers, lay the arch, place the reinforcing metal (if any is used), and finish the interior. If fewer divisions than these are made, the total costs obtained may sometimes show the cost to the contractor of this particular job as a whole and may also indicate the probable cost of another conduit of exactly the same design, but these are the limits of their value.

(2) That accurate records are necessary would seem self-evident, but the difficulty in making an exact count of the men at work on the job, and an exact memorandum of the times, is surprising. Generally the men are constantly changing position, and frequently one or more of the men in the gang may have been taken away to fetch material or for some other purpose, so that they are left out in the count. A timekeeper learns to guard against these difficulties to a certain extent, although frequent mistakes are made unless the man is constantly on the spot. The time on force accounts, or even on a contractor's cost keeping records, is often taken by days or half days instead of by hours or quarter hours, and the workman's time is charged to the job he is on when the timekeeper makes his round, so that the returns are inaccurate. In other cases a whole day's work is credited to a certain item even when the men leave before quitting time or change on to other work.

(3) Knowledge of the exact quantity of work performed is as necessary as the recording of the times for doing the work. In certain classes of work differences in the condition of the material affect the quantity. For example, in earth work, or in the handling of sand and gravel, not only is it difficult to measure the quantities, but there is a large percentage of difference in quantity depending upon whether the material is measured in the cut or loose or shaken.

(4) The cost of the plant, including its first cost, depreciation, repairs, and renewals, is an extremely important item and requires careful judgment in apportioning. The factors which must be taken into account in a concrete mixing plant, for example, are the probable value of the plant after this work is complete, the number of days per year in which it can be operated, the time lost in shut-downs for repairs, and the actual cost of repairs and renewals. The cost of tools, such as shovels, picks, etc., must be included in the cost of plant unless otherwise provided for.

(5) On a small job the general expense is readily apportioned. Upon a large job where the work includes, for example, earth excavation, rock excavation, concrete, and riprap (and often several different classes of each) not only the pay for the foreman, but the salaries of the general superintendent, the contractor's engineer, the timekeeper, and the office force (a part of which is sometimes located on the work and a part at the contractor's general offices) must be fully known, and properly apportioned to each class of work. The method that sometimes has been followed of dividing the total general expense by the number of classes of work into which the job is divided is inaccurate, because one class may cost ten times as much as another. The division of cost is difficult because the cost is not known until after the records are taken. A simple method, which is sufficiently accurate in most cases, is to approximately divide the general expense in proportion to the number of men engaged on each class of work. The division need not be made mathematically, but by estimation. The accountant may judge, for example, from inspection of the records that three-tenths of the general expense should go to one class of work, one tenth to another class of work, and so on.

(6) The cost of materials must be divided among the work actually performed. Materials sufficient to last for several months may be purchased during a single week. If this total cost is divided by the number of yards of concrete laid, for instance, in a week or a month, the result will be very misleading. On one job, for example, the unit cost of a certain class of work, as given in the engineer's cost sheets, varied from 73c. in one month to 19c. in another, solely for the reason that most of the materials were purchased the first month and were all charged up to the cost of the work during that month. To provide for this, the accountant should know the approximate amount of material used in a definite quantity of work, and should carry forward the material on hand. If this division is impracticable, the next best way is to keep the material and labor separate, and allow the man who is making up the cost sheets to estimate the cost of the material from his knowledge of quantities.

(7) Lack of description renders many careful records of cost absolutely valueless, except for determining whether a contractor is making money. For example, on one job very accurate records of cost of earthwork were made by the engineers, giving the number of men employed, the number of carts, cost of superintendence, cost of tools, and many other details, while the length of haul or the character of the material handled was not stated. The result was an accurate record of the cost of labor on this particular job, but one which was absolutely useless in estimating the probable cost of other work, of a similar nature, that was being done by the same engineering commission. In another case, the times of the men on all classes of work, including the engineer and other men in the various offices of the contractor, were carefully recorded on large cost sheets. The work included several kinds of concrete construction. One kind was found to cost $4.08 per cubic yard, another kind $6.28, and another kind $7.98, but nothing was shown on these sheets to indicate the reason for these differences. No definite description was given of the character of either job, and the only means of comparing them would have been to look up the contract and the plan, and then probably find that each class covered so broad a range as to provide no

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*From "Concrete Costs," by Frederick W. Taylor and Sanford E. Thompson. Copyright, 1912, by Frederick W. Taylor.

definite information. The amount of information required to properly describe any piece of work depends upon its character and the minuteness of the cost or time observation. If simply general costs are being compiled, the analysis of almost any class of work will show that there are a few, perhaps not over a half dozen, essentials which will usually give reason for an apparently low or for an excessive cost. Although, even with such data, cost keeping will not give the exact basis for estimates that may be obtained with the more scientific methods of unit times, the results may be recorded in such a way as to aid materially the judgment of an experienced engineer or a contractor.

STRENGTH AND FATIGUE PROPERTIES OF WELDED JOINTS.

At the meeting of the Institution of Civil Engineers on Tuesday, December 12, Mr. T. E. Stanton, D.Sc., M.Inst. C.E., and Mr. J. R. Pannell, presented an account of some experiments on the strength and fatigue properties of welded joints in iron and steel, which were undertaken at the suggestion of Sir John Wolfe Barry in 1908, the object being to obtain a comparison of certain properties of welded joints —made by different processes and by different makers— with the corresponding properties of the unwelded material from which the joints were made. It was hoped that by this means some estimate of the general reliability and efficiency of modern welding processes might be arrived at. In order to obtain material for the work a circular letter was sent from the National Physical Laboratory to various engineers inviting them to submit specimens of welded joints for testing. Sixteen firms responded to this invitation and the total number of welded joints received was 167. The method of welding and treatment of the joints was left entirely to the makers, the only condition being that all specimens should be made from bars 1¼-in. in diameter. The tests to which the joints were subjected were: First, a tensile test; and secondly, a fatigue test by the Wöhler method. The former included determinations of the elastic limit, the yield point, the maximum stress, the total elongation, and the general and local elongations.

For the rapid carrying out of the fatigue tests a machine was constructed in which the specimen was rotated at a speed of 2,200 r.p.m. Owing to the results of a previous investigation with another type of machine having shown a decided reduction of fatigue strength with increased rapidity of stress-alternation, preliminary experiments were carried out to determine the amount of this effect for the particular type of machine used. The results showed that for speeds of 200 and 2,200 reversals per minute there was practically no difference in the fatigue strength. The assumption was therefore made that the apparent reduction of fatigue strength with rapidity of alternation in the case referred to was a characteristic of the machine used.

The mean results of the tensile tests on the welded joints, expressed as a percentage of the strength of the original material from which the joints were made, were:—

	Per cent.
Hand-welded iron	89.3
Hand-welded steel	81.6
Electrically-welded iron	89.2
Electrically-welded steel	93.4

Joints made by the oxy-acetylene process were also submitted by two makers, but the results were not comparable with those obtained by the hand or electric processes.

The various determinations made in the tensile tests showed a distinct want of uniformity in the material in the region of a weld, but the results of the fatigue tests proved that this does not materially effect its resistance to reversals of stress. When failure under alternating stresses of low value takes place, it is invariably due to a defect in the actual weld itself. The number of defective joints which were discovered in the whole investigation, however, leads to the broad conclusion that in important work, where the failure of any particular welded joint may involve serious damage to the structure, the subjection of each joint to a proof-load is still desirable.

WESTERN MILEAGE OF THE CANADIAN PACIFIC RAILWAY.

By H. M. P. Eckardt.

Canadian Pacific's recent announcement of a new stock issue of $18,000,000, which will bring $27,000,000 into the company's treasury, draws attention to the yearly additions to Canadian Pacific Railway mileage in western Canada. The immigration movement, which assumed its especial importance five or six years ago, is the principal factor in causing western prosperity. This immigration movement has, incidentally, been instrumental in inducing the railways to increase their western mileage. Then, in turn, the policy of active construction of new branch and main line of railroad, has induced more immigration and more prosperity. By means thus of action and reaction, western progress has been steady and rapid. It will be interesting to study the extent of the Canadian Pacific Railway's yearly construction work west of Lake Superior during the period 1905 to 1911.

Before detailing the additions made to the western portion of the system, it will be well to trace the development of the mileage of the whole system. In the following table the summary for the six years is given:

Year.	Mileage in C.P.R. Traffic Returns.	Mileage Other Lines Worked.	Mileage Under Construction.	Total.
1905	8,568.0	438.0	481.4	9,487.4
1906	8,776.9	438.0	923.7	10,138.6
1907	9,153.9	262.4	823.0	10,239.3
1908	9,426.4	261.7	708.4	10,396.5
1909	9,878.5	261.7	403.2	10,543.4
1910	10,270.6	261.7	471.4	11,003.7
1911	10,480.9	291.9	983.3	11,756.1

In the six years the total mileage of the company, exclusive of that pertaining to the Minneapolis, St. Paul and Sault Ste. Marie Railway, and the Duluth, South Shore and Atlantic Railway, increased 2,268.7 miles, or an average of 378.1 miles per year.

In connection with this increase of mileage it is interesting to review the increase of capitalization concurrently taking place.

(Thousands omitted).

Year.	Common Stock.	4% Pref. Stock.	4% Cons. Deb. Stock.	Mortgage. Bonds.	Total.
1905	$98,738	$37,853	$89,200	$55,238	$281,029
1906	105,995	42,719	101,519	41,738	291,971
1907	121,680	43,936	106,045	40,238	311,899
1908	141,534	48,803	115,657	39,621	345,615
1909	150,000	52,696	128,930	39,621	371,247
1910	173,530	55,616	136,711	39,621	405,478
1911	180,000	57,076	142,861	38,648	418,585

Incidentally this table shows one respect in which the Canadian Pacific Railway finances are exceedingly strong. The portion of the capitalization represented by mortgage bonds is relatively insignificant; and it grows smaller every year. In the Canadian Pacific Railway's case there is no danger of decreasing prosperity resulting in the property passing into the hands of the holders of mortgage bonds. More than nine-tenths of the whole capitalization consists of stock in three classes.

Proceeding now to the matter of additions to the mileage in western Canada, we get the follofing table:

Year.	Central Div.	Western Div.	Pacific Div.	Total.
1905	3,129.2*	1,270.7	951.7	5,351.6
1906	3,526.4	1,369.3	953.9	5,849.6
1907	*3,438.1	1,364.9	1,093.6	5,896.6
1908	2,938.5	1,983.4	1,077.9	5,999.8
1909	2,905.9	2,146.4	1,077.9	6,130.2
1910	2,934.2	2,509.1	1,070.4	6,513.7

*Decrease due to the disappearance from the table of mileage of Qu'Appelle, Long Lake and Saskatchewan Railway, 253.6 miles, formerly worked by the Canadian Pacific Railway for account of owners.

In the annual report for June 30th, 1911, the mileage is grouped under the new style—according to provinces. It appears as follows: Manitoba Division, 2,353.7 miles; Saskatchewan Division, 1,878.8 miles; Alberta Division, 1,677.9 miles; British Columbia Division, 1,170.4 miles; Total, four western divisions, 7,080.8 miles. Thus the additions to the western portion of the system in the six years amount to 1,729.2 miles. The extensions in the West, constitute more than 76 per cent. of the extensions effected for the whole system.

It should be remembered that the Canadian Pacific Railway expends a portion of its newly raised capital and its accumulated earnings in other things than construction and purchase of new mileage. The steady additions to the steamship fleet absorb a considerable amount of funds; the extensions and improvement of stations and terminal property—notably the enlargement of the Windsor Street Station in Montreal—have required much funds. The building of new hotels, and the extensive irrigation works in the neighborhood of Calgary, should also be mentioned, and the constant increase in number and capacity of the locomotives, cars, and other equipment.

The balance sheet as at June 30th, 1911, showed the company's treasury to be in good condition. There was cash on hand, $34,371,550; temporary investments in government securities, $10,088,734, and current assets (consisting of agents' and conductors' balances, net traffic balances, and miscellaneous accounts receivable) amounting to $8,049,899. These items of the quick assets made up a total of $52,510,183. On the other side of the balance sheet were: Current liabilities (consisting of audited vouchers, pay rolls, and miscellaneous accounts payable), $17,203,651; coupons due 1st July and accrued fixed charges, $1,392,316. The surplus of available assets as at 30th June last therefore amounted to $33,914,216. This, however, represents a fall of about $16,000,000 as compared with the surplus of such assets shown on June 30th, 1910. That perhaps explains the new issue of common stock. The payments on the new stock are to pass gradually into the treasury. Judging from the record of extensions above given, western Canada will have the benefit of a considerable part of the expenditures based upon the increase of capital.

NEW BRUNSWICK.

The close of 1911 finds the people of St. John and of New Brunswick animated by a greater spirit of hopefulness and confidence than at any former period in the history of the province. There have never been at any one time before as many large projects under way, nor as bright an outlook for the development of the resources of the province. Premier Flemming stated recently that $20,000,000 would be spent in the province within the next five years. If we include the expenditure for harbor development at St. John, the Premier's estimate is too small. The St. John Valley Railway will cost $9,000,000. The harbor works at East St. John will cost nearly $8,000,000. There will be another $1,000,000 or more spent at West St. John. The railway from Fredericton to the Queen's County coal fields will cost $1,000,000. The Grand Trunk Pacific will expend considerable money, and there will also be the development of the oil shales of Albert County, the iron mines of Gloucester, and other enterprises of importance.

In view of the brighter outlook, the province will make a more determined and effective bid for immigrants than ever before. The St. John Board of Trade has agreed to subscribe $5,000 to establish a branch of the Imperial Home Re-union Association, which provides funds to enable immigrants already in the province to bring out their families. Branches will be formed in other centres, and the Provincial Immigration Department will co-operate in the work. In addition an agreement has been reached by representatives of the Provincial and Federal governments, under which the Federal government will undertake to induce immigrants to come in larger numbers to New Brunswick, and the Provincial government will undertake to look after them when they arrive.

A Washington concern is willing to erect at St. John a branch factory for the manufacture of paper bottles, provided some local capital is invested in the industry. The Board of Trade has taken up the matter, and it is believed satisfactory negotiations will be concluded.

The government of New Brunswick is negotiating with the Canadian Pacific Railway to have agricultural trains tour the province next spring and summer, giving demonstrations at various points on the modern science of farming, as is already done in the west and in the United States. Such matters as dairy and fruit farming, stock raising and seed selecting, will be given special attention.

While the contract for extensive developments at East St. John has not been signed, the government press publishes semi-official statements to the effect that the contract will be awarded to Norton Griffiths & Company, and that in the spring they will begin work on the breakwater, dredging, wharves, and dry-dock, which together will cost about $8,000,000. The work will cover a period of about five years.

While frozen halibut from British Columbia is being sold on the St. John market, very large quantities of frozen smelts are being shipped from New Brunswick to the American market.

The American lumber market has improved considerably, and orders are being received by local shippers.

The St. John City Council has adopted resolutions providing for a reduction of the assessment on improvements by 50 per cent., and an increase in the assessment on land, especially on vacant lots.

Sir William Mackenzie has purchased one hundred and ninety-two square miles of property in the oil shale areas of Albert County, and he intends to erect there a retorting and distilling plant, such as is used in the shale areas of Scotland. This great project, if carried out, will give employment to thousands of men, and with the natural gas and oil wells and the plaster quarries, will prove a source of enormous wealth in Albert County. The fact that the Canadian Northern Railway interests are investing in the province is in itself regarded as a very significant fact.

The exports by the winter steamships from St. John thus far this season are larger than those for the like period last year, and as usual a considerable portion of the exports are American goods brought to the Canadian port for shipment. The Canadian-Australian line will make five voyages from St. John this winter.

The Kent Northern Railway, which runs twenty-seven miles from Richibucto to Kent Junction, on the Intercolonial Railway, has been purchased by a Toronto syndicate. A local paper says the price was about $100,000. The line is one of the profitable short branches of the Intercolonial.—W. E. A.

Metallurgical Comment

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

Correspondence and Discussion Invited

WROUGHT IRON, BUSHELLED IRON, INGOT IRON.

What is the significance of these terms? The first name is more or less familiar as a name to almost every one; the distinction between the first and second would puzzle many; the third term is becoming more and more familiar to engineers, but the meaning of is not yet generally understood.

Wrought iron is the result of a process in which a good grade of pig iron is worked in a puddling furnace as it is called (the operation of making wrought iron is known as puddling) the impurities, carbon, manganese, silicon, phosphorus, and to a certain variable extent sulphur, being oxidized out to form a slag. Owing to the fact that a high temperature is not attainable in the type of furnace used, the final metal, instead of lying in a molten state on the hearth, is found to exist as small soft globules distributed throughout the slag, the slag and intermixed iron being of a pasty consistency. Large balls of this mass are taken out of the furnace and, while still hot, are submitted to mechanical working, the idea being to squeeze as much slag out of the mass as possible; but in spite of all the squeezing and rolling there is always some slag left in the resultant bars of iron. If the metal be examined, however, it is seen that this slag is distributed evenly in fine lines (see Fig. 1.) and does not seriously interfere with the strength of the iron. The nature of the iron itself is worthy of note. It is extremely pure, the carbon percentage being low and as a consequence the iron is very malleable and ductile.

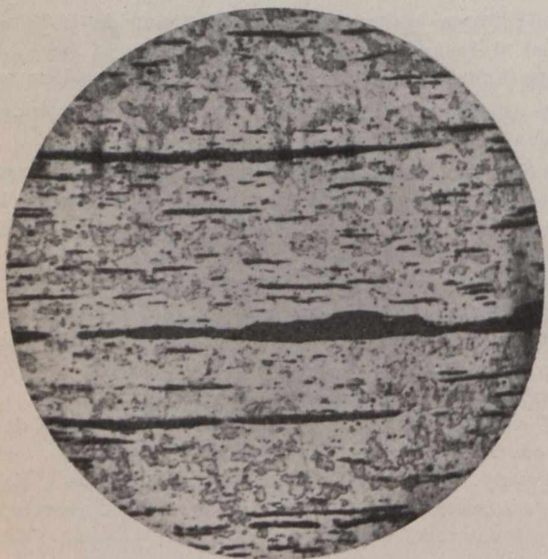


Fig 1.

The processes coming under the head of "bushelling," permitting as they do the utilization of scrap, might be referred to as economizers, but while they undoubtedly have a large and useful field to serve, this field should be thoroughly recognized and adhered to. In short, these processes consist of bushelling, i.e., making up bundles of suitable scrap, and subjecting a number of these piles to the heating action of a furnace somewhat similar in construction to a puddling furnace. When the scrap becomes more or less pasty, it is taken out and worked to a certain extent in the same manner as in making wrought iron. Ostensibly, the idea is to get a product similar to wrought iron, but since the scrap does not undergo the same refining action as in making wrought iron, it follows that if the original scrap is of a mixed quality (as it usually is) the final product will not be homogeneous. Furthermore, examination often shows that the metal contains a great deal too much slag very badly distributed, thus unfitting the metal for a number of structural purposes.

Ingot iron is a very pure form of iron made in an open hearth furnace. In its manufacture, the elimination of carbon and other elements in the original metal is carried on to a much greater extent than in the making of ordinary low carbon steel, the final product containing less than .06% total impurities which is remarkably low. Thus we get a metal that is almost pure iron, and since it is made in an open hearth furnace in which a very high temperature may be obtained, the final metal exists in a molten state and can therefore be tapped out and cast into ingot form—hence the name ingot iron.

Keeping in mind these general outlines, it is comparatively easy to arrive at a conclusion as to some of the uses to which the products under discussion may be put. A consideration of a few of the principles that seem to underlie the cause of corrosion in iron will perhaps give us a better understanding of the discussion.

At the present time the evidence seems to point to the fact that the purer iron is the less likely to corrode. (The presence of manganese seems to enhance the corrosive actions.) Not only does the purity of the iron have a great effect, but the homogeneity also seems to be a great factor. The more homogeneous the iron or steel is the less likely it seems to be open to corrosive action. It is obvious, of course, that the purer the iron is the more likely it is to be homogeneous.

From the standpoint of resistance to corrosion, it is easy to see why wrought iron, being a very pure form of iron, might be specified in construction work. On the other hand, the bushelled product, with its lack of homogeneity, seems to be anything but suited to resisting corrosive action.

A knowledge of such facts as these has led engineers to be extremely careful these days when specifying wrought iron, especially as the true wrought iron industry seems to be on the wane in America in spite of production figures that are given out. (It is lately pointed out by good authority that these figures must include, in many cases, the product of the bushelling furnaces.) One often wonders why, if there is a demand for good wrought iron, the American firms do not protect themselves by stamping their iron, as do the English and Swedish makers. It is argued, of course, that a stamp is easily copied or wrongly used, but this merely adds force to the claim that, as far as wrought iron and the bushelled product are concerned, there is a loose tendency in America. This is augmented by the fact that in many cases the buyer is indifferent. The bushelled iron does the work just as well as the pure wrought iron, there being nothing at stake in most cases, and besides it is cheaper.

Through the tangle, though, there appears a good solution to the whole problem. If purity and homogeneity in the iron are what are desirable, the products to which we may give the name ingot iron seem to be admirably suited to the case. The name "ingot iron" has been used as a trade name but a broader significance than a mere brand should be placed on it. If the corrosive question is to be solved, it would seem at present that it must be done so by using these pure irons (in reality very pure steels) made in open hearth furnaces. To such irons as these then, let us apply the term ingot iron. Be the outcome on this point what it may, it behooves the engineering public to investigate thoroughly the general good qualities of such a product as herein outlined as ingot iron."

THE PRESERVATION OF IRONWORK.

Ironwork enters so largely into the everyday life of municipal engineers, and is used in so many forms in works of construction, that a little consideration given to the methods and need for its preservation may be of service in understanding the principles that are involved.

William Ransom in The Surveyor and Municipal and County Engineer sums up some of the principles underlying the preservation of ironwork from rusting as follows:—

The oxidation or rusting of iron is not due simply to the combination of iron and oxygen. Iron under ordinary atmospheric conditions will quickly rust, but in the presence of dry oxygen will remain bright for a long time. Rusting appears to require not only air, but moisture and carbonic acid. Lime will prevent iron rusting quickly, because it absorbs the carbonic acid which is always present to some extent in the atmosphere.

During the process of rusting ammonia is formed through the nitrogen of the air combining with the hydrogen of the water. The oxide of iron, or rust, as it forms, sets up a galvanic action with the unaffected metal, and although a very weak current of electricity is produced, it decomposes the water, allowing the hydrogen to combine with the atmospheric nitrogen. This galvanic action causes the corrosion of ironwork to proceed with increasing rapidity, after rusting has once been allowed to commence.

The action of water upon iron depends largely upon the presence of carbonic acid. In the presence of sea-water the iron may be dissolved without the formation of visible rust. Sewage matter has a greater action upon iron than ordinary water, probably due to the presence of sulphides.

One of the principal causes of accelerating rusting is electrolysis. When the iron is brought into contact with another metal in the presence of a solution or atmosphere through which an electric current can pass, one metal will decompose. When iron railings are fixed by means of molten lead, the iron will decompose, especially if moisture be often present. This action can be seen in almost all cases where railings have been thus fixed for any length of time.

It will thus be realized how necessary it is that ironwork which has to do duty for many years should be preserved from rusting. In works of construction, unless precautions were taken, the strength of ironwork would speedily be reduced below the factor of safety.

Ironwork can be protected from rusting by (1) coating with oxide films, (2) coating with paint or varnish, (3) coating with some other metal, and (4) enamelling.

(1) When super-heated steam is allowed to pass over red hot iron the water vapor is decomposed, the oxygen combines with the iron, and the hydrogen is liberated. The oxide which forms on the iron makes a protective coat or film against future oxidation. This has become known as the Bower-Barff process, from the two manufacturers who most successfully applied the process. The oxide which is formed is the magnetic oxide Fe_3O_4. If the coat or film becomes broken, or is imperfectly formed, galvanic action would cause corrosion of the iron.

(2) Ordinary paint will form a preservative for ironwork, especially when the base used for the paint is red oxide of iron. Red and white lead are both used, but are likely to be acted upon by carbonic acid gas, etc., and galvanic action also may occur. Paint should be applied to cast-iron as soon as possible after it has left the mould, before rust has had time to form. The cast-iron should first receive a coat of linseed oil before the iron has become cold. Various patent preparations—such as graphite, etc.—are now on the market for the preservation of iron. These are largely used for the painting of railings and outdoor ironwork, and are found to last longer than ordinary paints.

Bituminous varnishes are most commonly in use for the preservation of iron pipes, etc. They consist of various mixtures of coal-tar, pitch, linseed oil, resin, and the like. Dr. Angus Smith's process is the best known, and consists of first cleaning the iron, heating to 700 deg., and then dipping for fifteen or twenty minutes into his mixture at a temperature of between 300 deg. to 400 deg.

(3) Iron can be coated with another metal—such as zinc or tin. Iron is coated with zinc by the process of galvanizing, which consists of first cleaning the iron by steeping in an acid solution, and then plunging into molten zinc, which forms a protective coat to the iron. If, however, the zinc be worn off or the coat imperfectly formed, galvanic action is set up, which will corrode the zinc. Zinc is very readily acted upon by acids, and is therefore not suited to manufacturing districts. When iron is coated with tin, if galvanic action is allowed to set up, the iron is corroded.

(4) Enamelling is only of value for iron articles used for domestic purposes, and consists in applying a pottery glaze, which should contain very little lead. Where the enamel becomes chipped the exposed iron will quickly rust and cause further disintegration of the enamel.

CAST-IRON AND STEEL PIPE.*

By Nicholas S. Hill, Jr.

My remarks will be confined, as were those in the paper under discussion, to the relative value of cast-iron and steel for large supply mains, as nothing has been developed which so readily adapts itself to street distribution mains of smaller size as does cast-iron.

In first cost steel mains of large size ore cheaper than cast-iron mains. As a rule they are more easily handled because lighter.

The question of strength is one of design; and in making comparisons it should be assumed that both the cast-iron and riveted-steel pipe will perform the function for which they are designed.

From the data available, it appears that the cost of maintenance and depreciation on cast-iron pipe is less than on riveted-steel pipe. The data at hand, however, is not sufficient to enable one to say definitely that the difference is sufficiently great to offset the difference in interest charges resulting from the additional first cost of the cast-iron pipe. Interruptions to service where a community depends upon a single supply line, resulting from repairs as a result of corrosion, are usually of more importance, however, than the mere consideration of cost.

Experience has shown that the more nearly steel approaches a pure iron, the longer it resists corrosion. The properties of wrought-iron are the nearest approach to pure iron, notwithstanding its slag. This is because the slag is mechanically mixed and does not interfere with the chemical properties of the product.

Investigations by a Committee of the American Society of Testing Materials have failed to produce any conclusive

*Abstract of discussion of paper by Mr. Allen Hazen, M. Am. Soc. C.E., read before the American Water Works Association in June, 1911.

evidence with regard to the relative rapidity with which wrought-iron and steel corrode; so many elements seem to affect the rate of corrosion. Field experience, however, indicates that the riveted pipe of wrought-iron is more resistant than steel. In considering this question, it must be remembered that it is difficult to obtain wrought-iron plate at this time, and that in specifying riveted pipe, low carbon steel should be considered.

Cast-iron is more highly resistant in corrosion than either steel or wrought iron. Every examination which I have made of steel and cast-iron mains, laid under the same conditions, has fairly demonstrated the greater resistance of cast-iron pipe to corrosion.

The greater resistance of cast-iron to corrosion than steel is probably due, in a large measure, to the silicious coating which it receives when the molten metal is poured in the mould. The silicious coating adheres very firmly to the pipe. Also the roughness of the exposed surface of the cast-iron offers a firmer foundation for the coating than does the smooth surface of the steel pipe, and hence the same coating applied to cast-iron is usually more durable than when applied to steel pipe.

We have much data with relation to the life of cast-iron pipe. We know that it is good for a hundred years when properly coated, and under almost any condition of soil. There are instances of much longer life.

The intake pipe at the first pumping station for supplying Paris (which extended into the River Seine, and which was laid in 1802), after an immersion lasting for over a century, was recently removed and was found to have been in such good condition that it might have been relaid. The lettering on the pipe was not disturbed. Instances of cast-iron pipe laid in Europe as early as 1765, which is now in serviceable condition, have been recorded. The speaker has removed cast-iron pipe from low ground saturated with a salt solution which had been in service since the early part of the last century and which was in excellent condition when removed. There appears to be no practical limit to the endurance of cast-iron pipe and its resistance to ordinary corrosion.

In considering the effects of corrosion, reference must be made to the effects of chlorides, nitrates and sulphates, which are found in soils of high organic content, and in marsh lands adjacent to salt water. Weak solutions of these salts will produce harmful effects, proportionate to the rapidity with which a material will corrode. A minute quantity of soluble salts is sufficient to start corrosive action and a material which is liable to corrosion should not be placed therein.

Reference has been made to the life of cast-iron pipe. Experience with riveted-steel pipe is very much more limited but there are examples which tend to show that lines of riveted-steel pipe, constructed within the last twenty years, have materially depreciated and great trouble has been experienced from the effect of corrosion. These effects seem to proceed more rapidly in clay soils and marsh land than in sand. Among the pipes which have thus been affected, is the second Hemlock Lake conduit, in Rochester (N.Y.), which was laid in 1893; the Portland (Ore.), conduit, the Atlantic City conduit, and certain conduits laid in the marshes of the Hackensack meadows in New Jersey.

Electrolysis is manifestly more rapid on steel pipe than the cast-iron is several times as thick, will, owing to the rapidly than cast-iron, and electrolysis may be defined as a more serious form of corrosion, occurring where an electric current leaves the pipe and which, in so doing, sets up corrosive electrolytic action.

Rolled steel plates, as compared with cast-iron, although the cast-iron is several times as thick, will, owing to the higher conductivity of steel, have from one to three times the conductivity of a cast-iron pipe designed for the same pressure. This is important, as the electrolytic action is mainly dependent upon the volume of the current, and hence in territories where street railway currents are returned over pipe lines, the riveted-steel pipe offering a better conductor will carry more current, and hence electrolytic action will be aggravated on this account.

There are few places of any size, in which the suburbs are not, at the present time, traversed by numerous suburban lines. If the mains pass in the vicinity of these lines, they may absorb their proportion of the return trolley current and deliver it to the ground at some point nearer the power station. This was clearly demonstrated to me in a recent survey of certain steel and cast-iron pipe lines laid in the marshes of the Hackensack meadows. I found that these pipes were carrying quite an appreciable quantity of current from distant points to the power station, and that they were unloading it in the marshes, to be returned through the saturated soil, to the power station. The result of these surveys indicated the superior conductivity of the steel pipe, and the much greater corrosion resulting from the effects of electrolytical action, than in the case of the cast-iron mains.

In summing up, it may be said: (1) That where first cost is of prime importance, steel may be used on large supply mains. (2) Where the difficulties of transportation are serious and the cost of hauling is heavy, expediency may call for the use of this material. (3) In sections where dry sandy soil is encountered, one would be justified in securing the benefit of reduced first cost by recommending steel pipe. (4) In clay and wet soil, such as marsh lands and meadows, particularly where the presence of salts in solution increases corrosion riveted-steel pipe should not be used. (5) Where pipe is laid in wet soil and will be subject to electrolysis, cast-iron should be used. (6) Where permanency is a prime consideration, our present knowledge indicates that cast-iron is preferable.

THE INFLUENCE OF ELECTRICAL SMELTING OF IRON ORE ON THE SWEDISH IRON INDUSTRY.

At a discussion on the above subject which took place at the Jubilee Meeting of the Technical Association, at Stockholm, the following views were expressed:—

Mr. Arvid Johansson said that the whole of the present pig-iron output might easily be produced by the aid of 180,000 h.p. By adopting electrical smelting this would mean that 60 per cent. of the total quantity of charcoal now used could be saved. The Province of Norrbotten, or the northern part of the country, on the whole offered the widest scope for the development of electrical smelting, (1) because the iron ore was cheaper there; (2) because there were fewer consumers of the available electrical energy; and (3) because there was a cheaper supply of charcoal. The central part of Sweden also offered a vast field for electrical smelting. For instance, after harnessing the Dalelfoen only (the valley river), there would be 250,000 h.p. available for industrial purposes, of which 135,000 h.p. would belong to the Stora Kopparberg Company.

Major-General Geijer (Vice-Chairman of the Gränges-berg Company) expressed great faith in the development of an electrical iron industry in Norrland. In regard to Norway, he thought that country was placed at a disadvantage in regard to its capacity to compete with Sweden, chiefly owing to the higher percentage in sulphur of the Norwegian iron ores.

Director Stridsberg, of the Trollhättan Works, said that after the completion of the Trollhättan Canal, which would connect the central parts of the country with the sea, there would be no difficulties in the way of a large export trade in pig-iron to be started. He was an advocate of placing a tax on ore for export.

Director Hult pointed out that the iron industry in Central Sweden was threatened with keen competition from the iron-sponge process at the Höganäs Works.

Director Sahlin called attention to the imports of German pig-iron, which were steadily on the increase.

Director Amilin emphasized the injurious policy of utilizing semi-products from abroad, whereby the quality of Swedish goods would suffer.

Director Wahlberg, of Fagersta, did not share this pessimistic opinion, and thought that the Swedish iron-masters were not so easily led astray.

NEWS ITEMS.

It has been reported that cinnabar has been recently found in the Porcupine region. Cinnabar, the ore of mercury, would be a lucky find in the district mentioned.

* * * *

We have an enquiry for a second-hand analytical chemist's balance. Address replies to Editor "Metallurgical Comment."

MONTREAL STREET RAILWAY.

It is generally allowed that the complaints which began to be heard some time ago against the Montreal Street Railway were probably the outcome of the change of ownership of the railway. There is no denying that the service is becoming gradually less effective, and that, at the present time, it is less satisfactory perhaps than ever before since its electrification. During the last fiscal year of the company, the number of tickets and transfers amounted to upwards of 150,000,000, this being an increase of some 15,000,000, or 10 per cent. on the number collected in 1910. During the same period it is hardly likely that the efficiency of the railway increased ten per cent., so that though the company operated fully as many cars and as good cars as during the last year of the old regime, and operated them as rapidly as the previous year, the congestion would still be approximately ten per cent. greater. It is not thought that the company added to its rolling stock and otherwise increased its efficiency proportionately with the increase in population. In reality, this question of increase in population in Montreal raises some very serious considerations. The price of real estate has advanced considerably during the past year, which one must attribute in large part to incoming population.

In the vicinity of Montreal houses are being erected in all directions, extending for miles out into the country wherever any sort of tramway connection can be had. This makes the work of the tramway company much more difficult than it was a few years ago. The fear in Montreal seems to be that some considerable expenditure may be put out upon schemes for more rapid transit, which will become almost totally inadequate before they are finished. Meantime nothing is being done, and the car lines become more crowded daily and the citizens experience ever-increasing difficulty in getting accommodation.

A resolution was adopted by the special civic committee having charge of this street railway question during the past week, by which it is proposed to ascertain how many large cars the tramway company is employing on its routes, the total number of cars available, and the number of improved cars which have been added during the past five years. Certain questions concerning less frequent stops will be asked, and suggestions will be made as to new streets and new plans to facilitate the operation of cars. Among citizens, the inadequacy of most of these suggestions to meet the situation which is growing up, is keenly felt.

WINNIPEG BUYS AMERICAN CEMENT.

Last week the Board of Control in Winnipeg accepted the tender of the Lehigh Portland Cement Company of Chicago for 25,000 barrels of cement to be delivered as required in 1912. The tender of the Lehigh Company, the lowest of five submitted, will give Winnipeg its cement supply for next year at a net price of 60 cents per 100 pounds net weight, laid down in Winnipeg, excluding sacks, which will be returned at the cost of the manufacturer. This means a saving of 14 cents per barrel of 350 pounds on the price paid during the present year.

The actual price which the city will pay the Lehigh Portland Cement Company of Chicago for its supply next year may be less than the price submitted, as the company has agreed that if there is any reduction in duty or any revision of freight rates, the city will be given the benefit of reduction. This, it is understood, will include the rebate of two cents per barrel on sacks returned to the United States, which it is expected can be collected, and if this is done will increase the saving over last year's prices to 16 cents per barrel.

PERSONAL.

Mr. A. J. Latorned, city engineer for Edmonton, Alta., has forwarded his resignation to the municipal commissioners. Mr. Latorned cites an offer from another city as his reason for resigning.

Dr. J. W. S. McCullough, Provincial Health Officer, and Mr. N. J. Ker, City Engineer of Ottawa, are on a tour of the principal United States cities, inspecting water and sanitary methods. The City of Ottawa is preparing to install water and sewage systems that will in the future protect the citizens from a recurrence of a typhoid outbreak such as the one of last year, and the information gathered by Dr. McCullough and the city engineer will largely determine the kind of system to be constructed. In Ottawa Dr. McCullough and City Engineer Ker will consult with Mr. Allen Hazen, the sanitary expert.

Mr. Arthur St. Laurent, deputy minister of public works and engineer in charge of the Georgian Bay Ship Canal, has left Ottawa in company with Mr. Coultlee, the assistant engineer of the Georgian Bay Ship Canal, for Panama, via New Orleans. The object of the two engineers is to examine the works and obtain information that may be useful when the Georgian Bay Ship Canal is placed under construction. The two gentlemen will be absent from Ottawa for six weeks, and during that time will consult with all the eminent engineers who made possible the opening of the Panama route, as the latest machinery and appliances for work of that kind are at the canal. Mr. St. Laurent and his assistant will make a report on them.

Mr. F. A. Yerbury, formerly with the Canadian Boving Co., Ltd., has severed his connection with that company, having accepted an appointment with a new company in Vancouver, known as the Heaps Engineering Co., Ltd., the president of which is E. H. Heaps, a gentleman well known throughout British Columbia, from his long connection with industrial concerns there. This new company will install rolling mills, and probably will put in the first electric steel making furnace in Canada of the well known Gronwell type. They will also manufacture motors of the internal combustion type for marine and automobile purposes. Mr. Yerbury will be remembered as the man who had the privilege of introducing the Diesel engine into Canada, of which there are quite a number now in successful operation.

FORESTRY CONVENTION.

The members of the Canadian Forestry Association and others interested in forest conservation will on February 7th and 8th, 1912, gather in Ottawa to discuss what they hope will be the most practical programme of any of their conventions.

H. R. H. the Duke of Connaught evinces his interest in the subject by extending his patronage to the gathering, and the concern of the government is shown in the fact that the meetings will be held in the Railway Committee Room of the Parliament Buildings, and that a number of parliamentary leaders will be in attendance. The railways have granted special rates.

On the evening of February 7th a banquet in which the members of the Canadian Lumbermen's Association will participate with the Forestry Association, has been arranged. The lumbermen will hold their annual meeting in Ottawa on February 6th, and it is expected they will attend in large numbers to discuss with the members of the Forestry Association matters respecting fire protection, logging methods and regulations which vitally affect them, and which are also of concern to every taxpayer in Canada.

Details are now being worked out by the committee in charge, of which Mr. James Lawler, Canadian Forestry Association, Ottawa, is the secretary, and from him may be obtained any needed information.

COMING MEETINGS.

THE AMERICAN INSTITUTE OF CONSULTING ENGINEERS.—January 16th, 1912, Annual Meeting, Aldine Club, Fifth Avenue and 23rd Street, New York City, at 8 p.m. Secretary, Eugene W. Stern, 103 Park Ave., New York.

CANADIAN FORESTRY ASSOCIATION.—February 7th and 8th, 1912. Forestry Convention Meetings held in the Railway Committee Room, Parliament Buildings, Ottawa. Secretary, Mr. James Lawler, Canadian Bldg., Ottawa.

CANADIAN LUMBERMEN'S ASSOCIATION.—February 6, 7 and 8, 1912. Annual Meeting to be held at the same time and place as the Canadian Forestry Association.

THE CANADIAN SOCIETY OF CIVIL ENGINEERS.—Jan. 24, 25, 26, 1912. General meeting, 413 Dorchester St. West, Montreal. Prof. C. H. McLeod, Secretary.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, C. H. Rust; 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, H. E. T. Haultain, Acting Secretary; E. A. James, 57 Adelaide Street East, 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—
Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N. T. Ry., Cory Bldg.

MUNICIPAL ASSOCIATIONS.

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

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

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

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

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. E. McMahon, Warden, King's Co., Kentville, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

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

CANADIAN TECHNICAL SOCIETIES.

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

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

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

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

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

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

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

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

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

CANADIAN FORESTRY ASSOCIATION.—President, Thomas Southworth, Toronto; Secretary, James Lawler, Canadian Building, Ottawa.

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

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

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

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

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, T. A. Starkey, M.B., D.P.H., Montreal. Secretary, F. C. Douglas, M.D., D.P.H., 51 Park Avenue, Montreal.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Alfred T. de Lury, Toronto; Secretary, J. R. Collins, Toronto.

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

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

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

WESTERN CANADA RAILWAY CLUB.—President, Grant Hall; Secretary, W. H. Rosevear, 199 Chestnut Street, Winnipeg Man. Second Monday, except June, July and August at Winnipeg.

CONSTRUCTION NEWS SECTION

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

TENDERS PENDING.

In Addition to Those in this Issue.

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

Place of Work.	Tenders Close.	Issue of.	Page
Medicine Hat, Alta., church	Jan. 20.	Dec. 28.	59
Ottawa, Ont., iron posts	Jan. 31.	Dec. 21.	68
Ottawa, Ont., wharf, Evandale, N.B.	Jan. 8.	Dec. 21.	59
Ottawa, Ont., coverings for piping	Jan. 3.	Dec. 21.	59
Ottawa, Ont., rails and rail fastenings	Jan. 10.	Dec. 28.	68
Ottawa, Ont., breakwater, Devil's Island, N.S.	Jan. 11.	Dec. 28.	59
Toronto, Ont., sewers	Jan. 16.	Dec. 28.	70
Westmount, Que., road roller and bituminous macadam mixing plant	Jan. 3.	Dec. 14.	68
Westmount, Que., road roller and macadam mixer plant	Jan. 3.	Dec. 21.	68
Winnipeg, Man., supply of fire hose	Jan. 8.	Dec. 14.	59
Winnipeg, Man., drawings for government buildings		Dec. 21.	68
Winnipeg, Man., motor generator set	Jan. 22.	Dec. 21.	59
Woodstock, Ont., church	Jan. 15.	Dec. 21.	59

TENDERS.

Hamilton, Ont.—Plans have been prepared and a company is being organized to turn the old St. Lawrence Hall property into a modern apartment building.

Montreal, Que.—Tenders will be received until January 9, 1912, for 3,000 tons of unbroken macadamizing stone and 6,000 tons of unbroken concrete stone. Copies of specifications may be obtained upon application to Mr. F. W. Cowie, Chief Engineer. David Seath, Secretary Harbor Commissioners of Montreal, Montreal.

Ottawa, Ont.—Tenders will be received until January 15, 1912, for supplying 10,000 cubic feet of round yellow spruce in the log, and 40,000 cubic feet of round white pine timber, all in accordance with specifications prepared by the Dept. of Marine and Fisheries, delivered at Sorel, P.Q. Specifications, etc., can be obtained from the Purchasing and Contract Agent, Dept. of Marine and Fisheries, Ottawa, and from the Director of Shipyard, Sorel, P.Q. Alexander Johnston, Deputy Minister of Marine and Fisheries, Dept. of Marine and Fisheries, Ottawa.

Ottawa, Ont.—Tenders will be received until January 15, 1912, for the construction of a wharf at Anse Aux Canards, Gaspe Co., Que. Plans, etc., may be seen at the office of the District Engineers, Quebec, Montreal, and on application to the Postmaster at Newport, Que. R. C. Desrochers, Secretary Dept. of Public Works, Ottawa.

Ottawa, Ont.—Tenders will be received until January 15, 1912, for the delivery of Indian supplies during the fiscal year ending the 31st of March, 1913, duty paid at various points in Manitoba, Saskatchewan and Alberta. Particulars may be had on application to J. D. McLean, Asst. Deputy and Secretary, Dept. of Indian Affairs, Ottawa.

Ottawa, Ont.—Tenders for the construction of a public wharf at New Liskeard, District of Nipissing, Ont., will be received until January 10, 1912. Plans, etc., may be obtained at the offices of J. G. Sing, Esq., Dist. Engineer, Confederation Life Bldg., Toronto; on application to the Postmaster at New Liskeard, Ont., and at the office of R. C. Desrochers, Secretary Dept. of Public Works, Ottawa.

Toronto, Ont.—Tenders will be received by the chairman of the Board of Control, until noon Tuesday, January 16th, 1911, for the supplying and driving of timber sheet filing at the Sewage Disposal Works site. G. R. Geary, Mayor, Chairman Board of Control, City Hall, Toronto. (See advertisement elsewhere in the Canadian Engineer).

Victoria, B.C.—Plans for the new steel bridge to span the South Thompson River at the city of Kamloops are completed and it is expected that tenders for the erection of the structure will be called for very shortly.

Walkerton, Ont.—Tenders will be received until January 23, 1912, for the erection of a steel bridge over the Saugeen River, 10th Concession, Township of Brant. Bridge to consist of two spans of 125 feet each and one span of 90 feet, or two spans of 165 feet, 16-ft. roadway and with concrete floor. Specifications may be seen at the office of James Warren, Engineer in Charge, Walkerton.

CONTRACTS AWARDED.

Hamilton, Ont.—The contract for the glass factory for the Diamond Flint Glass Co. on James street north, has been awarded to the H. L. Dickinson Construction Co., Pittsburg, Pa. Estimated cost, $40,000.

Montreal, Que.—The Board of Control have awarded to Messrs. T. Lessard & Son, the contract for the construction of a fire and police station in Villeray, for $72,000.

Halifax, N.S.—The Berlin Woodworking Company has been given the contract of finishing the interior of the post office, and have sub-let contracts for parts of the work to Messrs. Falconer and McDonald. The contract price for the completion of the work is about $15,000.

Saskatoon, Sask.—Mr. B. Lancaster of this city, has the contract for additions and alterations at the Empire Hotel, the work costing in the neighborhood of $80,000.

Port Arthur, Ont.—Messrs. John S. Metcalf & Co., of Montreal and Chicago, have received the contract from the Grand Trunk Pacific to erect another 2,500,000 bushel unit to their elevator on Mission Island. Estimated cost, $500,000.

Vancouver, B.C.—Messrs. J. McDiarmid & Co., 138 Portage avenue, Winnipeg, have received the contract for the erection of a six to ten-story warehouse and cold storage plant on Water street for Messrs. Swift & Co. Estimated cost, $300,000.

Victoria, B.C.—The Westholme Lumber Company have received the contract for the Sooke Lake Waterworks, their price being $1,169,720. This was the lowest tender of the nine that were received for the complete work, including a reinforced concrete pipe between Sooke Lake and Humpback reservoir, and a riveted steel pressure pipe line from Humpback reservoir to the city.

Victoria, B.C.—Mr. Thomas Stedham has the contract for the repair of Smith's Hill reservoir, the contract price being $19,600. The contract calls for making water-tight the big receptacle and the construction of a wall ten feet in height through the centre of the basin, with necessary alterations to the intake and outlet pipes.

Windsor, Ont.—The contract for the construction of the new sewer on Tuscarrora street and Gladstone avenue has been awarded to Mr. Thomas Chick.

RAILWAYS—STEAM AND ELECTRIC.

Guelph, Ont.—The profits of the Guelph Street Railway for 1911 amounted to $7,449.

New Westminster, B.C.—Two new boats are under construction for the Grand Trunk Pacific Railway. These boats will be 140 feet long by 34 feet wide, stern wheelers, with a carrying capacity of 250 tons each. Two barges will be built in addition, and each boat, with a barge in tow, will have a carrying capacity of 500 tons of cargo each trip. The engines for these boats have been removed from the "Conveyer" and "Operator," which have been operated on the Skeena River for the past two years, and will give these boats a speed of fifteen miles an hour.

Ottawa, Ont.—At the operating sittings of the Board of Railway Commissioners, to be held in Ottawa on Tuesday, February 6th, 1912, commencing at ten o'clock in the forenoon, the board will consider the matter of requiring all railway companies subject to its jurisdiction to equip their locomotive engines with dump ash pans, or other appliance, to avoid the necessity of enginemen or others going underneath to clean the same.

Montreal, P.Q.—From 1,000 to 1,500 more miles of telephone train despatching circuits will be put into operation by the Canadian Pacific Railway during the coming year. The system of despatching trains by telephone has proved entirely satisfactory. The C.P.R. now has 1,000 miles of telephone wires in use for train despatching and is the second largest user of this method of despatching trains in the world. The additions which will be made during 1912 will make it the largest. Practically all the main lines in the eastern division of the C.P.R., with the exception of the line to Ottawa, are using this method to-day. By means of the system it is possible to get telephonic connection with any train on the line. Every train carries a telephone and a long pole, which may be hooked to the wire along the right of way whenever the need arises.

Thamesville, Ont.—Locomotive No. 1890, of the Mogul type, on a westbound Wabash freight exploded. The explosion was terrific, awakening the whole town and burning pieces of debris were blown blocks from the tracks. The whole body of the engine was blown several yards ahead of the lower part of the engine and turned completely upside down, parts of the car being found yards away. The exact cause of the explosion is not known.

Winnipeg, Man.—The Canadian Northern Railway have hauled wheat in large quantities to their elevators at Port Arthur and also to the Atlantic seaports. The total number of bushels of wheat marketed at points along the company's lines this year is 38,750,000 bushels, against that of twenty-four million bushels marketed last year for the same period, which shows an increase of fourteen million bushels. The Canadian Northern Railway have in store in their interior elevators eight million bushels of grain, while last year, for the same period, they only had three and three-quarter million bushels.

LIGHT, HEAT AND POWER.

Brockville, Ont.—To encourage the erection of uniform cluster lamps for street lighting, the board of light commissioners have decided to allow a special discount of 25 per cent. off present net current rates (10c. per K. W. H. for current used in same and for window lighting when said window lights are used only when lamp standards are used and connected with same meter.

Dundas, Ont.—A defective insulator in the hydro-electric station at this point, was indirectly the cause of the death of one workman and serious injury to another. During the light load period of January 1st repairs were undertaken with the above mentioned results.

Guelph, Ont.—According to the new electrical rates customers will have to pay a minimum charge of $5. It is the Commissioner's intention to keep the minimum charge in Guelph at $5 for the present at least, the reduction over the old basis will be from twenty-two and one-half to twenty-five per cent. Some customers will have a greater reduction on account of being larger consumers. The rates they are adopting at the beginning of 1912 are a fraction lower than any other city outside of Toronto and London, Ont. The net charge has been nine cents; the average price now will be between six and seven cents. The churches will have a reduction of from nine cents to six cents, the hotels will average a little over six cents, the stores and houses between six cents and seven cents.

Hamilton, Ont.—A report states that the Mackenzie and Mann interests will take over the Dominion Power and Transmission Company and all its holdings, including the Hamilton Street Railway, the Brantford and Hamilton Railway, Grimsby and Beamsville Railway, the Hamilton and Dundas Railway, the Hamilton, Burlington and Oakville Road, and the Cataract Power Company.

Hamilton, Ont.—Needle ice getting in the flumes at the De Cews Falls generating plant of the Dominion Power and Transmission Company caused considerable trouble recently. The city was in darkness one night, all traffic on the street railway and suburban roads being tied up. Hamilton's industrial establishments were helpless, and thousands of people were thrown out of work. Similar trouble last year tied things up for several days, causing heavy loss to the company, manufacturers, and thousands of men.

Port Dalhousie, Ont. — The Maple Leaf Rubber Company, who have been supplying this municipality with light for some time, have come to an agreement with the town authorities whereby the supply will not cease until further negotiations may be undertaken.

St. Thomas, Ont.—The hydro-electric service has been interrupted at intervals of late owing to defective wiring between London and Woodstock. The cause for the interruption, it was thought, could be traced to a broken insulator, which there are some reasons to believe was wilfully smashed on the line wire by a rifle shot.

Victoria, B.C.—A compromise may be reached between the city and the British Columbia Electric Railway Company with regard to the dispute over light and power rates. The city's contention is that the new rates agreed upon should have gone into force when the Jordan River power plant was completed on October 12 last. The company's contention has been that the new rates are not effective until a new ten-thousand horse-power plant has been installed at Jordan River, which will be next September. The company wrote to the city offering to put the new rates in force on March 1. The City Council replied that the threatened legal proceedings will be dropped if the date is made February 1, 1912.

Winnipeg, Man.—An announcement of a big reduction in light and power rates has been made. This matter has been pending since the opening of the new civic power plant and final action was taken by the city council and board of control in joint session. The rates fixed were three and a third cents per kilowatt hour for light, with a ten per cent. discount for cash, which places the price for light at less than three cents per kilowatt hour. The minimum charge per month was fixed at fifty cents, as against one dollar charged previously. The Winnipeg Electric Railway Company's rates have been ten cents per kilowatt hour up to a recent date, when it was lowered to seven and a half cents. Power rates fixed by the city range from a quarter of a cent to one and a half cents per kilowatt hour. These prices work out on a basis of cost so far below that which was obtained heretofore that the citizens on the whole are highly pleased over the matter.

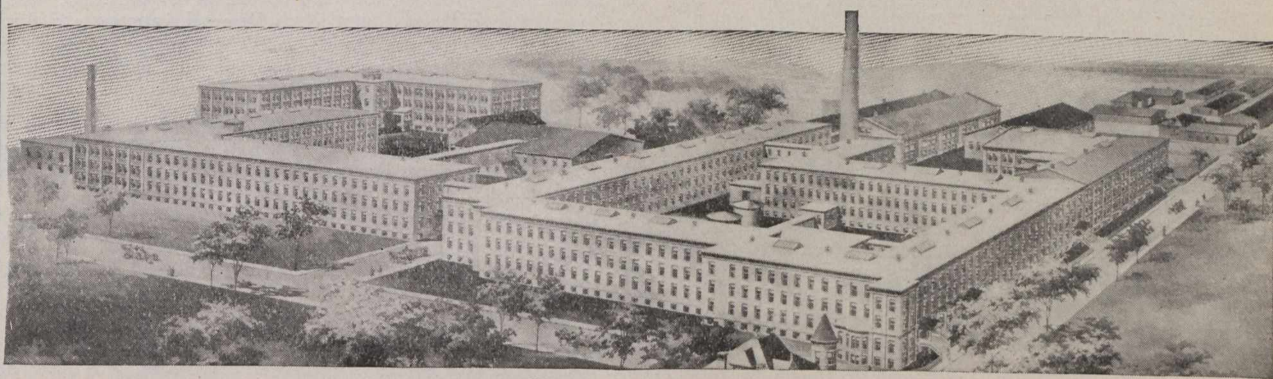
SEWAGE AND WATER.

Merriton, Ont.—The municipal receiver was out of commission one day last week, owing to anchor ice at the intake pipe.

Chatham, Ont.—The Civic Waterworks Department is handing over a surplus of $3,500 to the city after an exceedingly successful year, characterized by decreased cost of maintenance and considerable extensions to the plant.

Sarnia, Ont.—The intake pipe has been found to be broken at a point about 200 feet from shore. A diver discovered that the pipe had been dragged north about twelve feet, so that the connection was completely severed. From appearance the intake had evidently been in that condition for some time, the pipe not having been inspected for the past three years.

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.

CURRENT NEWS.

Brantford, Ont.—The by-law to raise $85,000 for the improvement of the John H. Stratford Hospital was carried by nearly 500 majority.

Bracebridge, Ont.—The by-law for a loan of $60,000 to the Dominion Linen Mills, Ltd., was defeated.

Brampton, Ont.—The by-law to purchase the Brampton Electric Light franchise was carried by a majority of 140.

Berlin, Ont.—The by-law to raise $100,000 for extensions to the waterworks system was carried by 576 majority. The by-law to raise $10,735 for the deviation of Wilmot raise $125,000 for storm sewers, the vote being 1,269 to raise $10,000 to purchase additional appliances and equipment for the fire department, including a motor truck, was defeated by 163 majority. The by-law to raise $7,400 for meeting the expense incurred in making extensions of the Berlin & Waterloo Street Railway was carried by a majority of 344. The by-law to raise $1,700 for a trunk sewer was carried by a majority of 302.

Barrie, Ont.—The by-law to raise $50,000 for improvements to the Barrie Collegiate Institute was beaten by 581 to 238. The by-law to raise $35,000 for sewers carried by 571 to 269.

Clinton, Ont.—The two by-laws voted on both carried: Hydro-electric by-law, majority 109; good roads by-law, 123 majority.

Edmonton, Alta.—A suggestion has been made to conduct the municipal scavenging department differently than it has been in the past. It will be made a separate department from the medical health officer's department, and conducted along different lines. The reason given for such a change was that the scavenging work is not being properly done. Several instances are recorded where refuse is not cleaned up, and also in the backyards of several citizens where the refuse is not burned, thus becoming a menace to the public.

Edmonton, Alta.—A company is forming to operate certain gravel pits adjoining the city. The company's officers are in communication with the commissioners asking if the city would allow the company running rights over the street railway tracks to the company's stations and depots for the carriage of freight; if the city would allow running rights over the railway for the supply of gravel and coal; and if the city would allow the company the privilege of the tracks for delivery of coal and gravel at special points within the city. The letter was written to enable the promoters to arrive at a correct estimate of the value of the proposal which they have in hand at the present time.

Edmonton, Alta.—The municipal telephone department in November netted a surplus. The revenue was $7,129.46, and the expenditure $5,722.38, thus showing a surplus of $1,407.08 for the month. The grand surplus for the year amounted to $32,219.01. The capital receipts, including balance on hand, amounted to $8,137.31. The capital expenditure was $4,448.42, against $1,705.65 in 1910.

Fort William, Ont.—The committee controlling the public utilities, consisting of electric light, water and telephones, have a surplus of $10,105 on the yearly operation of the combination. The gain of the electric light system amounts to $12,270.21, the water department $1,000, and the telephone system shows a deficit of $3,165.21.

Guelph, Ont.—The by-law to erect a new fire hall, equipped with auto apparatus, was defeated by 589 votes. The by-law to further extend the street railway in St. Patrick's Ward was carried by 623 majority. The by-law to place the sewerage and public works under a commission, carried.

Hamilton, Ont.—The Steel Company of Canada intend to open two new hearth furnaces of fifty tons capacity a day, also a blooming mill, a continuous billet mill and a combination rod and bar mill. They will be in operation by next October, employing a thousand additional skilled workers. Later on it is intended to erect factories for finishing wire goods. The extension will cost $2,000,000.

Hamilton, Ont.—By-laws to raise $833,000 were submitted, and the electors carried all but one, that to purchase the Oaklands property on the north shore of the bay, at a cost of $40,000. They authorized an expenditure of $793,000 as follows:—Waterworks extension, $650,000; east end park, $60,000; central fire station, $65,000; Gore Park convenience, $14,000. The vote was:—Waterworks, 3,705 for, 1,169 against; east end park, 2,353 for, 1,965 against; fire station, 2,903 for, 1,468 against; Gore Park, 2,922 for, 1,608 against.

Ingersoll, Ont.—The $125,000 by-law for the purchase of the waterworks was carried by a majority of 48.

Lethbridge, Alta.—The commission sitting at Lethbridge to arbitrate on the recent differences in mining matters between the United Mine Workers and the Western Coal Operators Association, have forwarded their report to Ottawa. The question of wages occupied a prominent part in the proceedings, and the following has been recommended to apply to Maple Leaf Coal Company, Bellevue, Alta.:—

	Per Day
Minimum wage	$3.00
In Parallel airway old mine	6.35
In Angle Chute old mine	3.50
Parallel airway	5.90
Pillar work (per cubic yard)	0.43

London, Ont.—The ratepayers voted in favor of all but one of four by-laws. The by-law to be defeated was one to raise $125,000 for storm sewers, the vote being 1,269 to 2,272. A by-law to bonus the North Midland Railway for a radial terminal station to the extent of $65,000, was carried by a vote of 2,345 to 1,357. One to appropriate $20,000 toward a bridge from South to West London by 2,113 to 1,596, and a third, to spend $50,000 on a garbage system, by 1,883 to 1,816.

Montreal, P.Q.—A shack, in which was stored the civic dynamite, was destroyed, when the contents exploded in the early morning of December 31st last, a watchman narrowly escaped death. He was struck and knocked down by a piece of the flying timber and badly cut and bruised. Many windows in the immediate neighborhood (Rosemount) were smashed, and the explosion was heard in all sections of the city.

Montreal, P.Q.—The legislation committee of the city council has decided to petition the Provincial Government for power to grant franchises to automobile omnibus companies, with a view of relieving the present congestion on the street railway cars.

Ottawa, Ont.—Work on the new civic incinerator has been started. Many difficulties have had to be faced in this project, among which were legal differences regarding the transfer of the site.

Owen Sound, Ont.—The by-law to loan $20,000 to a nut and bolt factory was carried by a large majority, as were also the hydro-electric and gas extension by-laws.

Ottawa, Ont.—The by-law submitted to the ratepayers to vote a sum of money to obtain a water supply from McGregor Lake, was defeated, very few votes being recorded in its favor.

Port Stanley, Ont.—The plans of the $600,000 sea-wall which is to be constructed by the Dominion Government at the east side of Port Stanley harbor, which was decided upon by the Laurier Government at the last session of parliament, has been approved by the new Conservative Government, and the work will be proceeded with, it is expected, during the year. It is reported that the contract will go to a construction company now being organized by Mr. A. E. Ponsford.

Quebec, P.Q.—Dr. J. A. Beaudry, chief inspector, Province of Quebec, has gone to the provincial capital to be at the disposal of the authorities should need arise from the present alleged smallpox epidemic. Dr. Beaudry is considered an expert in smallpox diagnosis.

Renfrew, Ont.—A by-law to pay $60,000 for the further development of the power plant carried.

Ridgetown, Ont.—The canning factory by-law was carried in this municipality by a majority of 313.

Sarnia, Ont.—The Mueller Brass Company bonus by-law was carried by 1,407 for and 96 against. When the company have invested $100,000 in buildings, etc., and employ 100 men, they will receive a bonus of $20,000 and another $10,000 when 50 more men are employed.

Stratford, Ont.—The by-law to loan the Jennewitz Co. $10,000 to assist in starting manufacture of piano accessories, was defeated.

St. Thomas, Ont.—The by-law to raise $10,000 for an Isolation Hospital carried by 400 majority. The plebiscite on extending the Citizens' Street Railway to Port Stanley was given an adverse vote of 750.

Toronto, Ont.—An old twenty-four-inch water main burst just before midnight, New Year's eve. The break occurred between two railway tracks on the esplanade in the vicinity of John Street. In a few moments ten tracks were covered with water so that they could be counted only by means of the cars on the rails. The water spread from the Union Station to a quarter of a mile west. The workmen of the water service could not get to the main, so that the only way of fixing it was to shut off the main near the pumping station. The main was the first one laid in Toronto, and it was put in thirty-nine years ago. It was sunk ten feet under the tracks. At the time the break took place the pressure was 100 pounds to the square inch.

Toronto, Ont.—The ratepayers have voted to spend $2,200,000 on extensions of the hydro-electric scheme; $1,783,333 on an extension of Bloor street, and $139,488 on car line extensions.

Vancouver, B.C.—It is recognized that the Fraser River will supply all the waterfront that will be required by the expansion of Vancouver and the greater city that lies between Burrard Inlet and the Fraser. But before permanent improvements are carried out, it is the opinion of Mr. Louis Coste, civil engineer of Ottawa, who is on the coast on a mission for the Dominion Government, that a commission of engineers should be appointed to decide the best course of action. Tenders are being called for the construction of a jetty at the mouth of the Fraser. This is the recommendation of a prominent engineer, who stated that with this jetty, perhaps two, the river would clear its own channel and keep it clear. Mr. Coste expresses the opinion that the construction of this jetty is premature, and thinks the best results would be obtained by a commission of three experts, for the task is too big to leave to one man

Winnipeg, Man.—The fire commissioner states that 100 fires during the past year in Winnipeg were due to defective chimneys, the fault of knowingly careless workmen or contractors. His contention in one case was supported by the city building inspector, who said that a new house which was almost destroyed by fire had no mortar in the layers of bricks in the chimney against the woodwork.

Welland, Ont.—The ratepayers decided to adopt the hydro-electric by-law by a majority of 334. The settling basin measure was defeated.

Winnipeg, Man.—The committee of the Board of Trade investigating the municipal telephone rates have started their task. The investigation will cover a wide area, and, will cover the whole management of the telephone system since it was taken over by the Manitoba Government. The question of telephones is causing considerable trouble throughout the province, owing partly to the recent deficit in the operation of the system.

The following is a list of Ontario municipalities which voted for the hydro-electric by-laws:—

Municipality—	Majority for
Ailsa Craig	85
Blyth	52
Brampton	140
Brussels	Large
Caledonia	180
Clinton	109
Cornwall	Large
Exeter	Large
Goderich	Large
Hagersville	Large
Hastings	71
Hensall	88
Kincardine	286
Kingston	Large
Lakefield	201
Listowel	Large
Lucan	Large
Owen Sound	Large
Paisley	Large
Paris	Large
Peterboro'	1,315
Prescott	154
Richmond Hill	118
Southampton	186
Tillsonburg	Large
Thornbury	149
Wingham	Very large
Wroxeter	Very large

The receivership for Allis-Chalmers Company, Milwaukee, U.S., will be of a friendly character and is one of the preliminary steps necessary in the reorganization of the company. Meantime the shops at Milwaukee, Chicago, and Cincinnati are running as usual and the operations of the company will not be curtailed. It is understood that $5,000,000 new capital has been provided. This will place that company in a far stronger position than it ever was before, and will enable it to take advantage of the revival of business which is anticipated in the United States at an early date. Allis-Chalmers-Bullock, Limited, of Montreal, is an entirely separate and distinct corporation, and is not in any way affected by the proceedings in connection with the American company. It has not felt adverse conditions similar to those in the United States; but, on the contrary, the shops are full of work and running regular time. The present proceedings will not affect the operations of the Canadian company.

TRADE ENQUIRIES.

The following were among the enquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., during the week ended December 18th, 1911:—

A Swiss firm is desirous of appointing Canadian agents for the sale of pipe-straw hats.

A London firm desire to get into touch with Canadian importers of dressed bath stone.

A firm of brokers and sales agents at Lucknow, India, are open to act for Canadian manufacturers of fancy goods, stationery, leather goods, sugar, provisions, piece goods, etc.

A Toronto firm stated to have a large staff of salesmen are desirous of taking up United Kingdom agencies.

The Canadian agent of an English manufacturer of condiments and essences is desirous of securing the agency for another line which he could work in conjunction.

A Montreal importer desires to obtain the representation of a United Kingdom manufacturer of fancy goods.

A Montreal firm of mechanical engineers stated to have a large connection wish to represent English manufacturers of railway contractors' and general engineering supplies.

A Nova Scotia correspondent desires to interest English financiers in an undeveloped coal area in that province.

A Vancouver firm of stationers, printers and bookbinders would like to get into touch with manufacturers in Great Britain of corduroy and canvas suitable for bookbinding. Samples and quotations required.

A Montreal correspondent enquires for names of miners of China clay in Cornwall.

A correspondent in Canada is desirous of finding a market in Great Britain for slaughter-house offal.

A Vancouver firm are in the market for Irish linen table cloths and similar goods. Quotations required f.o.b. Vancouver and Cape Horn or Tehauntepec.

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

An Italian importing firm invite quotations from Canadian shippers of hog and beef casings.

A London firm ask to be placed in communication with Canadian manufacturers of wood pulp who are in a position to fill orders for regular shipment.

A North of England company manufacturing a patented safety valve wish to get into touch with some Canadian resident firm possessing an established connection with railways, etc., who would act as their representative.

A manufacturers' agent in Toronto wishes to secure the representation of United Kingdom manufacturers of druggists' sundries, food specialties (such as jams, custards, etc., not already represented) and novelties in photographic lines.

A Toronto manufacturing company ask to be placed in correspondence with United Kingdom producers of picker cuttings from hide stock as used in the manufacture of glue.

An engineering firm in Ottawa desire the addresses of British manufacturers of oil burners for steam boilers.

A Winnipeg firm wish to be placed in communication with manufacturers of linen-lined paper bags for sending sample seeds through the post.

PUBLIC UTILITY COMPANIES IN BRITISH COLUMBIA.

The British Columbia Electric Railway Company operates in Vancouver and New Westminster, with suburban and interurban lines on the lower mainland. It owns the light and gas franchises in Vancouver and the lighting franchise in New Westminster, also in Victoria, where it has the lighting franchise. It has a power plant on the mainland, another near Victoria, on Vancouver Island, and is the biggest company in the West.

The British Columbia Telephone Company's charter enables it to have systems throughout the province, but its main operations are in Vancouver, Victoria, New Westminster and between these points.

The telephone company has had its own troubles to give an adequate service in Vancouver, which has grown so rapidly. There have been complaints regarding service, and suburban districts have complained also of the rates. There is a suggestion to have the provincial government take over the telephone system. The latest public body to recommend this is the combined board of trade of Richmond and Point Grey. The statement was made at the meeting that while the rates might be about the same, the service would be better. The telephone company has had to increase its rates for business telephones in Vancouver and Victoria, and this will bring further criticism.

The difficulties that beset the telephone company are infinitesimal compared with those of the British Columbia Electric Railway Company. The Point Grey by-law, giving the company power to operate in Point Grey, has been dismissed in the courts, and all construction and service has been discontinued in that suburb of Vancouver. The company has stood strictly upon its rights, and naturally will have nothing to do with any compromise proposals.

The City Council unanimously agreed to see if the company's franchise in Nanaimo cannot be cancelled, because of the persistent ignoring of requests for a better service. Certain it is that in many points which tend to the comfort and convenience of the people, the company has been deficient. In some cases passengers have to wait fifteen minutes for connecting cars. After the action of the city this week, to seek annulment of the franchise, the company, which by the use of passes keeps criticism out of the papers, gave figures to show that the number of cars used were as large in proportion as on street railway systems in other cities. It based its calculations on the population of Vancouver proper, allowing so many cars to these people. The real facts are that 30,000 to 40,000 more people are served, and Vancouver proper cannot be considered by itself, for all the people in the districts immediately adjoining work in the city and come and go morning and evening.

It is reasonable to suppose that because conditions are such that the company cannot adequately cope at present with the situation, the government will not allow cancellation of the franchise. The company has at least been sincere in its general attempts, and if it has been overwhelmed by circumstances, the fault is not altogether its own. All these inconveniences are incidents of sudden and enormous growth in the city.

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.

CIRCULAR NO. 73.

FENDERS OR WHEEL GUARDS.

The Board of Railway Commissioners ask that all electric railways subject to the Board's jurisdiction file, within sixty days from the date of this circular, plans showing the system of fenders or wheel guards in use on their equipment.

15595—December 12—Authorizing Government of Province of Saskatchewan to construct highway over C.P.R. in S.W. ¼ of Sec. 30, Twp. 15, R. 13, west 3rd Meridian.

15596—December 9—Suspending Wabash Railroad Co.'s Tariff 686, re "Baggage of Excess Size," until parties can be heard.

15597—December 12—Approving location of C.P.R. station at Lydiatt, Man.

15598-99—December 12—Approving revised location of Dominion Atlantic Ry. (under C.P.R. lease) from west side of St. George St., Annapolis, N.S., to west side of Allen's Creek, a distance of 2,790.5 feet, and authorizing reconstruction of Allen Creek bridge.

15600—December 14—Approving plans of C.N.O. Ry. for undercrossing of C.P.R. at Smith's Falls.

15601—December 14—Authorizing Esquimalt & Nanaimo Railway to cross with its Cowichan Lake Branch two highways in British Columbia.

15602—December 13—Authorizing C.N. Pacific Ry. to use crossing of C.P.R. Mission Branch for construction purposes only until 29th February, 1912, pending installation of interlocking plant.

15603—December 18—Approving revised location of C.N.O. Rly. (Montreal-Port Arthur) through Twps. of Bristol, Clarendon and Litchfield, in County of Pontiac, Que., mileage 162 to 176, from Montreal.

15604—December 19—Directing C.N.O. Ry. to install improved type of electric bell at crossing near Brighton, Ontario.

15605—December 16—Authorizing C.N.O. Ry. to construct bridge over Blende River, at mileage 23.96, east of Port Arthur, Ont.

15606-07—December 18—15608—December 19—Authorizing C.N.R. to cross with its Maryfield Line public road between Secs. 12 and 11, Twp. 5, R. 8, west 2nd Meridian, and with its Swift Current Line 7 highways in Saskatchewan, and with its Swift Current Line three highways in Saskatchewan.

15609—December 15—Approving location of Alberta Central Railway Co. from a point on its main line 135.58 miles west of Red Deer to Big Horn Range Coal Fields, mileage 0 to 28.

15610—December 19—Authorizing G.T.P. Ry. to cross highway at mileage 197.2, Range 6, Cassiar District, British Columbia.

15611—December 18—Approving plans of G.T.R. for station at Stevensville, 19th District, Southern Division.

15612—December 19—Authorizing C.P.R. to open for carriage of traffic its Swift Current to Brooks Branch from mileage 0 to 33.

15613—December 19—Authorizing C.P.R. to operate until June 30, 1912, its Manitou Lake Branch from a point on its Pheasant Hills Branch, being from mileage 0 to 27.8, between Wilkie and Cut Knife, Saskatchewan.

15614—December 16—Approving revised location of C.P.R. Lauder Extension between mileage 32.28 and 54.63, Saskatchewan.

15615—December 16—Authorizing C.P.R. to cross with its Wilkie Northwesterly Branch (formerly known as Manitou Lake Branch), 14 highways between mileage 13.90 and 25.78, Saskatchewan.

15616—December 18—Authorizing C.N.R. to cross with its Maryfield Line 16 highways in Saskatchewan.

15617—December 13—Approving overhead clearances of West Canadian Collieries, Ltd., for siding of C.P.R. at Bellevue, Alta.

15618—December 20—Approving location of C.N.R. Crosse Isle Extension, mileage 4.33 to 25.68, west P.M., Manitoba.

15619—December 19—Authorizing G.T.P. Ry. to cross highway at mileage 204.5, Range 6, Cassiar Dist., British Columbia.

15620—December 19—Authorizing G.T.R. to construct spur for joint use with C.N.O. Ry. on Don Esplanade, Toronto, Ont.

15621—December 12—Authorizing C.N.R. to construct spur line to Hospital for Insane at North Battleford, Saskatchewan.

15622—December 13—Authorizing Dominion Atlantic Ry. to construct spur from a point on its Cornwallis Valley Branch to Government wharf, at Canning, N.S.

15623—December 15—15624—December 13—15625—December 9—Authorizing C.P.R. to construct spurs for Alberta Consolidated Coal Co., Ltd., near Elcan Ballast Pit, Alta., and for Messrs. Anderson & Rosenroll at mileage 59.2, on Wetaskiwin Subdivision, near Ohaton, Alta., and for Messrs. Wiens & Reimer at Foam Lake, Saskatchewan.

15626—December 14—Authorizing Esquimalt & Nanaimo Railway to construct spur on Vancouver Island, at mileage 47.5 (from Victoria) to near village of Croftonat, mileage 0.78 in Chemainus District, British Columbia.

15627—December 18—Recommending to the Governor-in-Council for sanction lease by C.P.R., or Alberta Railway & Irrigation Co.

15628—December 15—Approving location of Alberta Central Ry. from mileage 100 to 140, west of Red Deer, Alberta.

15629—December 20—Authorizing G.T.P. Ry. to operate trains over overhead crossing of C.N.R., in Sec. 14, Twp. 53, R. 24, W. 4 M.

15630—December 12—Extending until February 1st, 1912, time for installation of power brakes by C.P.R. on electric cars.

15631—December 18—15632—December 15—Authorizing C.P.R. to construct spur for A. E. Burns, near Henry Avenue, city of Winnipeg, Manitoba, and spur for Rock Springs Sootless Coal Co., Ltd., near Elcan Ballast Pit Spur, Alberta.

15634—December 20—Approving location of Esquimalt & Nanaimo Ry. from Black Creek to near Duncan's Bay, on Vancouver Island.

15635—November 21—Directing that Supplement to Canadian Classification No. 15, be issued reducing carload rating of Macaroni, Spaghetti and Vermicelli, from 4th to 5th class to become effective not later than January 15th, 1912. Application Transportation Bureau of Montreal Board of Trade, on behalf of the Montreal Wholesale Grocers' Guild.

15633—December 16—Authorizing C.N.O. Ry. to use for construction purposes only crossing of C.P.R. at Chaudiere Jct., near Ottawa, until June 1st, 1912, pending completion interlocker.

15636-37—December 13—Directing that Wabash Railroad (G.T.R.) install gates at Manitoba Street, St. Thomas, Ontario, before 1st May, 1912, 20 per cent. from Railway Grade Crossing Fund, also G.T.R. to install electric bell at St. George St., Chatham, Ont., before 1st February, 1912, 20 per cent. from Railway Grade Crossing Fund.

15638—December 16—Extending until June 1st, 1912, time for installation of interlocking plant at crossing by C.N.O. Ry., of C.P.R. and G.T.R. near Ottawa, Ontario.