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The Canadian Engineer

A weekly paper for engineers and engineering-contractors

CRIB CONSTRUCTION FOR WELLAND SHIP CANAL

NOTES ON THE DESIGN AND CONSTRUCTION OF THE REINFORCED CONCRETE CRIBS WHICH ENTER INTO THE HARBOR DEVELOPMENT AT PORT WELLER. THEY WILL BE FIFTY-FIVE IN NUMBER, EACH WEIGHING ABOUT 2,000 TONS.

THE new Welland Ship Canal is a $50,000,000 waterway at present under construction between Lake Erie and Lake Ontario. It is being built under the direction of the Department of Railways and Canals, Ottawa. When completed, it will be the third to bear the name of "Welland Canal," its predecessors having, each in its turn, given place to the demands of commercial and industrial development for greater and better accommodation of Great Lakes traffic. The importance to Canadian trade and commerce of the present extensive improvement in the water transportation route from the central west to the Atlantic may be better imagined when it is remembered that last year the Port of Montreal handled some 72,000,000 bushels of Western grain alone.

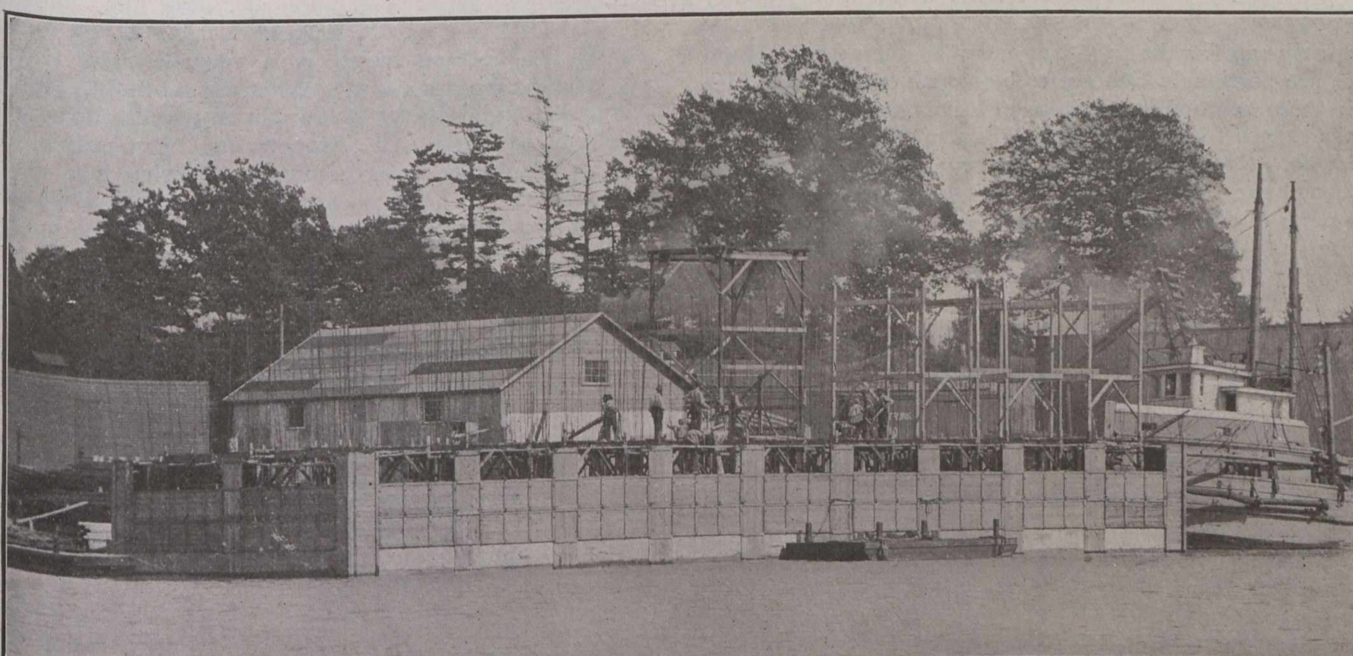

Fig. 1.—A Crib Under Construction—12 feet of concrete in place. Its weight has just sunk the supporting pontoon a few inches below the surface.

The new canal will be 25 miles in length and will include 7 lift locks 800 ft. long and 80 ft. in width, each with a lift of 46½ ft., providing a depth of 25 ft. over the sills, this depth to be ultimately increased to 30 ft. Detailed particulars respecting the undertaking and the essential features of the design adopted, are to be found in *The Canadian Engineer* for August 21st, 1913. Another article, appearing in the issue for November 5th, 1914, covers the work of construction to practically the end of last season. One feature, however, which is of world-wide importance in that it is being constructed in dimensions beyond comparison with any similar work, the nearest approach being the Kobe harbor improvements in Japan, is the construction of 55 reinforced concrete cribs which, when placed, will provide dockage and protection to the extent of about 6,000 ft. inside the harbor which is being developed at Port Weller. The construction of these cribs marks the latest development, not only in Canada but in all countries where this form of construction has been adopted. Besides the enormous dockage and protection which they will adequately and economically provide, there is to be considered the fact that over 5,500 ft. of it is to be constructed ready for use in the short space of three working seasons. Further, the harbor design calls for cribs with a height of 34 ft., while the available location for their construction provides a depth of only 16 or 17 ft. of water. It will be seen that it was necessary to design a crib that would not have a greater draft than this but that would be stable nevertheless, as it is to be towed, when built, a distance of several miles to its permanent location.

The harbor is being formed by building two parallel earth embankments from the original shore line for a distance of one mile and a half into the lake and dredging between them. These embankments will be protected by rough rip-rap for the greater portion of their length, but there are portions which are to be sustained on the inside with these reinforced concrete cribs. They will provide vertical faces for the mooring of ships and, at the outer end where the embankments converge, will give a navigating channel for the full width between embankments. The parts of the harbor where cribs are situated are shown in Fig. 5. On the west side they extend inshore to meet a retaining wall. This retaining wall is carried as near the lake shore as is possible without resorting to subaqueous construction.

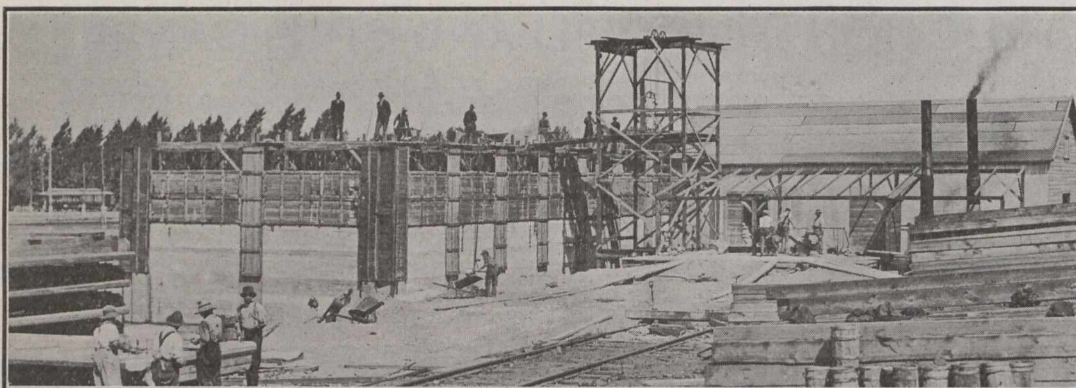

Fig. 2.—Concreting Plant, Showing Transportation Method. Removable Bottoms for the Compartments Under Construction at Left.

The design which was adopted required a crib 110 ft. long x 38 ft. wide x 34 ft. in height, having a displacement of about 2,000 tons. As stated, there are to be 55 of these cribs. Each is divided by a longitudinal centre wall and 8 interior cross-walls, thus providing 18 compartments. The outside end and longitudinal walls extend from top to bottom without an opening of any description, while the interior walls have a rectangular opening 8 ft. x 14 ft., the bottom of which is 12 ft. from the top of the crib. The purpose of these openings is to reduce the weight of the crib and, since they are near the top, to bring its centre of gravity lower down. Thus each pocket is separated from those adjoining for a depth of 22 ft. and it is intended that each shall be watertight. Watertightness is important, since the crib is required to float during construction and possibly for some considerable time after it is built. A feature of the complete separation of the lower portion of the pockets is that, in the event of a leak developing in some part of the structure, only one or two pockets are flooded and the crib, instead of sinking, merely heels over somewhat from the vertical. As the crib draws 16 ft., it requires about 18 ft. of water in the crib to cause it to rest on the site. When in this position there is no flow between pockets and more water is not let in until the crib is correctly placed.

A new and very important feature is the provision of a removable watertight bottom for each compartment. By its use the crib may be sunk directly on the sea bottom by admitting water through sea valves. When properly placed, the braces which hold the removable bottoms in place are released and the latter are removed, to be used over and over again in the construction and transportation of other cribs. Attention is called to the fact that the filling for the crib will rest directly on the sea bottom, which is a very desirable feature.

During the process of sinking, by carefully admitting the water, the crib can be brought to within a few inches of the bottom and, when brought into exact position and line, a little more water admitted will bring it to rest in position. If, for any reason, it gets out of line while sinking the last few inches, some of the water can be pumped out and the crib will float again, thus allowing the error to be corrected. Each crib is provided with vertical projecting ribs at opposite ends and arranged in such a way that the crib will be keyed to the two adjoining ones.

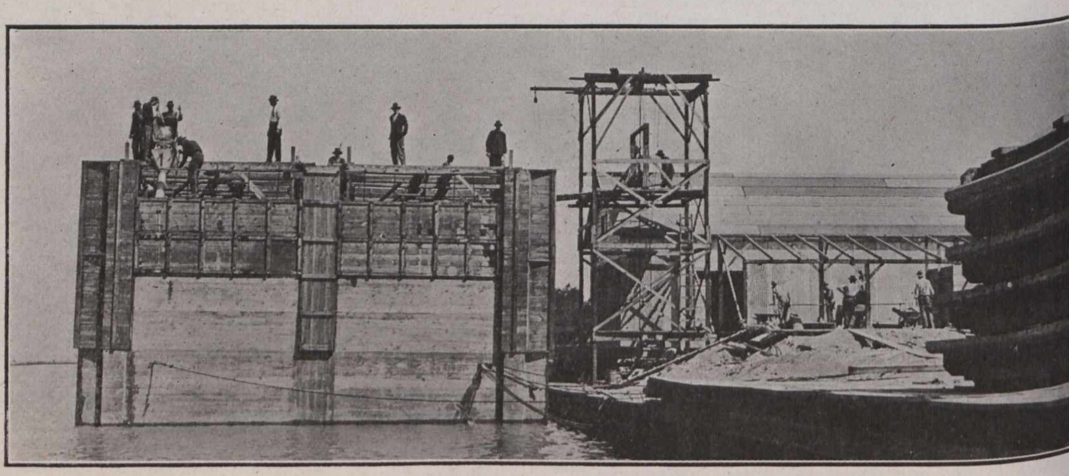

Fig. 3.—View Showing Method of Placing Concrete. It is elevated in barrows and transported over various runways to different parts of the crib. A pile of completed wooden bottoms is shown at extreme right.

The reasons for constructing a crib with bottomless pockets are for economy, since, as stated, the timber bottoms can be used over and over again, and for the purpose of allowing the crib filling to rest upon the sea bottom instead of on the bottom of the crib as is ordinarily the case. This tends to prevent settlement and prevents undue strains upon the crib and secures an even bearing on the foundation. It obviates any danger of the crib ever becoming undermined.

In the construction of one of these cribs a wooden pontoon is used, the interior dimensions of which are 110 ft. in length, 38 ft. in width, with a height of 6 ft. The concreting forms and the reinforcing steel are set in position inside of the pontoon, while afloat at the building site, which, in this instance, is at Port Dalhousie, about 2½ miles from Port Weller, where they are to be placed. The pontoon floor is made up of 8 x 10-inch longitudinal stringers, placed 2 ft. c. to c., and one course of 2-inch planking on the bottom. Then there is a course of 2-inch matched sheeting, in the jointing of which there is applied a special preparation, giving a remarkable degree of watertightness. One of the pontoons launched recently has not taken in more than 8 inches of water in the course of three weeks afloat.

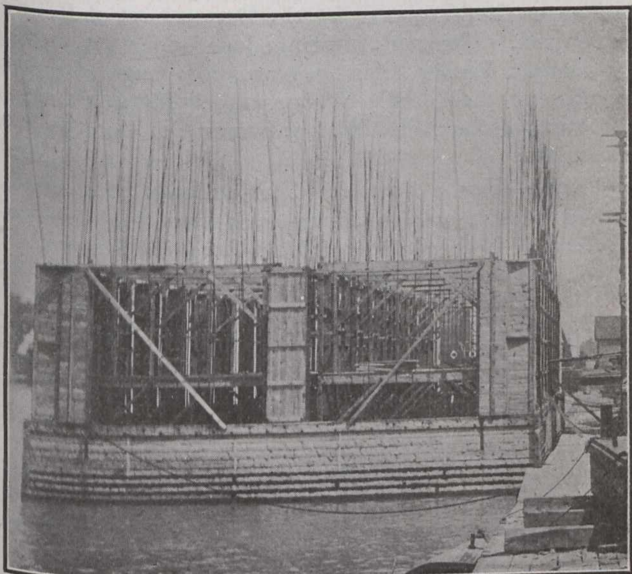

Fig. 4.—End View, Showing Reinforcing and Form Bracing.

As the concreting is proceeded with, the pontoon sinks in accordance with the added weight. The concrete is placed in courses 3 ft. in height. Fig. 1 illustrates a stage in the construction of one of the cribs where 12 ft. of concrete work have been placed, and at which stage the pontoon has just become submerged. The operation is continued until the crib is completed to its full height. The removable bottoms, which the accompanying illustrations show under construction, are then placed in the different compartments, where they are securely braced down and packed. Water is then admitted between the pontoon and the removable bottoms for the purpose of carefully testing the latter against leakage. A watertight joint is made between the bottoms and the concrete ledge upon which it rests by placing between them a rope made of jute yarn covered with canvas which is tightly squeezed down by the wedges that serve to hold the bottom in place.

The next operation consists in removing the pontoon from the crib. This is very easily accomplished, the sides and ends being detachable. The pontoon is ballasted to overcome buoyancy, and the crib is then towed away by tugs to the harbor site and sunk into position by opening the sea valves as described above. This pontoon is thereupon reassembled and the construction of another crib begun. It is to be noted that in the finished crib there is no timber or other material susceptible to decay; it is entirely a reinforced concrete structure.

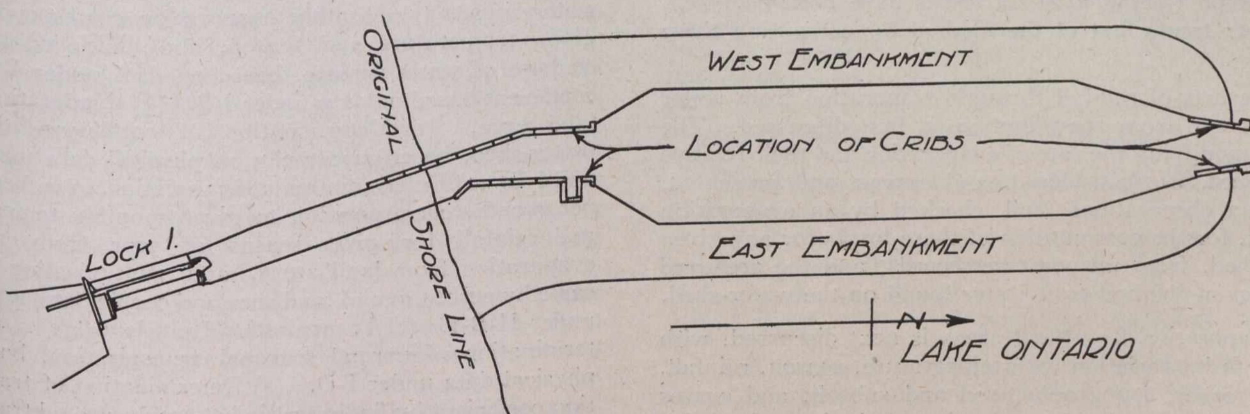

Fig. 5.—Plan of Harbor at Port Weller, Showing Location of Cribs.

On the construction work which has already been accomplished the contractors have poured the concrete in lifts of about three feet, placing the horizontal reinforcing

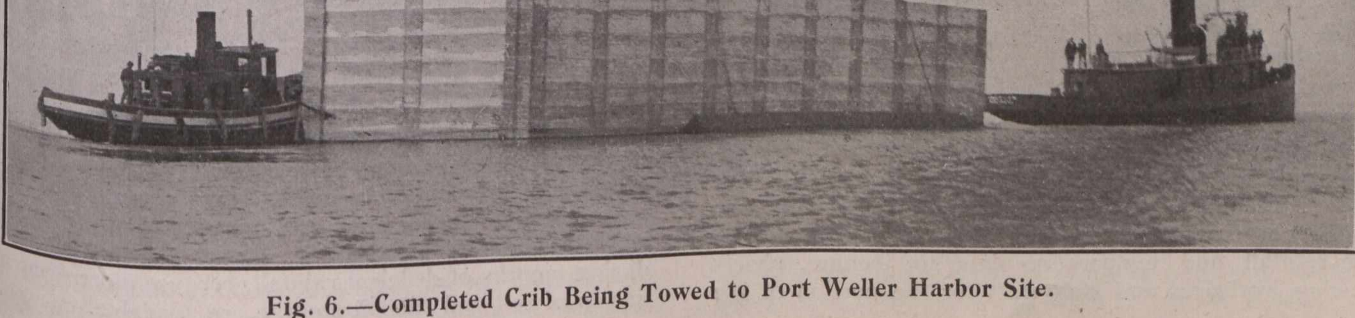

Fig. 6.—Completed Crib Being Towed to Port Weller Harbor Site.

steel in position for each lift and pouring concrete alternately. The vertical steel extending from top to bottom without a break must be placed before any concrete is poured. The forms creep up in lifts of about three feet, according as the concrete is poured and sets.

The concreting plant used in the work consists of two Ransome 2-sack mixers running in tandem. A 1:2:4 mix is used. In the first crib built sand and gravel with a proportion of crushed stone was used, and no water whatever seeped through the walls of the completed crib, although the concrete in the bottom course was subjected to a head of 15 ft. No waterproofing was used in any of the concrete. This particular crib was completed last fall and was, as stated, the first to be constructed.

It is expected that during the coming season construction will proceed on three cribs at a time, and in all likelihood about 15 cribs will be completed before closing down operations in the fall.

These cribs are being constructed by the J. H. Tromanhauser Co., Toronto, for the Department of Railways and Canals. The work is being done under the direction of Mr. J. L. Weller, C.E., engineer in charge of the construction of the canal. We are indebted to Mr. H. E. Harcourt, of the J. H. Tromanhauser Co., for the above particulars.

[Note—For a detailed description of the pontoon method of subaqueous concrete construction the reader is referred to the issues of *The Canadian Engineer* for July 31st, 1908, and June 10th, 1910.—Editor.]

COMPUTATION OF RUN-OFF FROM RAINFALL.

The necessity of basing conclusions with respect to stream flow on extended physical data is pointed out in a paper to be presented at an early date by Adolph F. Meyer to the American Society of Civil Engineers. The author shows that as most stream-flow observations available for the engineer's use extend over a comparatively few years, there is need for a method of computing run-off from other physical data for the purpose of extending and supplementing short-term stream-flow records. Inasmuch as run-off or stream flow consists of the residual rainfall after all losses have been deducted, the paper treats first of the method for computing these losses.

The loss of rainfall through evaporation from water surfaces and from snow and ice is first discussed. The factors modifying the rate of evaporation and their relative importance, are considered, and curves are presented, based on observations and checked by an evaporation formula, for the computation of these losses for any given water-shed, from temperature records, and the area and character of the bodies of water found on the water-shed.

Evaporation from land areas is next discussed, with respect to its variation with temperature, season, rainfall, vegetal cover, topography, soil and subsoil, and curves are presented for the determination of the loss of rainfall through evaporation from land areas for various temperatures and rates of rainfall. The values taken from these curves are to be modified by the use of certain coefficients based on water-shed characteristics.

The losses out of rainfall resulting from the transpiration of plants, as determined by various investigators, are briefly mentioned, and some of the underlying principles governing the transpiration of plants are pointed out. The water requirements of plants are discussed, and a curve is presented to aid in computing monthly transpiration losses. A summary statement of the author's method of computing run-off is next made. The main features of the method are as follows:—

I.—Collection of physical data.—(*a*) Rainfall and temperature data for stations on and near the given water-sheds from which monthly rainfall and temperature for the water-shed are estimated. Rates of excessive rainfall at different seasons of the year, as indicated by weather bureau observations at the nearest regular station. In case rainfall and temperature data are meagre, charts showing isotherms and isohyetals for the portion of the territory in which the water-shed is situated are of assistance. (*b*) Data relating to wind velocity, relative humidity, and any other prominent weather characteristics. (*c*) Data relating to topography, vegetal cover, soil and subsoil, as affecting evaporation. (*d*) Data relating to character and density of vegetation and length of growing season, with reference to temperature and hours of sunshine. (*e*) Data relating to area of open water surfaces, swamps, and marshes.

II.—Determination of losses.—(*a*) Evaporation from water area. (1) Monthly evaporation corresponding to given temperature and season, and multiplied by percentage of water surface, based on data under I-E, and coefficient based on data under I-B. (*b*) Evaporation from land area. (1) Determination of coefficient for given water-shed, based principally on physical data under I-C and I-B. (2) Determination of evaporation, in inches depth per month, corresponding to given monthly temperature and rainfall for given season of year, from curve of evaporation from land areas, and multiplication of the same by percentage of land area and coefficient determined under II-B-1. (*c*) Transpiration from land area. (1) Determination of normal seasonal transpiration, based on physical data under I-D. (2) Determination of transpiration coefficient by finding ratio between seasonal transpiration determined from base curve of transpiration for the normal monthly temperatures for the given water-shed, and the normal seasonal transpiration determined under II-C-1. (3) Determination of monthly transpiration by applying transpiration coefficient to monthly values taken off transpiration curve for given monthly temperatures, and modification of these monthly values on basis of rainfall, percolation, and storage.

III.—Determination of total loss by summation of monthly losses from land and water areas, the deduction of these monthly losses from the monthly precipitation, and summation of these monthly residuals to give the annual yield of the given water-shed, with or without correction of this annual total for fall surface run-off, or changes in ground and surface storage.

IV.—Where the annual yield and its distribution throughout the year are both desired, additional curves and computations must be made. When the more detailed computations, as here indicated, are carried out, it is possible to make more accurate estimates of transpiration during months of deficient rainfall, because more accurate values of soil and subsoil storage are available.

CANADIAN PRODUCTION AND USE OF ASBESTOS.

UNDER the name asbestos, there are several fibrous minerals used in commerce; anthophyllite, amphibole or hornblende asbestos, and chrysotile or serpentine asbestos. The last of these three is the best in quality, and is of most importance to Canadians, since the product of the mines of the eastern townships of Quebec is of this variety.

It occurs in reticulating veins up to 4 or 5 inches in width, in serpentine rock, the fibres being arranged at right angles to the walls of the veins. These fibres, which are easily separable, are very fine, of a silky appearance, and flexible to a high degree. Asbestos is unaffected by heat, except on continued exposure to high temperatures, and is non-combustible. It is a poor conductor of both heat and electricity, and is not attacked by the common acids. These characteristics make it an important raw material in a number of manufacturing industries.

Asbestos fibre may be spun into yarn and rope, and woven into fabric, in which forms it finds many uses where a fire-resisting fabric is required. For these purposes a long fibre, both strong and very flexible, is desired. At present there are no factories in Canada weaving asbestos. The principal manufactures in this country are mill board, paper and shingles, for which purpose a short fibre is used. In the making of certain mineral flooring short fibre asbestos enters into the mixture, where it acts as a binder.

On account of its low electrical conductivity it is used as an insulator in electrical instruments. While asbestos paper and mill board are principally used for this purpose, considerable long and short fibre are also employed.

Short fibre is mixed with paints to produce a fire-resisting paint. It is also used in making stove cement, pipe covering, etc.

Long fibre, besides the uses referred to above, is used in making gaskets for packing glands and pipe joints where high temperatures or acid solutions are encountered, making of chemical and water filters, and as a surfacing of gas grates.

Asbestic is a name applied to impure very short fibre asbestos. It is used by plasterers, manufacturers of roofing, and also for a number of the purposes referred to above.

In most cases in Canada asbestos is mined by open-cut methods. From the mine it is conveyed to the mill, where it is hand cobbed. The long fibre asbestos is separated as completely as possible, by hand, from the waste rock, and from that carrying the short fibre. The waste is discarded and the balance subjected to a complicated milling treatment in order to separate the fibre from the gangue. The first crushing is done by jaw crushers, and the final by cyclone or similar crushing devices. The fibre is removed partly by means of air currents and partly by screening out the finely powdered rock.

The asbestos is graded according to length of fibre. The market price varies greatly, according to grade and the demand. The long fibre always commands a much higher price than the short.

Amount of asbestos used in the manufacturing industries, as reported by the consumers:—

Location.	No. of firms reporting consumption.	Domestic. Tons.	Imported. Tons.
Maritime Provinces...	1	11	—
Quebec	10	6,536	—
Ontario	27	537	33
Prairie Provinces	3	251	—
British Columbia	1	100	—
Canada (Total)	42	7,435	33

Amount of asbestic used in the manufacturing industries, as reported by the consumers:—

Location.	No. of firms reporting consumption.	Domestic. Tons.	Imported. Tons.
Maritime Provinces...	—	—	—
Quebec	2	3,000.5	—
Ontario	5	43.5	—
Prairie Provinces	—	—	—
British Columbia	1	15	—
Canada (Total)	8	3,059	—

The following imports are reported by the Department of Customs:—

	1910-11.	1911-12.	1912-13.
Asbestos in any form other than crude, and all manufactures of	$254,331	$349,655	$498,215

These figures are from a report on the non-metallic minerals used in Canadian manufacturing industries, prepared by H. Fréchette, M.Sc., and published by the Department of Mines, Ottawa.

GRANBY POWER DEVELOPMENT, B.C.

An interesting example of water-power conservation is exhibited in the plant of the Granby Consolidated Mining, Smelting and Power Company, on Granby Bay, along the coast of British Columbia. The power plant is situated at tide level, the floor being only 20 feet above high tide. The water for driving more than 6,000 h.p. of Pelton-Doble wheels, is taken from Falls Creek, a small stream flowing through a heavily timbered canyon opening into Granby Bay. A mile and a quarter from the stream mouth, a rock and timber dam is built across Falls Creek. Twenty feet below the crest of the dam, a short tunnel is driven through a rock ledge which forms part of the dam foundation. A wood stave pipe line runs through this tunnel, thence following the contours and on the hydraulic gradient to a point on the canyon wall back of the power house. Here it connects to a riveted steel pipe line, which carries the water to the manifolds outside the power house foundation wall.

Ten Pelton-Doble tangential wheels, ranging in size from 3 feet to 24 feet in diameter, drive air compressors and blow engines for mine and smelter operation and the hydro-electric plant for supplying electric energy to all parts of the workings. This plant is one of the notable installations of 1914.

The Commissioner of Conservation will shortly issue a report on the various waterworks systems of Canada. The report notes that while there are now 61 sewage disposal plants in operation, there are no fewer than 57 inland river systems in Canada, which receive raw sewage from 159 municipalities. Water supply systems for 111 municipalities still obtain water from streams or bodies of water into which raw sewage has been discharged above the intake points.

GOOD ROADS AND THE CONTRACTOR.*

By Herbert T. Routly, O.L.S., A. M. Can. Soc. C.E., Huntingdon, Quebec.

In discussing any subject it is well, if possible, to first clearly define it so that all will know exactly what is under discussion and the various remarks will therefore be more to the point. Next to building a good road, the greatest difficulty is, perhaps, to define one. Every other man will have a different definition, the terms of which will depend more upon the type of man and his personal experience and associations than upon the type of road; and as there are multitudinous types of men so there is an unlimited variety of descriptions for both "Good Roads" and "The Contractor." But, among the countless varieties or types of men who do so consciously or unconsciously attempt these definitions, there is one particular class whose opinion or definition is especially valuable. The experience and training, the powers of observation and deduction, the honesty and integrity, the intimate and unprejudiced association with both subjects particularly fits this class of man to voice an opinion or frame a definition. Our highway engineers compose this class. Though no definitions would satisfy a large proportion of the general public, the following are submitted in the hope that they will at least be found sufficiently accurate and comprehensive as to serve for a basis of further discussion.

A Good Road.—A comparative term incapable of exact definition. Generally speaking, however, "a road with a general alignment of tangents joined by regular, easy curves, a profile consisting of a series of minimum to moderate grades, with adequate surface and sub-drainage with sufficient foundation composed of consolidated non-perishable materials, with shapely, well-bonded and lasting surface, hard, smooth but non-slippery" would be considered a good road. You will note the absence of any reference to cost or location. If you were to find such a highway in the jungles of Africa, built at fabulous cost but absolutely devoid of traffic or apparent purpose, you would still be justified in exclaiming that it was a "good road." Plainly the term "good road" is inadequate to describe what we are striving for. The vital and the most essential qualifications are those which will appeal to the competent engineer as to no other and would more properly be defined as follows:

The Best Road.—"That road which, in its location, dimensions, material, mode of construction, and cost is the most suitable and the most economical of all possible roads for the accommodation of the present and probable future traffic it will have to carry." Should we not alter our printed announcements, our very name, and in many cases our very motives, and hereafter speak and strive for "best roads" rather than simply "good roads."

The Contractor.—"One whose practical experience, plant equipment, staff of employees and executive abilities especially qualify him for undertaking a certain line of construction work and who engages for a stipulated price to perform a certain definite quantity and quality of work thereon."

Best roads or even good roads, in the modern sense, are still practically unknown in Canada outside large cities and with a few particular exceptions. We are at the beginning of what, during the next two or three decades, will be the outstanding feature of our municipal constructional work. We have exceptionally variable and difficult climatic and soil conditions with which to contend; we have a traffic whose rapid changes in type and volume make the problem of economic design most puzzling and we have a people whose transportation education has been somewhat onesided. It is a source of constant wonderment why our people give so lavishly in support of steam railways, so conservatively to rural electric lines, and so grudgingly, sparingly and hesitatingly to the improvement of our country roads. Many taxpayers rarely use the steam railroad for direct personal pleasure or convenience. In any case, it has a very unaccommodating schedule of time and stops, compelling us to regulate our whole day's programme in order to keep its appointment, but giving no guarantee of being on time itself. We may have to drive five miles over abominable roads to a station, only to have the train take us back past our very door on the way to our destination. Though our money has secured its construction, yet when we ride or make freight shipments on it we are compelled to pay in cash much more, usually, than the actual cost of the service rendered. We must expect to provide our share of cost of operation, maintenance and dividends on that portion of the capital cost which we have not ourselves provided. But why should we also contribute an extra tax to provide for dividends on a large amount of watered stock as well? The electric rural lines treat us better, being a much closer approach to individual accommodation, for the service is more frequent and the stops more convenient. But when we consider the convenience of location, the variety of accommodation, the blissful absence of fares, time schedules and other restrictions, and the almost perfect freedom and mobility to all persons at all times and for all transportation purposes of a general system of modernized country roads, it is almost incomprehensible why we have so long denied ourselves this great modern utility.

It has been said, in effect, that the state of a country's transportation system is an index of the stage of its civilization. If this be so, we in Canada have attained a sort of super-civilization, being very highly developed at the top or steam railroad portion and sadly behind in the department represented by our common country roads. Military men would liken our position to that of an army whose heavy artillery has been pushed away ahead of supporting infantry instead of following behind and taking up new positions only after the surrounding country has been cleared of the enemy and occupied in force by friends. Our strategic position is bad, economically, and it behoves us to halt our railway expansion until we develop its main supporting arm—the country road.

It is not here intended to question the necessity or propriety of our railway appropriations, but to criticize their relative disproportion to those for the other branch of our transportation system, our country roads. Why is it that we deny ourselves the pleasure and benefits of a modern system of rural highways though still giving magnificently to railroad extension? Is it not due to the freedom and public ownership of the one and the charter monopoly and private control of the other—to the difference in the status of the organizer, promotor and contractor with regard to the two schemes? In the one case all the work of preliminary examination, of organization and of public education (such as the present convention) is voluntary, public-spirited and disinterested labor for which no man has any surety of reward, either financial or in the appreciation of the public whom he seeks to

*From a paper read before the Second Canadian and International Good Roads Convention, Toronto, March 25th, 1915.

benefit. In the other case, we legislate to certain individuals a monopoly of certain transportation privileges granting the rights of regulation, of restriction and of operation for profit, and these favored individuals then have every inducement and protection in organizing support and securing the appropriation of public funds to assist their enterprise. Our public ownership of country roads has been largely a failure through neglect and lack of proper organization. What is everybody's business is usually nobody's business, and so we have advanced but slowly, and in many localities not at all. Fortunately, the times are changing, and we are now feeling the effects of the last ten years or more of organization and education, and we look to see tremendous developments during the next few years. Otherwise, I would suggest that we revert partially to private control, assist with government guarantees, subsidies or other means, granting a limited franchise with favorable terms for the construction at least of the leading trunk roads. Under present improving conditions the proposition is inadvisable, but if some such scheme were adopted we would soon have hundreds of miles of the finest roads in the world, because our monopolized friends would see to it that we contribute on a scale far in excess of the present expectations of our most advanced good roads enthusiasts. That energetic and capable individual, "the contractor," would then come into his own, for in that event straight competition, economy, efficiency and speed would control the selection of methods and the system of his rival "day labor" will seldom stand long against him under those conditions.

But, returning to the present, let us consider these two principal methods by which our road construction is now undertaken, *viz.*, "Day Labor" and "The Contract System." Each has its strong advocates who proclaim its virtues and decry the deficiencies of its rival. Observation, however, has shown that the most important consideration in instituting a road improvement campaign is not the choice of system but the choice of man—the engineer or superintendent who is to be placed in charge. The right man will make a success under either system; the wrong man under no system. The proper man having been selected, his advice should influence the choice of system to the same extent as it does the choice of rival locations for a particular piece of road or rival types of bridge construction. Conditions vary—in some cases the contract system is impracticable, in others the day labor highly inadvisable. Generally, however, where the proposed system is of sufficient magnitude and continuity to attract competent contractors the contract system is almost invariably the better. If a superintendent or engineer can handle such a proposition successfully by day labor he will have no serious added difficulty in changing to the contract system. He will have much more time to devote to the strictly engineering duties of location, design and supervision, duties which are the same under both systems but are so often interfered with by the extra pressure of executive details under the day labor system. And if an engineer or superintendent fails to make good under ordinary conditions with the contract system, nothing but Providence can save him and the municipality from disaster if he attempts the day labor system. Among others it will add the duties (1) of securing, transporting, housing and feeding teams and workmen; (2) selecting and instructing foremen, timekeepers and other staff; (3) choice, purchase, care and setting of machinery; (4) daily planning of work and distribution of forces with all the complications and derangements due to illness of men, breakdowns of plant, delays of shipment and changes of weather. No one who has not worked under both systems can realize the difference or appreciate the possible results in altered efficiency and economy of a change from one system to the other.

A very general and justifiable objection to the day labor system is the fact that political or personal influence has too much weight in the appointment and retention of all employees, from the superintendent to the water-boy. We will not attempt a lengthy discussion of this objection which perhaps is the one most often and most thoroughly expounded. There are engineers and superintendents who take violent offence—and rightly so—at any imputation of improper influence having had anything to do with their personal appointment or thereafter with the appointment of those under them. They demand and receive absolute control of all employees and run the work on an efficiency basis. We have no quarrel with them—and usually no criticism of their work, either. Such men in such positions are a credit and an honor to the community in which they serve, and a source of strength and inspiration to all other engineers and superintendents. But the instances of municipalities run on such a perfect day labor system are rare. And the day labor system has now reached its maximum efficiency and metamorphosed into a species of contract system—a modified cost plus a fixed sum or cost plus a percentage form of contract, with the municipality furnishing the plant and capital. Your superintendent has become a contractor though working under somewhat unusual financial arrangements. There are reasons, however, why the regular contract system is to be preferred, especially in its distribution of duties into those of design and supervision on the one hand, and of execution on the other.

Many municipalities unconsciously deceive themselves when attempting a comparison of the two systems. The prices tendered by contractors seem outrageously higher than the prices they believe themselves to have attained by day labor. The difference is more apparent than real. How many such municipalities count as a part of the cost of any piece of work the following charges, every one of which the contractor *must* count and every one of which the municipality *should* count; for they are truly and inescapably a part of the cost of every portion of road built under either system:—

1. *Bonds.*—Generally bid bond, construction bond and maintenance bond. Company bonds are now preferred by nearly all municipalities and should be insisted upon in preference to private bonds.

(a) Bid bond guarantees that if the tender of the contractor is accepted, the said contractor will proceed to the signing of the final contract and the bonding company will become his surety for its due fulfilment.

(b) Construction bond guarantees that the work for which the contract is drawn will be carried to completion within the time limit and for the contract price, regardless of what the actual cost may be to the contractor, the effects of war, acts of Providence, and similar causes alone granting relief.

(c) Maintenance bond further guarantees to the municipality that, free of charge of it, the contractor will maintain the work in good condition for a specified term of years.

If the day labor superintendents, commissions and councils had to back their estimates of day labor costs, with cash bonds guaranteeing to the ratepayers the same results as they demand of the contractor, would there be a revision of their estimates?

2. *Public Damage and Employers' Liability Insurance.*—The risks are there just as certainly for the municipality as for contractor, and they have a considerable cash value. The contractor *must* count them and the municipality *should* as it absolutely cannot escape the liability, though it often does the penalty.

3. *Machinery and Plant Charges.*—When a municipality undertakes day work road construction, it has two alternatives with regard to machinery. It may rent or it may purchase. Invariably a purchase is made and this is often a costly error, for the ordinary township council is not an expert judge of the relative value or suitability of various makes of road machinery. But plant rentals look too ominously large and would figure indisputably as part of the cost of the various pieces of work. So purchase is resorted to, the cost paid from a general fund and rarely apportioned to the various sections of roads on which the plant is subsequently used. Can any body of intelligent men giving the matter fair consideration escape adding to the cost of every mile of road an item to cover machinery charges? These are (1) interest on purchase price; (2) allowance for depreciation or sinking fund; (3) upkeep, (4) boiler and fire insurance; (5) winter storage and transportation from one job to another. These charges are nearly all operative during the whole year, *whether the machinery is working or idle.*

4. *Capital Charges During Construction.*—The contractor has usually to wait from one to three months for his pay. His interest charges are considerable. The municipality may borrow funds during construction under either system. Under day labor system they borrow and pay promptly. Under contract system they very often delay and the contractor has to bear the interest charges throughout the season on one, two, three or more times his total monthly pay roll and expense accounts.

5. *Uncertainty of Continuous Work.*—An item seldom considered by either the municipality or the contractor, is the uncertainty of finding continuous work for the plant. And yet we have but to travel around to see thousands of dollars worth of idle plants. Little of that actually in use has the guarantee of continuous work during the remainder of its ordinary period of usefulness. Who stands the loss if the money supply fails and the work is suspended for a year or so? Three road engines were purchased for a definite contract near Toronto. The money supply failed before the contract was half finished and after several months of idleness the plant was moved over 300 miles to a new contract in the Province of Quebec. To which contract should the lost time and expenses of moving be charged? Were the municipality working by day labor, it could do little except store its plant until times got better, meanwhile carrying the interest, depreciation and other charges. Should not this risk be considered in estimating the cost of day labor work and in explaining some of the variation between the figures furnished by a day labor superintendent and a prospective contractor?

6. *Specifications and their Fulfilment.*—Here you may have the greatest of all discrepancies. Municipalities expect—and rightly so—a thorough and proper fulfilment of the specification by the contractor. One of the principal arguments advanced in favor of the day labor system is the greater ease with which the specifications can be altered to suit circumstances. Granted. But if the specifications were prepared by a competent engineer, after a thorough examination, there should be few instances where changes are necessary, and these will be found to have been properly provided for, whether the work is to be done by day labor or by contract. This discrimination in the power of changing the specifications under only one of two competitive systems is unfair, and is often dangerous, for such changes are almost invariably to the detriment of the work in the saving of cost. The specifications are designed to give a road of a certain standard and the contractor must overcome all difficulties and attain this standard or expect trouble. It is wonderful the difference in the sacredness and inviolability of the specifications as viewed by a day labor council and superintendent and the same men when a change has been made to the contract system. How different is the care taken to secure accurate measurements of the quantity of material moved, the thickness of consolidated metal or the bottom grade of a side ditch.

Many municipal councils have a bias against contracting, wholly due to a misconception of the type of men engaged therein and to the methods by which they endeavor to make their profits. It is a similar prejudice to that which usually manifests itself in isolated communities where the people are all of one religion and do not meet or mingle to any extent with those of other religious beliefs. In both cases the prejudice generally melts away when new conditions cause a free intermingling and closer personal relationship between the rival elements. We then find much to admire and little to fear in the members of the other denomination. So you will find that road contractors as a class are quite similar to men in any other line of business. They are guided by the same principles of economy, integrity and honor. But they are objects of more general discussion, unfair opposition and personal criticism because their work is public work and at all stages it is wide open and exposed to the public gaze. Few can see the finished work through the apparent litter and disorder of construction. There are always soreheads and busybodies and it is easy to pick on a multitude of trivial incidents, each of which is misunderstood or wilfully distorted and magnified to the general discredit of the contractor.

Many municipalities, however, have changed from the day labor system after finding it impossible to attain satisfactory and economical results thereby—even to keep the actual current outlay within their estimates. The province of Quebec is a fine instance of a rapid awakening in this regard. When instituting the programme under the Good Roads Act of 1912, it was assumed that all the townships availing themselves of government assistance would work under day labor system only. All blank forms for by-laws, inspectors and engineers' reports, etc., were printed for this system. A great many of the municipalities thus commenced the work, but with few exceptions they have changed to contract system, and most townships now undertaking the work for the first time profit by the experience of their neighbors and contract their work from the beginning. An entirely new lot of blank forms had to be prepared suitable to contract work.

A few suggestions for the consideration of municipal bodies may here be permitted. They will be mostly don't's, but the first is a positive and emphatic *do*. When you first decide to adopt some system of modern road improvement for your municipality consult a competent road engineer. Don't wait until you have decided upon the particular roads or the type of construction. And don't hamper your engineer by a false economy during the preliminary examination. He should make a general study of the present and prospective traffic requirements—available supplies of suitable local materials—supply and cost of local labor—and cost of outside materials likely to be required. Then, with the additional knowledge of soil and drainage conditions your engineer will be prepared *to advise* as to the relative cost and economy of various types of road; the *decision or choice*, of course, remaining with the council. He must then thoroughly examine in detail the various roads to be improved so as to revise any false locations—establish grades—design culverts, bridges or other structures and finally prepare proper plans, specifications and estimates of cost.

In calling for tenders, all available data with regard to labor and supplies of material should be summarized and furnished intending bidders. All contractors then clearly understand conditions, are on an equal footing, and there should be little excuse for misunderstanding or litigation after the contract is let.

It were better for a municipality to engage a competent engineer for the preliminary studies, the design, specifications and choice of a contractor, and then dispense with his services, than the more customary reverse method by which an engineer is employed only after the contract has been awarded. In the one case you are off to a right start with a definite programme—proper plans, clear and intelligent specifications. In the other the engineer finds a specification entirely inadequate—ambiguous or clearly unsuitable to the work in hand, and he is indeed fortunate if he and the contractor are able to read the same meaning from the different clauses. In any case it is usually then too late to make advisable changes in location, method, material or type of construction. Secure your engineer early and make every endeavor to have the best man available. You will probably have in your midst a surveyor or engineer of the right type and character though inexperienced in the special department of road-making. Engage him, but see that he has the benefit of consultation with an expert before any final decisions are made or contracts let. You may think all this unnecessary expense, but you will find it is the truest economy. The old saying: "A stitch in time saves nine" is very applicable. You who are about to engage upon a new programme may not see the full force of these suggestions. Experienced road men—be they engineers, superintendents, contractors, municipal councillors, township clerks or government officials will, however, heartily agree with and endorse them. Take your cue from those who have already been through the mill.

Those who adopt the above suggestion will scarcely require the following warning; those who do not, are more open to temptation. Herein lies the germs of a great deal of the trouble which develops between municipalities and their contractors. *Don't call for tenders simply for information. Don't call for tenders unless you really mean business.* A contractor's time is valuable and he resents being dragged half across a province—spending days away from his work preparing an estimate and bid only to have the same tabled with little or no action other than the exposure of his prices. This is sharp practice—the procuring of expert advice for which you should have paid an engineer. It will be resented by all honest contractors and many will refuse to bid a second time—when you do mean business. Usually in such cases the specifications are very crude and a resentful or crooked contractor may come back—take the work at what seems a very low figure and then, taking advantage of faulty specifications in a strictly legal way, squeeze out a satisfaction sufficient to have employed have a dozen engineers in the first place.

Or perhaps you call for tenders and find your local or favorite contractor in whom you have confidence and to whom you wish to let your work, underbid by an outsider. Be men with the courage of your convictions and allot the work just the same. To call again, trusting your choice to underbid the other, is inviting all kinds of trouble. If your local man was away high he was trying to take advantage of you and should be treated accordingly. A local contractor already has a big enough advantage over an outsider in his local following and personal knowledge of conditions. If the other man was unreasonably low, he probably did not examine the work properly, is inexperienced or incompetent, and had better be left out of consideration unless he can bring satisfactory proof to the contrary. On the other hand, if the two bids are reasonably close, but the favored contractor a shade higher, there is no reason why the contract should not be awarded to him if the municipal officers feel that it is worth the difference to have the one man rather than the other. A contractor who has established a local reputation for fair and honest dealings and for the excellence of his work is entitled to some favorable consideration, and it shows good courage and judgment on the part of a council when such an award is given and becomes an added incentive to all worthy contractors to feel that superior workmanship is so appreciated. But to table a set of bids and advertise again simply to give the local man a chance to get down low enough to secure the contract is a very bad practice and puts a premium on dishonesty.

The practices of calling for bids for information only —or of exposing tender prices and calling again for no proper reason—are all too common and much to be deplored. Good contractors should refuse to bid a second, third and fourth time on the same work. A test case for damages for loss of time and expert services placed against some municipality indulging in this practice would have a salutary effect, and a fair chance of success.

These and similar cases of deliberate or thoughtless bad practice are seldom chargeable against a municipality who has employed a competent engineer.

A word to my fellow contractors. It has been said that "honesty is the best policy" and I believe contractors possess and practice this virtue as consistently as any other class of business or professional men. As a class, we are vitally interested in the expansion and development of the good roads movement. For this the confidence and support of the public must be gained *and retained continuously.* Anything, therefore, that causes marked dissatisfaction or irritation will have a distinctly retarding effect. Bid carefully and fairly, avoid litigation over technicalities or other legal complications. Count all your items of cost and insist on a fair price for your work. Then leave behind you a standing monument to your credit and an object lesson to the municipality.

The municipal officials and the contractor will find it to their mutual benefit and satisfaction, to the efficient and speedy prosecution of the work and to the approval of the general public if the work is conducted throughout in a spirit of friendly co-operation and helpfulness. Remember always that your written contract is a *partnership agreement*—not a *declaration of war.*

DOMINION GOVERNMENT MAY PURCHASE TWO RAILWAYS.

Hon. Frank Cochrane, Minister of Railways and Canals, gave notice in parliament the other day of important legislation affecting the expansion of the system of Canadian Government Railways. One resolution provides that the whole or a part of any railway, railway bridge, station, terminal, ferry in Quebec, New Brunswick, Nova Scotia and Prince Edward Island may be constructed, purchased or otherwise acquired. It is provided that a copy of every such lease or contract must be laid before parliament, and no railway of more than 200 miles in length is to be acquired, and no railway may connect directly with the Government railways system. No railway of more than 25 miles is to be constructed until after a sum of money for the purchase is appropriated by parliament. All lines so constructed, or acquired, are to become part of the Government railways system.

Another item ratifies the purchase by the Government of the New Brunswick and Prince Edward Island Railway, including the main line of 36 miles from Sackville to Cape Tormentine. The purchase price is $270,000.

A third relates to the purchase by the Government of the line of the International Railway of New Brunswick, extending from Campbellton to St. Leonards, a distance of 125 miles, the purchase price being $2,700,000.

CORUNDUM AND EMERY IN CANADA.

CORUNDUM, which is practically pure alumina, is, next to diamond, the hardest mineral found. It has a hardness of 9 on Mohs' scale. It occurs in a rock matrix from which it must be separated by crushing and concentration, after which it is ground and sized according to the demands of the markets, great care being taken to obtain uniform grading as regards the size of the grains. Owing to its hardness and to the fact that it is not brittle it is admirably suited for use as an abrasive. It is employed for grinding and polishing both in the form of powder and wheels.

In the making of wheels the grains of corundum are mixed with clay and fluxes and moulded into shape, after which the wheels are "fired" at such a temperature as to establish a strong bond between the particles.

Emery is an impure corundum. It is almost black in color, and contains magnetite and hematite intimately mixed. Its uses are the same as pure corundum but its abrasive power is very much less.

The prices as reported by Canadian users vary from 5½ to 12 cents per pound for corundum, and from 2½ to 7 cents per pound for emery, according to a recently issued report of the Mines Branch, Department of Mines, Ottawa, on the non-metallic mine and quarry products used in the various manufacturing industries of Canada.

Amount of corundum used in the manufacturing industries, as reported by the consumers:—

Location.	No. of firms reporting consumption.	Domestic. Tons.	Imported. Tons.
Maritime Provinces...	1	1/20	—
Quebec	2	1 2/20	—
Ontario	17	141 13/20	3
Prairie provinces	2	6/20	—
British Columbia	—	—	—
Canada (Total)	22	143 2/20	3

Amount of emery used in the manufacturing industries, as reported by the consumers:—

Location.	No. of firms reporting consumption.	Domestic. Tons.	Imported. Tons.
Maritime Provinces ...	13	—	8 5/20
Quebec	13	—	12
Ontario	92	—	1,046 6/20
Prairie Provinces	10	—	6 4/20
British Columbia	7	—	17/20
Canada (Total)	135	—	1,073 12/20

The following imports are reported by the Department of Customs:—

	1910-11.	1911-12.	1912-13.
Emery, in bulk, crushed or ground	$42,188	$47,263	$48,469

COMPLETION OF PATRICIA BAY WHARF.

A wharf, 441 ft. in length and 64 ft. wide, with an approach from the shore 1,800 ft. in length, has just been completed at Patricia Bay, Saanich Inlet, B.C., by Mr. S. Doe, contractor, and formally taken over by Mr. D. O. Lewis, chief engineer of the Vancouver Island Branch of the C.N.P.R. Its construction involved the driving of over 2,000 piles.

RAILWAYS IN QUEBEC PROVINCE.

ACCORDING to the latest report of the Quebec Minister of Public Works and Labor (for the year ending June 30, 1914) the mileages of steam railways in operation or ready to be opened to traffic on that date were as follows: Intercolonial, 328.75; Quebec Central, 252.85; International (C.P.R.), 81.25; Grand Trunk, 450.74; South-Eastern, 220.50; Canada Atlantic (G.T.R.), 53.09; Quebec & Lake St. John, 298.26; Montreal and Lake Maskinonge (C.P.R.), 13.00; Drummond County (I.C.R.), 130.66; L'Assomption (C.P.R.), 3.50; Vermont Central, 121.00; Boston and Maine, 39.75; Canadian Pacific, 560.16; Temiscouata, 69.28; Vaudreuill and Prescott, now the Montreal and Ottawa (C.P.R.), 23.50; St. Lawrence and Adirondack (N.Y.C.), 36.48; Hereford (M.C.R.), 53.52; Orford Mountain (C.P.R.), 57.30; Pontiac and Renfrew, 5.00; United Counties (Q., M. & S.), 59.84; Montford Colonization (C.N.R.), 32.27; Lotbiniere and Megantic, 30.00; Philipsburg Jct. and Quarries, 5.87; New Rockland Slate, 4.12; Ottawa and Gatineau Valley, now the Ottawa, Northern and Western (C.P.R.), 80.10; Montreal and Western (C.P.R.), 70.00; Great Northern (C.N.R.), 276.05; Napierville Jct., 27.10; Ottawa Valley, 6.74; Pontiac and Pacific Jct., now Ottawa, Northern and Western (C.P.R.), 79.50; Lower Laurentian (C.N.R.), 38.84; Baie des Chaleurs (A. & L.S.), 100.00; Quebec, Montreal and Southern, 48.33; Quebec, Montmorency and Charlevoix, 30.00; Lake Temiscamingue Colonization (C.P.R.), 45.88; Cap de la Madeleine (C.P.R.), 4.91; Northern Colonization (C.P.R.), 58.00; South Shore (Q., M. & S.), 61.50; Carillon and Grenville, 12.75; Beauharnois Jct. (G.T.R.), 19.13; East Richelieu Valley (Q., M. & S.), 22.16; Matane and Gaspé, now Canada and Gulf Terminal, 35.80; Ha! Ha! Bay, 31.39; Atlantic, Quebec and Western, 102.00; St. Maurice Valley (C.P.R.), 27.96. Total, 4,108.81 miles.

The mileages of electric railways were as follows:—

Chateauguay & Northern (now Montreal Terminal)	12.00
Montreal Terminal	6.34
Levis County	10.25
Montreal Park and Island	37.99
Montreal Street	124.42
Quebec Railway, Light & Power (Citadel Division)	17.22
Quebec Railway, Light & Power (Q. M. & Charlevoix)—steam and electricity—30 miles.	
Hull Electric	14.50
Sherbrooke Street	7.00
	229.72

This makes throughout the province a total mileage of railways built, or in operation, or ready to be opened to traffic, up to the 30th June, 1914, of 4,338.53. Of this total, 3,763.28 miles have been constructed since July 1st, 1867, the date of Confederation.

These figures were compiled by Louis A. Vallée, Engineer and Director of Railways for the Department of Public Works and Labor. His report states that two contracts were signed during the course of the year: One by the Quebec Central Railway Company, and the other by the St. Francis River Railway Company for the construction of a railway 24.5 miles long from Drummondville, in the county of Drummond, to the northeastern boundary of the village of Melbourne, in the county of Richmond.

TORONTO TEST OF DRIFTING SAND FILTER.

REPORT OF A 30-DAY TEST OF THE RANSOME GRAVITY MECHANICAL FILTER, CARRIED OUT IN 1913, BY THE TORONTO DEPARTMENT OF HEALTH—DESCRIPTION OF FILTER APPARATUS.

By GEO. G. NASMITH, Ph.D., Director of Laboratories, and FRED ADAMS, M.B., D.P.H.,
1st Assistant, Department of Public Health, Toronto, Canada.

WHEN it became known that an additional 60-million-Imperial-gallon-per-day mechanical filtration plant was to be added to Toronto's present 32-million-gallon slow sand unit the John verMehr Engineering Company, Limited, asked the city's Department of Works to consider their new system of filtration.

This system depended upon an ingenious arrangement for automatically removing the surface sand of the filtering sand-body continuously, together with the dirt which it contained, washing it and returning it cleansed into the stream of raw water and coagulant coming on to the filter. As the system appeared at first sight to be not only ingenious, but practicable, and as there appeared to be a number of advantages over the standard types of gravity mechanical filters, it was agreed that if the company built a unit of half a million gallons capacity per day, it would be given a 30-day trial by the Director of Laboratories of the Department of Health, and if such test proved satisfactory the company would be permitted to put in a tender for the 60-million-gallons installation.

Location of Demonstration Filter.—Accordingly, a site was selected adjoining the old West Toronto pumping station on Ellis Ave., which drew water from the Humber Bay, and the demonstration filter plant was built there in the spring of 1913. The site was chosen because raw water could be obtained from Humber Bay, which is always polluted with sewage and frequently muddy, and also because water could be obtained from the city mains under pressure for washing back the filter whenever necessary. The plant was put into operation during the first week of May, 1913, and was turned over to the Department for the official test on May 21, 1913.

Description of Filter.—The arrangement of the demonstration plant is shown in Fig. 1. A centrifugal pump driven by an electric motor draws the water from Humber Bay in Lake Ontario at a point about 700 ft. from the shore and about half a mile east of the mouth of the Humber River, and delivers it, together with a continuous supply of washed drifting sand from the sand washer, to the centre of the filter at its top.

The filter consists of a vertical cylinder of reinforced concrete deeper than usual in filter design, and is nearly filled with sand. The filtered water collecting system is at the bottom divided into a number of small units consisting of a number of hoppers filled with graded gravel held in place by a brass screen fastened down to the concrete. At a distance of 2 ft. 6 in. above the underdrain system and all around the filter are a series of hopper-shaped ports down which the drifting sand passes. These ports converge downwards to extractor outlets, with glass inspection tubes so that the operation of the drifting sand can be watched. The extractors are controlled by cocks which can be adjusted to suit the character of the water being filtered.

The drifting sand from the inspection outlets is collected by a ring main system along which is a current of wash water which conveys the sand to the sand washer or sand separator. The sand washer consists of a flat-sided hopper-like vessel with glass windows at the flat sides through which the action can be observed. The sand washer is attached to the filter supply pipe immediately over a constriction in it something like the form of a Venturi meter tube. An opening in the bottom of the sand washer lets through the clean sand into the water

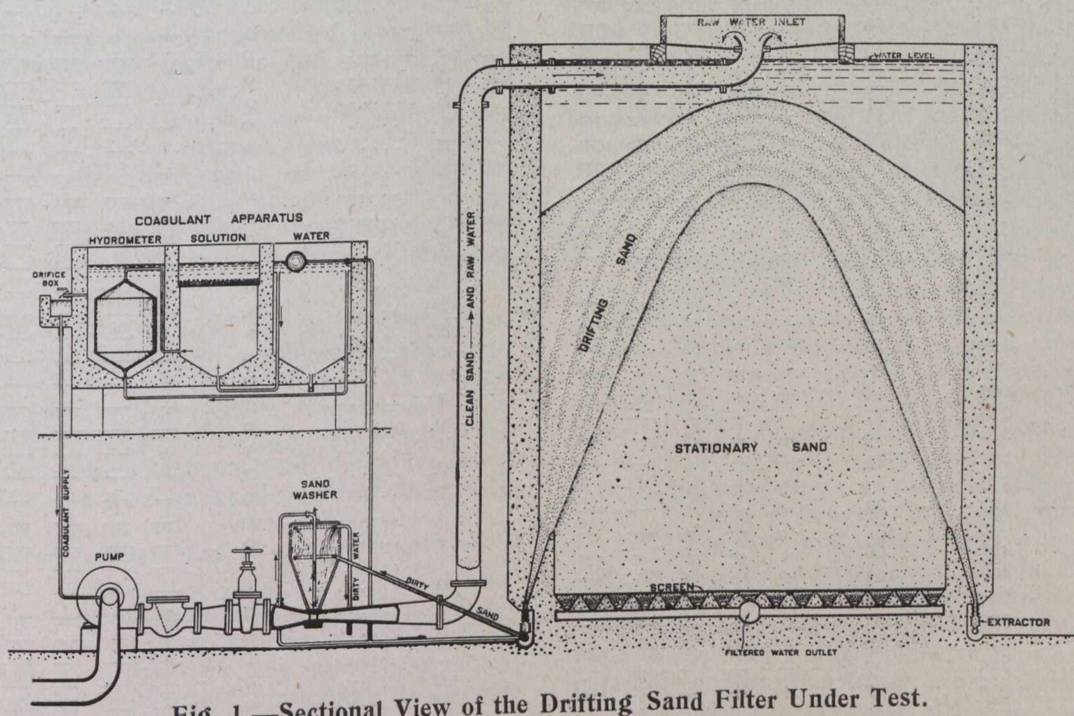

Fig. 1.—Sectional View of the Drifting Sand Filter Under Test.

TABLE No. I.

Results Obtained from the Ransome Drifting Sand Demonstration Filter at West Toronto, Showing Analysis of the Water Before and After Filtration.

Date 1913	Raw Water, Humber Bay: Bacteria per c.c. on Standard Agar at 37° C.	Raw Water: Red Colonies per c.c. on Neutral-Red Bile-Salt Agar at 37° C.	Raw Water: B. Coli on Lactose Bile 50cc	10cc	1cc	1/10cc	1/100cc	Filtered Water, Humber Bay: Bacteria per c.c. on Standard Agar at 37° C.	Filtered Water: Red Colonies per c.c. on Neutral-Red Bile-Salt Agar at 37° C.	Filtered Water: B. Coli on Lactose Bile 50cc	10cc	1cc	1/10cc	1/100cc	Alum used Grains per Gal.
May 21	2,800	....	√	+	+	+	—	11	..	√	+	—	—	—	¾
	1,800	....	√	+	+	+	+	6	..	√	—	—	—	—	"
22	1,900	....	√	+	+	+	+	12	..	√	+	+	—	—	"
	1,650	....	√	+	+	+	—	3	..	√	+	—	—	—	"
23	505	....	√	+	+	+	—	2	..	—	—	—	—	—	"
	460	....	√	+	+	+	—	2	..	+	—	—	—	—	"
24	509	....	+	+	+	+	—	1	..	+	—	—	—	—	"
	458	....	+	+	+	+	—	5	..	+	—	—	—	—	"
25	363	....	+	+	+	—	—	5	..	+	—	—	—	—	"
	560	....	+	+	+	+	—	3	..	+	+	—	—	—	"
26	272	....	+	+	+	+	—	2	..	—	—	—	—	—	"
	201	....	+	+	+	+	—	0	..	+	—	—	—	—	"
27	1,325	295	+	+	+	—	—	22	0	+	—	—	—	—	"
	1,345	271	+	+	+	+	—	31	0	+	+	+	—	—	"
28	805	180	+	+	+	+	—	33	1	+	+	—	—	—	"
	690	86	+	+	+	+	—	17	0	+	+	—	—	—	"
29	790	144	+	+	+	+	—	22	0	+	+	—	—	—	"
30	95	13	√	+	+	—	—	2	0		—	—	—	—	"
	114	20	√	+	+	+	—	3	0		—	—	—	—	"
31	353	27	+	+	+	+	—	5	0	—	—	—	—	—	"
	288	33	+	+	+	+	—	9	0	—	—	—	—	—	"
June 1	232	23	+	+	+	+	—	3	0	—	—	—	—	—	1½
	295	28	+	+	+	—	—	5	0	+	—	—	—	—	"
2	281	18	+	+	+	+	—	7	0	+	—	—	—	—	"
	203	11	+	+	+	—	—	5	0	—	+	—	—	—	"
3	527	33	+	+	+	+	—	5	0	+	—	—	—	—	"
	1,400	65	+	+	+	+	—	6	0	+	—	—	—	—	"
4	198	18	+	+	+	+	—	8	0	+	—	—	—	—	"
	127	27	+	+	+	—	—	2	0	—	—	—	—	—	"
5	251	17	+	+	+	+	—	5	0	+	—	—	—	—	"
	139	10	+	+	+	—	—	0	0	—	—	—	—	—	"
6	1,060	39	+	+	+	+	+	11	0	+	—	—	—	—	"
	1,095	43	+	+	+	+	+	5	0	+	—	—	—	—	"
7	252	27	+	+	+	—	—	6	0	—	—	—	—	—	"
	202	39	+	+	+	—	—	1	1	+	—	—	—	—	"
8	234	49	+	+	+	+	—	2	0	+	—	—	—	—	"
	223	41	+	+	+	—	—	2	0	—	—	—	—	—	"
9	143	22	+	+	+	—	—	3	0	—	—	—	—	—	"
	89	32	+	+	+	—	—	4	0	—	—	—	—	—	"
10	446	66	+	+	+	+	—	1	0	—	—	—	—	—	"
	492	103	+	+	+	+	—	0	0	—	+	—	—	—	"
11	202	21	+	+	+	+	—	1	0	+	+	—	—	—	"
	362	31	+	+	+	—	—	2	0	+	+	—	—	—	"
12	220	19	+	+	+	+	+	3	0	+	—	—	—	—	"
	244	27	+	+	+	+	—	2	0	+	—	—	—	—	"
13	490	57	+	+	+	+	—	0	0	—	—	—	—	—	" (1)
14	1,025	340	+	+	+	+	—	4	0	—	+	—	—	—	1 (1)
	515	67	+	+	+	+	+	0	0	—	—	—	—	—	" (1)
16	1,540	174	+	+	+	+	+	0	0	—	—	—	—	—	" (2)
	1,080	187	+	+	+	+	+	0	0	—	—	—	—	—	" (1)
	670	85	+	+	+	+	—	2	0	—	—	—	—	—	" (3)
17	1,010	75	+	+	+	+	—	3	1	—	—	—	—	—	" (4)
	550	49	+	+	+	+	—	0	0	—	—	—	—	—	"
18	3,850	270	+	+	+	+	—	22	0	+	+	+	—	—	"
	3,600	245	+	+	+	+	—	21	0	+	+	—	—	—	"
20	21,000	730	+	+	+	+	+	141	19	+	+	+	—	—	"
	20,000	840	+	+	+	+	+	115	12	+	+	+	+	—	"
21	1,380	126	+	+	+	+	—	53	1	+	+	+	—	—	"
	1,170	101	+	+	+	—	—	66	1	+	+	+	—	—	"
22	111	91	+	+	+	—	—	38	0	+	—	—	—	—	1½
	244	54	+	+	+	—	—	33	0	+	+	—	—	—	"
23	415	72	+	+	+	—	—	71	0	+	—	—	—	—	"
24	186	53	+	+	+	+	+	8	0	+	+	—	—	—	"
25	159	38	+	+	+	—	—	4	1	+	—	—	—	—	"
26	4,550	144	+	+	+	—	—	18	1	+	+	—	—	—	"
27	380	33	+	+	+	+	—	0	0	+	—	—	—	—	"

Chlorine added with Alum.—(1) .3p.p.m.; (2) .5p.p.m.; (3) .25p.p.m.; (4) .2p.p.m.

June 27th.—B. Prodigiosus added to raw water (240-600 per CC.). None found in effluent.

passing, which conveys it to the filter and maintains the conical heap of sand in it. By the well-known hydraulic principle the pressure in the pipe at the constriction is very much less than on the filter. This difference is sufficient to draw the loose or drifting sand charged with dirt out of the filter into and through the sand washer and into the supply pipe and so maintains the continuous motion of the sand while the filter is in operation. The sand, which by this time has become freed but not separated from the dirt, is led into the sand washer at about mid-height. The weight of the sand carries it to the bottom of the washer and the dirty water escapes at the top. Near the bottom of the washer is a jet of water which carries the sand downwards into the supply pipe, displacing the dirty water upwards in so doing. The water used for washing the drifting sand is unfiltered. The plan area of this filter is 143 square feet or 0.0033 of an acre. The estimated surface of the stationary cone is 306 square feet or more than twice the plan area. The average depth of the sand in the filter is about 13 ft., of which about 54% is drifting. The minimum thickness of drifting sand is about 2 ft. 6 in. and the maximum 10 ft. The minimum thickness of the stationary sand is 2 ft. 2 in. and the maximum 13 ft.

The sand used was a local sand containing a large proportion of limestone, and was prepared principally by screening out the coarser materials and washing away the finer. The physical analysis of this sand shows its effective size to be .4 millimetres and its uniform coefficient 2.7, and was passed through a sieve of 8 meshes per lineal inch. In the drifting sand the coarser particles tend to collect in the planes of maximum travel and the finer materials to drop through the coarser, thereby offering the coarser materials to the water first and the finer materials later.

Coagulating Plant.—A novel feature of the coagulating plant for the supplying of a solution of aluminum sulphate to the raw water is the employment of a large float or hydrometer-like arrangement for maintaining a solution of constant strength of about 1½%, which is fed through an orifice under a constant head, the orifice being changeable. The arrangement is shown diagrammatically in the section in Fig. 1, and consists principally of rectangular reinforced concrete tanks in series coated with solid paraffin.

The first tank contains water supplied from the pumping main and maintained at a constant level by a ballcock. The water from this tank may either pass direct to the bottom of the solution tank or through the needle valve at the bottom of the hydrometer tank.

Solid crystals of aluminum hydrate are fed into the upper compartment of the solution tank in sufficient quantity to maintain the solution at any convenient amount in excess of 1½%. The solution passes from this tank into the hydrometer tank through a needle valve at the top of the hydrometer.

Thus the hydrometer tank is supplied either with solution at the top or water at the bottom, depending whether the hydrometer is up or down. The hydrometer, which consists of an oak barrel with conical ends of concrete and provided with brass adjustable needle valve points, is weighted so as to just float in a solution containing 1½% of aluminum sulphate. Mixing of the two liquids takes place quite readily owing to variations in density. The heavier solution, coming in at the top, commences to travel downwards, producing circulation and conversely the lighter coming in at the bottom commences to travel upwards, again producing circulation, with the result that stratification at the orifice cannot be detected. The solution, before passing to the pump suction pipe, was further diluted about 200 per cent., so that when entering the raw water the solution was of about ½%.

Alkalinity of Raw Water.—The alkalinity as $CaCo_3$ of Great Lakes water at Toronto is about 100 parts per million, which is capable of breaking up several times the quantity of alum that would ever require to be used.

Operations Before Official Test.—The building of the plant was watched from beginning to end, so that no detail of construction was left unknown. Every subsequent change in operation or construction was also seen by us and the filter was run off and on from May 7th to May 20th, so that the plant was known to us and watched from every possible angle.

Duration of the Official Test.—The official test commenced May 21, 1913, and ended June 27, 1913, constituting a continuous test of 36 days. On June 13th the filter was closed down for five hours because the West Toronto pumping station was being used as a "booster" station for raising the city water pressure in the western part of the city. This was a matter in no way connected with the demonstration filter but the arrangement of pipes, etc., made it impossible during this five hours to get water for the filter through the intake pipe in Humber Bay. On June 15th the screen in the bottom of the filter broke, and the sand had to be taken out of the filter, the screen repaired and the sand replaced. The filter was consequently shut down on this date. On June 19th the filter was shut down because the hydro-electric power was off. With the foregoing exceptions, the operation of the filter was continuous during the period of the official test, both night and day.

Bacteriological Examination.—As a rule, two raw water samples and two filtered water samples were taken daily, and these samples plated about one hour after taken. Counts were made on standard agar at 37° C. for 24 hours. Red colony county were made on neutral-red bile-salt lactose agar, at 37° C. for 24 hours. B. coli estimations were made on standard lactose bile grown at 37° C. for 48 hours in the following quantities: 50 c.c., 10 c.c., 1 c.c., 1/10 c.c., 1/100 c.c. Counts on gelatin for three days at 20° C. were also made but were discarded for this reason: The filter was washed back with water from the city mains. In the city mains and in the reservoir, a bacillus multiplies at times which gives numerous yellow colonies on acid gelatin. This bacillus apparently multiplied in the filter. This yellow organism grows on acid gelatin, but does not grow on neutral gelatin such as used as a routine by Dr. Houston, of London, nor does it grow on agar in the warm incubator and is of no sanitary significance. The gelatin counts were consequently disregarded.

Chlorination Test.—On June 13, 14, 16 and 17 chlorine was added with the alum to the raw water to determine whether such a procedure would be suitable with this type of filter. The results of this test are included in the schedule of bacteriological results to follow presently.

Bacillus Prodigiosus Test.—Following the completion of the official test on June 26th, a culture of bacillus prodigiosus was added to the water coming on to the filter in such quantities that the number of prodigiosus colonies per c.c. in the unfiltered water varied between 204 and 600. No prodigiosus colonies appeared on the filtered water plates.

Turbidity Test.—The Humber Bay water pumped on to the filter during the official test varied naturally in turbidity from 3 to 45. The filter effluent was throughout

TABLE No. II.

Summary of Results Shown on Table No. I.

(a)—When using 3/4 grain of Alum per Imperial gallon.

		Total Count.	Average per c.c.
Bacterial Count on 21 tests on Standard Agar at 37° C.	Raw Water	17,283	823
	Filtered Water	196	9
	Efficiency	98.9%	
Red Colony Count on 9 tests on Neutral-Red Bile-Salt Lactose Agar at 37° C.	Raw Water	1,069	119
	Filtered Water	1	0.1
	Efficiency	99.9%	

B. Coli in Lactose Bile.

	Raw Water cubic centr.					Filtered Water cubic centr.				
	50	10	1	1/10	1/100	50	10	1	1/10	1/100
No. of tests	13	21	21	21	21	15	21	21	21	21
Positive	13	21	21	18	2	11	8	2	0	0
Negative	0	0	0	3	19	4	13	19	21	21
% Positive	100	100	100	86	9	73	38	9	0	0
% Negative	0	0	0	14	91	27	62	91	100	100

B. Coli in Lactose Bile.

		Total.	Average per 50 c.c.
Number of B. Coli in 50 c.c. water (21 samples).	Raw Water	18,150	864
	Filtered Water	139	7
	Efficiency	99.8%	

(b)—When using 1 grain of Alum per Imperial gallon.

		Total Count.	Average per c.c.
Bacterial Count on 13 tests on Standard Agar at 37° C.	Raw Water	57,390	4,414
	Filtered Water	427	33
	Efficiency	99.3%	
Red Colony Count on 13 tests on Neutral-Red Bile-Salt Lactose Agar at 37° C.	Raw Water	3,289	253
	Filtered Water	34	3
	Efficiency	99.0%	

B. Coli in Lactose Bile.

	Raw Water cubic centr.					Filtered Water cubic centr.				
	50	10	1	1/10	1/100	50	10	1	1/10	1/100
No. of tests	13	13	13	13	13	13	13	13	13	13
Positive	13	13	13	12	5	6	7	5	1	0
Negative	0	0	0	1	8	7	6	8	12	13
% Positive	100	100	100	92	38	46	54	38	8	0
% Negative	0	0	0	8	62	54	46	62	92	100

B. Coli in Lactose Bile.

		Total.	Average per 50 c.c.
Number of B. Coli in 50 c.c. water (13 samples).	Raw Water	28,550	2,196
	Filtered Water	710	55
	Efficiency	97.5%	

(c)—When using 1 1/2 grains of Alum per Imperial gallon.

		Total Count.	Average per c.c.
Bacterial Count on 32 tests on Standard Agar at 37° C.	Raw Water	15,452	483
	Filtered Water	261	8
	Efficiency	98.3%	
Red Colony Count on 32 tests on Neutral-Red Bile-Salt Lactose Agar at 37° C.	Raw Water	1,351	42
	Filtered Water	3	0.1
	Efficiency	99.8%	

B. Coli in Lactose Bile.

	Raw Water cubic centr.					Filtered Water cubic centr.				
	50	10	1	1/10	1/100	50	10	1	1/10	1/100
No. of tests	32	32	32	32	32	32	32	32	32	32
Positive	32	32	32	17	4	21	7	0	0	0
Negative	0	0	0	15	28	11	25	32	32	32
% Positive	100	100	100	53	12	66	22	0	0	0
% Negative	0	0	0	47	88	34	78	100	100	100

B. Coli in Lactose Bile.

Number of B. Coli in 50 c.c. water (32 samples).

	Total.	Average per 50 c.c.
Raw Water	27,250	852
Filtered Water	51	2
Efficiency	99.8%	

(d)—Average Bacteriological Results over whole test.

Average Raw Water Count per c.c. on Standard Agar at 37° C.	1,365
Average Filtered Water Count per c.c. on Standard Agar at 37° C.	13
Efficiency as per do. do.	99.0%
Average Raw Water Red Colony Count per c.c. on Neutral-Red Bile-Salt Lactose Agar at 37° C.	106
Average Filtered Water Red Colony Count per c.c. on Neutral-Red Bile-Salt Lactose Agar at 37° C.	0.7
Efficiency as per do. do.	99.3%

(e)—Average Bacteriological Results over whole test with all "Chlorine" figures thrown out.

Average Raw Water Count per c.c. on Standard Agar at 37° C.	1,420
Average Filtered Water Count per c.c. on Standard Agar at 37° C.	14.8
Efficiency as per do. do.	99.0%
Average Raw Water Red Colony Count per c.c. on Neutral-Red Bile-Salt Lactose Agar at 37° C.	100
Average Filtered Water Red Colony Count per c.c. on Neutral-Red Bile-Salt Lactose Agar at 37° C.	.79
Efficiency as per do. do.	99.2%

(f)—Average B. Coli Results in Lactose Bile over whole test.

	Raw Water cubic centr.					Filtered Water cubic centr.				
	50	10	1	1/10	1/100	50	10	1	1/10	1/100
Total tests	58	66	66	66	66	60	66	66	66	66
Positive	58	66	66	47	11	38	22	7	1	0
Negative	0	0	0	19	55	22	44	59	65	66
% Positive	100	100	100	71	17	63	33	10	2	0
% Negative	0	0	0	29	83	37	67	90	98	100

Average B. Coli Results in Lactose Bile over whole test.

Average number of B. Coli in 50 c.c.		
	in Raw Water	1,120
	in Filtered Water	14
	Efficiency	98.7%

(g)—Average B. Coli Results in Lactose Bile over whole test with Chlorine figures thrown out.

	Raw Water cubic centr.					Filtered Water cubic centr.				
	50	10	1	1/10	1/100	50	10	1	1/10	1/100
Total tests	51	59	59	59	59	53	59	59	59	59
Positive	51	59	59	40	8	38	21	7	1	0
Negative	0	0	0	19	51	15	38	52	58	59
% Positive	100	100	100	68	16	72	36	12	2	0
% Negative	0	0	0	32	84	28	64	88	98	100

Average B. Coli Results in Lactose Bile over whole test with "Chlorine" figures thrown out.

Average number of B. Coli in 50 c.c.		
	in Raw Water	965
	in Filtered Water	15
	Efficiency	98.3%

(h)—Classified Bacteriological Results depending on Condition of Raw Water.

(1) When Raw Water contained less than 50 bacteria per cubic centimetre.

Average of 28 samples in Neutral-Red Bile-Salt Lactose Agar at 37° C. (Red Colony Count)	Raw Water	28
	Filtered Water	0.07
	Efficiency	99.7%

(2) When Raw Water contained from 50 to 500 bacteria per cubic centimetre.

Average of 36 samples on Standard Agar at 37° C.	Raw Water	262
	Filtered Water	7
	Efficiency	97.4%
Average of 24 samples on Neutral-Red Bile-Salt Agar at 37° C. (Red Colony Count)	Raw Water	140
	Filtered Water	0.2
	Efficiency	99.8%

(3) When Raw Water contained from 500 to 2,000 bacteria per cubic centimetre.

Average of 24 samples on Standard Agar at 37° C.	Raw Water	1,037
	Filtered Water	13
	Efficiency	98.8%
Average of 2 samples on Neutral-Red Bile-Salt Agar at 37° C. (Red Colony Count)	Raw Water	785
	Filtered Water	15.5
	Efficiency	98%

(4) When Raw Water contained over 2,000 bacteria per cubic centimetre.

Average of 6 samples on Standard Agar at 37° C.	Raw Water	9,300
	Filtered Water	54.7
	Efficiency	99.4%

perfectly clear. Following the expiration of the official test, clay in a fine state of division was added daily for three days from 7 a.m. to 5 p.m. to the water coming on the filter. The addition of clay to the raw water was not uniform, so that the turbidity of the water coming on the filter varied from 375 to 650. The filter effluent was throughout this turbidity test perfectly clear. Throughout this test 1½ grains of alum per Imperial gallon were used and the filter was not washed back at any time.

Wash Water.—With this type of filter the wash water is of two kinds. That which constantly carries the drifting sand out of the extractors to the sand washer amounted, in this test, to 2% of the total water filtered. This is raw water. That used to wash back the filter (about every 8 days) amounted to somewhat under 1% of the total water filtered. This is filtered water The total wash water (both kinds) amounted to slightly less than 3% of the total water filtered.

Loss of Head and Washing Back.—The loss of head in the filter, immediately after washing back, when filtering at a rate of 500,000 Imperial gallons per day, was about 7 feet. Over a period of 8 days' operation the loss of head commonly increased to 14 feet. It was found advisable to wash back the filter only about every 8 days.

The accompanying tables give the bacteriological details of the official tests.

TABLE No. III.

Showing Rate of Operation, Etc.

Date.	Rate of Filtration in Imperial Gallons per day.	Equivalent in Million Imperial Gallons per Acre per day.	Alum Grains per Imperial Gallon.	Memoranda.
1913.				
May 21	350,000	107	¾	
22	350,000	107	"	
23	415,000	126	"	
24	470,000	146	"	
25	440,000	134	"	
26	405,000	123	"	
27	400,000	122	"	
28	385,000	117	"	
29	380,000	116	"	Washed back
30	500,000	152	"	
31	500,000	152	"	
June 1	500,000	152	1½	
2	500,000	152	"	
3	490,000	149	"	
4	540,000	164	"	
5	540,000	164	"	
6	470,000	143	"	Washed back
7	500,000	152	"	
8	540,000	164	"	
9	540,000	164	"	
10	605,000	184	"	
11	590,000	180	"	
12	515,000	157	"	
13 ..	510,000	155	"	
14	500,000	152	1	Washed back
16	540,000	164	"	
17	510,000	155	"	
18	515,000	157	"	
20	515,000	157	"	
21	515,000	157	"	
22	515,000	157	1½	
23	515,000	157	"	Washed back
24	515,000	157	"	
25	515,000	157	"	
26	515,000	157	"	
27	515,000	157	"	
Average for 36 days	490,000	149		

NOTES ON WIND PRESSURE.

One of the engineers of the works department of the British Admiralty read an interesting paper recently before the Concrete Institute. He was Mr. R. Graham Keevil, and his paper dealt with modern knowledge of wind pressures. It stated that provision in Great Britain against this load in the design of structures was the result of the destruction of the original Tay bridge in 1879. In an exceptionally heavy wind storm one or more of the piers gave way, bringing down eleven 245-ft. span and 227-ft. span girders, precipitating the train and seventy-four people into the Tay. The opinion among engineers about wind pressure was in a state of chaos. An endeavor was at once made to put matters on a satisfactory footing. After examining wind records, they, in 1881, recommended: "That for railway bridges or viaducts a maximum wind pressure of 56 lb. per square foot should be assumed for the purpose of calculation." This immediately came into force for railway work, and was also adopted generally for structures on public works, although such adoption was purely arbitrary, or specified in local by-laws.

Much opposition was raised to this standard of pressure, because it was considered excessive and not justified by experience of existing structures. As far as buildings are concerned, the horizontal pressure assumed for designing has gradually been reduced in Great Britain to the 30 lb. per square foot, now often taken.

Up to the present, assumed wind pressures, which are undoubtedly excessive, have been in general use for designing and very safe structures have been the outcome; but with the advance of knowledge, the very heavy structures, now common, will gradually give place to more scientific designs, and a corresponding saving of material. New methods, now being evolved, will then become of the greatest importance.

The Woolworth, of New York, is the highest office building in the world—760½ ft. from the street level to base of flag-pole on the tower, whose heaviest basement columns carry on each 4,740 tons, of which 1,300 tons is due to the action of the wind; whilst the weight of the steel framework is 24,100 tons. Probably the only commercial building in England approaching these dimensions is the Royal Liver building at Liverpool, which rises to a height of 290 ft. above sea level, and is built entirely of reinforced concrete.

CANADIAN RAILWAY STATISTICS.

According to the recent report of Mr. J. L. Payne, Comptroller of Statistics, Department of Railways and Canals, on June 30th, 1914, Canada had 22,891 miles of railway under construction, in addition to 30,795 completed. The largest mileage under construction was in the western provinces. In Alberta 1,188 miles were completed, but not in operation; in Saskatchewan, 555; in British Columbia, 698; in Manitoba, 102; in Quebec, 43, and in Ontario, 835.

Capitalization of railways increased by nearly $277,000,000, and was, on June 30th, $1,808,820,761. With stocks and bonds outstanding for railways under construction the total was $1,962,128,070. Dividends amounted to $30,434,601, and all interest charges on bonds were paid.

Net earnings were $64,108,280 on ten and a half millions less than 1913. Gross earnings were $243,083,539, a decrease of over thirteen and a half millions.

SEGMENTAL SEWER BLOCKS

BRIEF DESCRIPTION OF MODERN HOLLOW CLAY BLOCKS FOR LARGE SEWERS, NOW BEING MADE IN CANADA—SOME NOTES ON NEW EGG-SHAPE SEWER FOR CALGARY, ALTA.

In the earlier days of the cement industry, nearly all sewers were built of clay products. For the smaller ones, vitrified clay pipe was used; and the larger sewers were nearly all built of brick. Generally speaking, clay has always held the field for the small sewers, but concrete is being widely used for large work.

To offset this growing use of concrete, and to re-establish clay as the material for large sewers, ceramic experts have had to devise a system which would overcome some of the disadvantages of brick. The first feasible system of this kind to be invented was, so far as we are aware, that patented by one of the engineers of the American Sewer Pipe Company, and manufactured by that concern under the name of "Amco Segment Block." Two other systems have since been devised, *viz.*, the "Natco Lock-Joint Sewer Tile," patented and manufactured by the National Fireproofing Company, and the "Ferguson Segmental Block," patented and manufactured by the Summit Engineering Company, of Calgary, Alta.

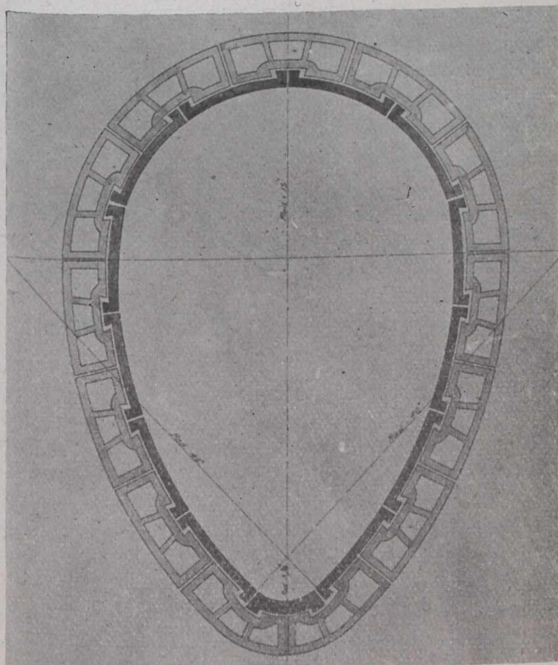

Fig. 1.—Egg-shape Segmental Block Sewer of design similar to that being used for Nose Creek Sewer at Calgary.

Sewers made of hollow clay blocks are not at all new, as there was such a sewer in ancient Rome. However, these Roman blocks and probably all later designs which preceded those mentioned above, had defects which mitigated against their use in sanitary sewers, or else were of such design that it was exceedingly difficult or impossible to manufacture them.

The modern segment block system is comparatively new, and many Canadian city engineers have never even asked for tenders on that system. There are no Natco tile sewers in Canada, and the first Ferguson block sewer is now being constructed at Calgary. About three miles of Amco blocks, 30-in. diameter, round, have been laid in Calgary. This sewer has been quite satisfactory, so far as the writer knows, and cost less than thirty cents per lineal foot to lay. There is 7,400 feet of Amco block sewer in Regina, Sask., which was very suc-

Fig. 2.—Test of Segmental Sewer Block Crushing Strength at Calgary City Yards.

cessfully constructed and which bears a heavy load in certain places. Some 30, 36 and 42-inch sewers have been constructed of Amco block in Edmonton during the past two years. Amco block has been tendered on a number of times in Canada, and sewers have been constructed of this particular block in a few other Canadian cities besides those previously mentioned. Both Amco and

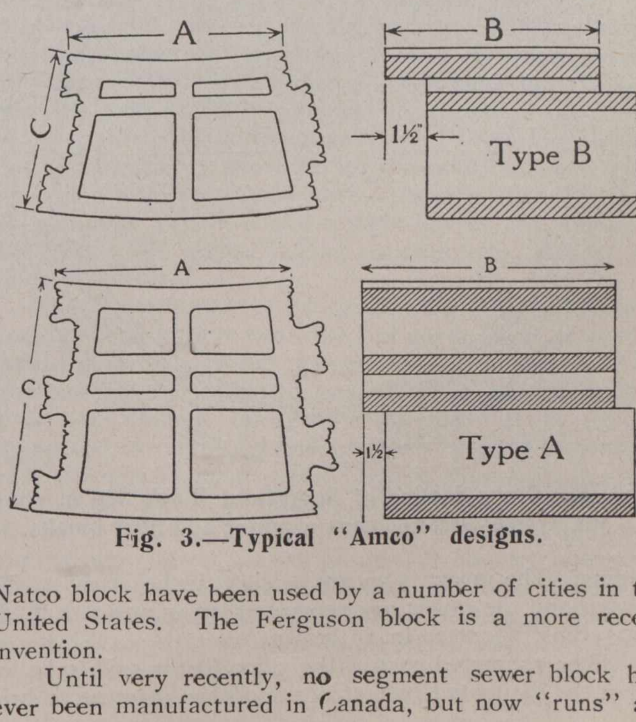

Fig. 3.—Typical "Amco" designs.

Natco block have been used by a number of cities in the United States. The Ferguson block is a more recent invention.

Until very recently, no segment sewer block had ever been manufactured in Canada, but now "runs" are being tried on all three blocks. The Dominion Sewer Pipe Company, of Swansea, Ont., is experimenting with the Amco block; the National Fireproofing Company is trying out glazes at its Waterdown, Ont., plant; the Alberta Clay Products Company, of Medicine Hat, Alta., is manufacturing the blocks of the Ferguson System, and the Don Valley Brick Works, Toronto, and the Toronto Pottery Company expect to make them this season; and Standard Clay Products, Limited, is already manufacturing Amco blocks at its New Glasgow, N.S., plant. A new line is thus being added to the manufactured products of Canada.

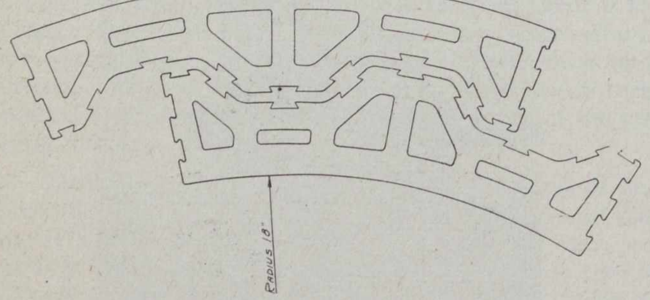

Fig. 4.—Typical "Natco" design.

Probably the most notable egg-shape Canadian sewer which has been designed for segment block construction is the Nose Creek trunk sewer at Calgary, now under construction. This sanitary sewer runs north from Bow River, and is being built by day labor. A portion of it has already been constructed of concrete, but Ferguson segmental blocks are being used for a 5,500-ft. section. Work on this sewer is progressing satisfactorily, as much as 160 ft. being laid in an 8-hour day. The cost of laying, exclusive of materials, is 32c. per foot.

This sewer is of special design, similar to that shown in Fig. 1. The crown is a semi-circle of fifteen inches

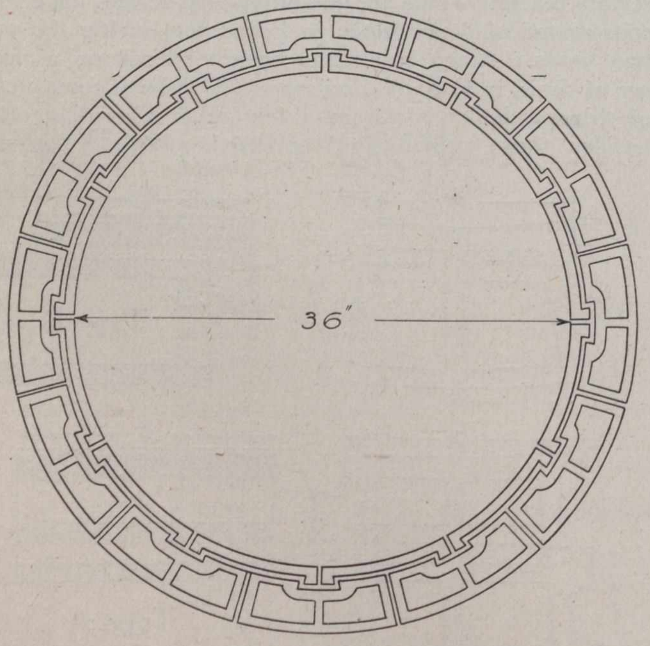

Fig. 5.—Cross-Section of Segmental Block Sewer, showing typical arrangement of outer and liner blocks.

radius. The invert is an arc of eight inches radius. The crown and the invert are separated by an arc of 4 ft. 8.1 in. radius, about 20 in. in height.

The estimated cost of the 5,500 feet is said to be less than the estimated cost of a monolithic concrete or brick sewer. Fig. 2 shows an experiment made at the Calgary city yards to determine the crushing load of a segmental block sewer.

George W. Craig is the city engineer. W. C. Ferguson is the engineer for the Summit Engineering Company, who have the contract for supplying the block, which is being made by the Alberta Clay Products Co.

Mr. Ferguson estimates the usual cost of laying a round sewer, by his system, to be in accordance with the following formula:

Cost (including mortar) = D cents per lineal foot, where D is the diameter of the sewer in inches.

Amco Block.—Typical Amco block designs are shown in Fig. 3. The lengthwise joints are effected by dovetails. The end construction is of the old-style ship-lap joint. The faces of the dovetailed sides are scratched to assist in retaining the mortar. The blocks are made as large as can be handled conveniently, in order to eliminate as many joints as possible.

The inner surface of the blocks is highly glazed. The outer ducts form a sub-drain and take care of surface water, and are of special value to the contractor when constructing a sewer in a wet trench, as it obviates the necessity for laying under-drains. These blocks are made in various sizes for sewers from 30 to 108 inches diameter.

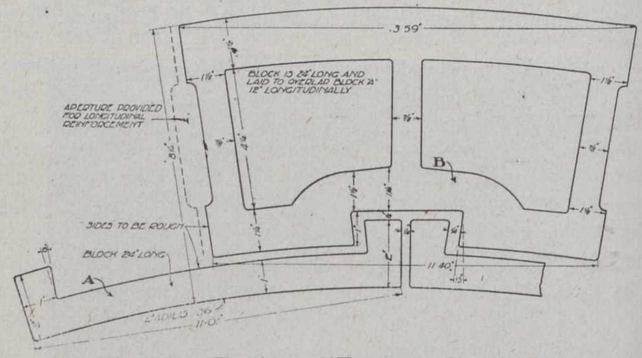

Fig. 6.—Typical "Ferguson" design.

Natco Tile.—Fig. 4 shows a typical design of the Natco tile. These tile are manufactured in all sizes for sewers from 30 to 144 inches diameter, the weight per lineal foot ranging from 400 pounds to 2,404 pounds, and the thickness of shell from six to ten inches. No sub-drainage is necessary with Natco tile. Both inner and outer blocks are vitrified and glazed, and the tile is shipped either in single pieces or in double pieces which can be separated at the work.

There is a special design of Natco tile for elliptical-shaped sewers, the three bottom blocks forming a square, level, stable base. It is claimed for Natco tile that a half or whole section of the sewer can be formed on the ground and then lowered into the trench.

Ferguson Block.—The aim of the inventor of the Ferguson block was to distribute the material in such a manner as to form a heavier unit at the interior surface, which must carry the external load. Typical Ferguson designs are shown in Figs. 5 and 6. Only the liner blocks are glazed, the outer blocks being simply hard burned. The outer blocks form approximately seventy percent of the material, and they can be made in almost any clay-working plant. The liner blocks, which do not take up much space, and which are easily shipped, without injury, from a sewer pipe plant, constitute a comparatively small portion of the material. Where the inner surface is subjected to considerable wear, such as on heavy grades, the liner blocks can be readily renewed whenever necessary.

The outside of the liner blocks and the inside of the outer blocks are roughed, in order to form better bond with the mortar. All sizes are made for sewers from 30 to 108 inches. The opening in the outer shell provides an underdrain.

The blocks are made two feet long and from nine inches to one foot wide, the thickness depending on the diameter of the sewer. This system can be reinforced transversely or longitudinally where conditions require it.

In constructing the sewer, the bottom blocks are laid to template and line up to the springing line. The liner blocks are then laid in up to the springing line, after which there is put in place the form on which the top half of the section is to be constructed. The liner blocks are continued over this arched form until the section is complete, and then the outside blocks are placed over the liner blocks in mortar. The composition of the mortar used is two parts of sand to one of cement. The form can be taken out almost immediately. The form used is approximately twelve feet long.

ROAD LOCATION.*

By C. R. Wheelock, County Engineer of Peel, Ont.

LOCATION is the first thing to be considered in planning a new road or road improvement, and as it is the most permanent thing in connection with the road it is probably the most important. The best of surfacing materials will in time yield to the wear and tear of heavy traffic and the action of the elements, and must be renewed more or less frequently, but the location and grade of a road, once properly established, become more fixed as years go by.

The establishment of location and grades should have the most careful consideration, a thorough examination of the locality should be made by an engineer with a well developed faculty for recognizing suitable road locations, and all the conditions in connection with construction, drainage, grades, maintenance and traffic, thoroughly investigated. The first considerations in the choice of locations should be the most direct route, easiest grades, and minimum cost of construction and maintenance.

Roads in Canada, with few exceptions, have been laid out to follow property boundary lines regardless of the topographical conditions of the locality through which they pass, and as these lines are generally unsuitable, the result is that most of our Canadian roads are poorly located and of the most expensive description, both to build and maintain. Hills are encountered where a small detour would have given a level road, swamps and bogs are crossed that could easily have been avoided, bridges have to be built at poor locations when places requiring shorter spans and having fewer engineering difficulties could readily have been found, and in many cases the length of the road is increased by being indirect between important points.

Upon a careful examination of the locality and conditions it may yet be found practical to remedy many of the above-mentioned defects. In some cases the expenditure of a small sum for land will provide for a detour around a hill which would cost much more to cut to a proper grade, or around a swamp where drainage difficulties exist and an expensive foundation would be required to support the surfacing, or perhaps a change of location for a bridge might be desirable. In considering the benefits of such changes the matter of maintenance should be taken into account. This saving alone may often be sufficient reason for making a change.

Municipal councils are authorized to alter the locations of roads, in a manner fair to all parties, and it is advisable that the power be judiciously used.

In all cases when land is acquired for the purpose of road improvement an accurate survey should be made and a correct description provided in order that such land may be conveyed to the municipality by a good and sufficient deed.

Probably the first matter to be considered to determine the amount of work to be done and money expended will be the amount and nature of the traffic that the road will be asked to take care of. This must not be based on present traffic census, for as soon as the road is improved the traffic increases so greatly that all former traffic data are of little or no value and the greatest foresight is required in making estimates. The unimportant road of to-day may be the important road of five or ten years hence. Local points, between which the greatest amount of traffic has existed in the past, are no longer the governing factors in the value of a road. The improvement of main roads must be considered as a whole, one link in a chain of improved highways. Uniformity in construction and co-operation between counties are most necessary to bring this scheme for a system of improved roads to a successful issue.

Pioneer roads in Canada, in passing along the allowances, generally followed the line of least resistance, avoiding stumps, logs, large boulders, etc. Many of these roads still follow the same old winding lines, although the obstructions may long since have disappeared. The roads now being built should be a permanent foundation for all future improvements and before grading is commenced should be carefully located in the centre of the allowance. If the boundaries or limits are not well defined by posts or fences a survey should be made by a competent person and the road allowance properly located.

The graded roadway should be straight and located in the centre of the road allowance. To delay straightening roads means that much of the work now being put on them will be torn up when the straightening is undertaken. Keep the earth grade in the centre of the road allowance and the metal in the centre of the grade.

Detours of the road should be made with curves as easy, and the driver's sight-line as long as circumstances will admit. With horse-drawn vehicles a fairly sharp curve is not objectionable, but the high speed of the motor vehicle makes a necessity of easy curves and long sight-lines as an ordinary provision for the safety of the travelling public. Curves should have a radius of not less than 100 feet when practical and a sight-line of not less than 125 feet. All sight-blocking obstructions should be removed.

The determination of the grade lines to be established should depend largely upon the amount and nature of the traffic and the topographical conditions of the locality, but unfortunately the foremost consideration has too often to be the amount of funds available. It is generally agreed by engineers and roadmen that the maximum grade on main highways should not be more than 5%, but this may not always be found practicable. The maximum allowed by the regulations under the Ontario Highways Improvement Act is an 8% grade. It should, however, always be kept in view that to have our roads up to the standard adopted by both the United States and Canada the grades on main or trunk roads should not exceed 5%.

Steep grades increase the cost of transportation; no greater load can be moved over a highway than can be

*Read at the Second Canadian and International Good Roads Congress, Toronto, March 25, 1915.

moved over the maximum grade. The cost of maintenance increases very rapidly with the increase of grade and is a very important consideration. It is roughly estimated that the destructive effect of heavy rains and spring freshets is four times as great on a 5% grade as on level ground and nine times as great on a 10% grade as on the level. It is not, however, on account of drainage considerations, desirable or economical to have a perfectly level road to obtain the best results. The minimum grade should be about one-half of one per cent.

On a stretch of road with a general ascending grade continuing to a higher elevation, descending grades should be avoided as much as possible, and vice versâ where the tendency is a descending grade toward a lower level.

For many years to come metalled or surfaced roads in Canada must be limited to a small percentage of the total road mileage, for every mile of surfaced road that is built there will probably be eight or ten miles of earth roads. Is it not, therefore, a matter of the greatest importance that these earth roads which form such a large percentage of the mileage of our road systems should be given more attention? In the past the questions of location and grade alignment in connection with the construction of such roads have received little or no consideration. Earth roads properly located and graded can be kept in good shape for light traffic and when located and built on correct principles will serve as a foundation for all future improvements.

GOVERNMENT BRIDGEWORK IN NOVA SCOTIA.

IN the report for the year 1914 on the larger bridges of the province of Nova Scotia, Hiram Donkin, C.E., road commissioner and provincial government engineer, states that entirely new specifications for the erection of steel bridges are now in use in that province. These new specifications were rendered necessary, generally from the facts that it is becoming increasingly difficult to obtain wood required for the floor systems, in some instances almost impossible to get the lengths and dimensions required for some of the bridges and that the weight of loads transported over the ordinary highways in Nova Scotia has been increasing of late years; these together have forced the designing of a heavier type of bridge than has hitherto been in use in the province.

The greatest point of difference between the new designs and the old, is in the floor system of the bridge, which is now designed strong enough to carry a concrete floor, when it is found necessary to put such construction on the bridge. It is intended for the present, to make wooden floors suffice, as long as it is found possible to get lumber in sufficient quantities, and at an economical price. It is the intention, however, to put in all joists of the bridges, of steel, and this fact will help considerably in procuring lumber for the floors of the bridges, as the greatest difficulty has hitherto been in securing plank of sufficient width for the required dimensions of the joists. Complete specifications covering the erection of masonry structures have also been prepared, as well as a complete set of drawings for larger bridges, covering spans of from 15 to 30 feet.

Already several of these structures have been built throughout the province and the experience so far gained has warranted the attempt to increase the standard drawings to further limits, making possible larger bridges up to 45-foot spans of concrete. It is thought, too, that a much larger use of concrete in the structures throughout the province will result in increased durability, and as the maintenance charges are practically nothing, there is considerable advantage over steel structures, even at the same cost.

The practice of the roads department in 1914 was, as in previous years, to build the substructures as far as possible by day work. In only one case in the province has the method of tender and contract been resorted to, this individual case being at the North River bridge in the county of Victoria, where the construction seemed to warrant a more economical method by contract than by day work. In this connection it might be said that the performance of this work has amply justified the method of construction adopted.

In every case where steel superstructures have been erected, this has been done by tender and contract, including the necessary stringers and flooring to complete the bridge ready for use.

The total number of contracts for steel spans let in 1914 amounted to twenty-five, all of which were contracted for within the province, as follows: Maritime Bridge Co., Limited, New Glasgow, 10 bridges, all of one span each; R. Musgrave, North Sydney, 4 bridges, all of one span each; Walter McNeil, New Glasgow, 11 bridges, all of one span each.

The number and sizes of the various spans which were awarded during the year are as follows:—

Fixed spans:	Fixed spans:
1—27-ft. (clear)	2— 60-ft. (end pin centres)
3—30-ft. (clear)	1— 65-ft. (end pin centres)
1—32-ft. (clear)	1— 75-ft. (end pin centres)
2—40-ft. (end pin centres)	1— 80-ft. (end pin centres)
1—42-ft. (end pin centres)	4— 90-ft. (end pin centres)
4—45-ft. (end pin centres)	1—100-ft. (end pin centres)
1—50-ft. (end pin centres)	1—110-ft. (end pin centres)
1—55-ft. (end pin centres)	

Lennox Passage Bridge.—During 1914 the construction of the Lennox Passage bridge was commenced. This structure, which is the longest steel bridge hitherto attempted by the province, spans both channels of the Lennox Passage and connects Isle Madame with the mainland of Cape Breton Island.

Tenders for this bridge were opened on October 11th, 1913. The contract for the substructure was awarded to the Standard Construction Company, Limited, of Halifax, their tender being the lowest. This company began the delivery of material at the site of the bridge, early in the spring, and construction was started in the month of July. The work was steadily prosecuted since that date until operations closed down in the fall.

In designing the substructure of this bridge, it was thought best to make all the piers and abutments of concrete. The foundations are generally of good character, and where rock cannot be found hard pan of very dense nature was encountered. To obviate the difficulty hitherto encountered in concrete structure in tidal waters where the action of the water has a disintegrating effect on the concrete, the piers and abutments are to be faced with granite ashlar from a point below low water to a point above extreme high water. The rest piers are to be constructed of creosoted hard pine timber, and to be fully ballasted.

The bridge superstructure is designed according to the new specifications, and is heavy enough to sustain a concrete floor, which it is proposed to put in at the time the bridge is erected. A draw span with arms of 100 feet is designed to pass ships through the channel. This part of the bridge is designed as a swing span to be operated by hand.

Editorial

"CLEAN-UP WEEK" IS IN ORDER.

Spring, with its many evidences of the triumphal march of the in-door broom, is upon us again and the house-cleaning epidemic was never more rampant. Municipal officials, in whose care is the cleanliness and health of the community, should take up the cudgel just where the housekeeper lays it down and proceed to remove the dirt and disease-producing organisms from every nook and corner of our city streets and lanes. No bacteria-harboring pile of dust or rubbish should remain within the corporation limits after the 15th of May. Besides a spick-and-span community with abounding cleanliness—the best assurance against disease—the employment which the cleaning-up process will provide will be a boon to many.

IMPORTANT HIGHWAY BILL FOR ONTARIO.

Last week Hon. F. G. Macdiarmid, Minister of Public Works, introduced into the Ontario Legislature a bill which is of much concern to the rural municipalities of the province. If it becomes law (and it is expected that such will be the case with slight amendment, the Act to become operative in 1916) it should go a long way toward a vigorous and systematic improvement of highway conditions.

The bill provides for the establishment of a Department of Highways which, together with the existing Department of Public Works, will be presided over by a Minister of Public Works and Highways. A deputy minister of highways will be appointed and in this way the road affairs of the province will have more direct government attention than they have ever had.

The next important item is the provision of a fund for the maintenance and repair of county roads. Heretofore counties conforming with the requirements of the Highway Improvement Act received from the government a grant amounting to 33⅓ per cent. of the cost of construction, with no similar contribution of any kind for maintenance. The result is well known to have been a rather general neglect in the matter of proper attention to the roads after construction. The proposed Act will change this state of affairs in an appreciative degree. There is to be a grant of 20 per cent. toward the cost of maintenance of county roads. Construction of new roads will be further augmented by increasing the provincial contribution towards the cost from 33⅓ to 40 per cent.

The bill also provides for reimbursing any township council to the extent of 25 per cent. of the salary paid yearly, for three years, to a township road superintendent appointed by by-law by the municipality.

With regard to suburban roads, provision is made for the appointment of commissions to define suburban areas around centres of population, the initiative being taken by the county councils. These commissions, who are to be appointed upon application, will define the areas and construct the roads, the distribution of payment for construction being 30 per cent. by the city, 33 per cent. by the county, and 40 per cent. by the government. Maintenance charges for these suburban roads will be met by a contribution of 20 per cent. by the province, the balance to be borne equally by the city and county.

Provision is also made for government assistance in the improvement of village streets.

The subject of main roads is dealt with in considerable detail. A provincial subsidy amounting to 40 per cent. of the cost of constructing and maintaining these roads is provided for, not to exceed $4,000 per mile. Each main road will be under the supervision of a board of trustees, whose control relates to construction, maintenance and repair, including bridges, culverts, etc.

WATER PURIFICATION BY LIQUID CHLORINE.

A description was given in *The Canadian Engineer* of March 25th (page 389) of the liquid chlorine installation at St. Catharines, Ont., for the disinfection of the city's water supply. It is of interest to note the following reference to the liquid chlorine apparatus recently installed in the Bubbly Creek filter plant at the Chicago Stock Yards. The information is from a paper read a month ago by Mr. C. A. Jennings before the Illinois Section of the American Water Works Association.

During the summer of 1908 this plant established the use of hypochlorite of lime as a means of protection against pollution, and was among the first in this respect. Subsequently experiments were begun at this plant with an electrolytic cell for the production of chlorine from salt brine. These experiments were carried out very extensively and thoroughly. It was concluded that in comparison with hypochlorite and liquid chlorine, the production of chlorine for water disinfection by means of an electrolytic cell was expensive, uncertain and demanded considerable attention.

A liquid-chlorine apparatus was purchased a short time ago. Chlorine is received in cylinders that hold 105 lb. of the liquefied gas. From the experience gained by operating this apparatus during the past month Mr. Jennings has concluded that in comparison with the use of hypochlorite at the Bubbly Creek filter plant—

1. There is considerably less labor involved.
2. The absorption of the gas by the water is more rapid.
3. There is no loss of chlorine, and smaller quantities can be used to accomplish equivalent results.
4. There is no deterioration of the chlorine in the cylinders while using or while stored.
5. The changing of the rate of application is easily, quickly and accurately accomplished.
6. There is no odor of chlorine about the plant.
7. The cost is considerably less.

The filter plant is attended by conditions that are rather peculiar to itself. According to the writer, these are the enormous amount of hypochlorite necessary to disinfect the water, the poor mechanical means for getting into solution all of the hypochlorite used, which resulted in a large loss of available chlorine, and the irregularity in the operation of the plant due to a varying consumption and small filtered-water storage capacity. It has often been necessary to run one or two filters for a time and then suddenly have to use eight filters.

The ratio of costs during one month's operation with liquid chlorine, with an average raw-water supply and the treated filtered water as low in bacteria as when using hypochlorite, was 1 to 3 in favor of liquid chlorine. It is hardly probable that every plant will show such a large difference in the costs of disinfection by the two methods.

LETTER TO THE EDITOR.

Grinding Slag for Concrete.

Sir,—In your issue of March 11 you published the result of some tests with regard to concrete made from slag, and again in your issue of March 18 you presented an article on the utilization of clinkers from garbage destructors.

As I have had considerable experience in this subject, perhaps some of your readers would be interested in a few remarks which are the result.

Some few years ago I was interested in a company manufacturing paving blocks and artificial stone from blast furnace slag and concrete. I found that, as then manufactured, the paving slabs did not wear well and were apparently soft and rotten. The proportion of cement was increased without at all diminishing this defect.

After microscopic examination, it was decided to pass the slag through a very fine mesh after grinding it in an edge-runner mill. The result of this treatment was that a perfect, hard artificial stone was obtained, which did not disintegrate with wear.

A short time after this I designed machinery for the treatment of destructor slag for the purpose of utilizing it in the manufacture of paving blocks. I found that the same conditions existed in this class of slag as obtained in furnace slag, and consequently it was found necessary to grind the refuse slag to a powder, from which excellent results were obtained.

The explanation of this is a simple one. The internal strains set up in the cooling of slag from the molten state, in which process the outer layers solidify first, are very great. They render every particle of it susceptible to cleavage with the slightest blow or even with variations of temperature. The same thing happens to a small atom of slag in a paving block when subject to passenger traffic as happens to a large slag cinder which is readily broken up by a hammer.

Thorough admixture of the component parts is also an essential to success.

The influence of variation of temperature on slag can be readily observed by the most elementary of experiments. Limestone, however, can be heated to a very high temperature before there is any appreciable effect, while granite does not disintegrate till it is red hot.

The above remarks refer particularly to paving blocks where the strength is not of the same importance as in the case of building blocks, but the test of blocks made under the above conditions came out equal to those made from granite chips and concrete.

From the use of slag concrete in building, other questions arise and the result of tests on test blocks is no criterion as to its suitability.

HENRY J. SCOTT, M.I.M.E.

Toronto, Ont., April 3rd, 1915.

ROAD CONSTRUCTION IN ALBERTA.

To effect closer co-operation between the provincial government and the rural municipalities in the matter of a well-defined and continuous system of trunk roads throughout the province, it was proposed, at the annual convention of Rural Municipalities and Local Improvement Districts, held in Calgary a few weeks ago, that a permanent good roads commission be appointed. The proposal met with the support of Hon. Chas. Stewart, minister of public works, and Mr. John Stocks, deputy minister.

Since the organization of the province in 1905, the provincial government has expended a large amount of money on the roads of the province, and very valuable work in this direction has been done by the public works department. Up to the present, however, there has been very little co-operation between the government and the various municipalities and it is with the idea of securing this, and getting down to a reasonable working basis, that the question of a good roads commission has been mooted, so that the main arteries of traffic may be linked up and a standard series of roads evolved. About half a million dollars will be available for trunk roads during the present year.

The difficulties of road-building in the province were pointed out by Mr. Stocks, who told of the various soil formations that have to be contended with, such as muskeg, bog, clay highly charged with vegetable matter, and soils of a spongy nature that would absorb all the rain that fell on them. Such soils could never be relied on for road material.

Outside of the cities there are no permanent roads in the province. The problem was as to how best to drain and maintain the existing roads at a reasonable cost, and maintain them in a manner to fairly meet the requirements.

Mr. Stocks made one statement which will surprise those who have been looking with longing eyes to the asphaltum deposits of the north as a means of cheapening the cost of permanent road-building in the province. "Tar sands on the Athabasca River," he said, "and at several other points, some not far from the city of Edmonton, give promise of an asphalt, suitable for road purposes, that would likely reduce the cost on this type of road surface in the future. It is hardly likely, however, that this possibly cheaper asphalt would very materially reduce the cost of paved roads, as such roads appear to require a concrete base to carry heavy traffic, which would raise the combined cost too high for very general use. The average cost of an eighteen-foot strip of paved road, extending into the outlying portions of the city of Edmonton, exceeded $30,000 per mile. Any possible cost reduction in top or surface would still leave the charge too high to permit of very general use in country roads, and while a cheaper asphaltum product would be of great value, the cost reduction in highway construction would not be what many expect."

Mr. Stocks went on to say that crude oil treatment of sand road surface, or or sand spread over a clay base, would seem to be a possibly cheaper road, and was used largely in districts adjacent to oil fields. Should crude oil be found in paying quantities in Alberta, great possibilities would be opened up along this line of construction.

Coast to Coast

Moose Jaw, Sask.—The steel bridge on the Eighth Ave. bridge over the C.P.R. has been completed.

Maisonneuve, Que.—About $800,000 worth of paving debentures have been sold and contracts will shortly be awarded.

Regina, Sask.—During five years ending December 31st, 1914, $20,000,000 have been spent in the construction of buildings in Regina.

New Westminster, B.C.—The work of deepening and widening the channel of the Fraser River at Hell's Gate has been completed at a cost of about $125,000.

Winnipeg, Man.—At the recent road conference, held at the Manitoba Agricultural College, Winnipeg, it was resolved to hold an annual Good Roads Convention.

New Liskeard, Ont.—A 180-ft. steel bridge, resting on masonry piers, has been built over the White River, and a similar bridge is now being constructed across the Otter River.

Toronto, Ont.—A deputation over one thousand strong applied to the provincial cabinet ministers of Ontario for a bonus of $3,500 per mile relative to the construction of hydro-electric railways in the province.

Renfrew, Ont.—The Renfrew Machinery Company has completed its building for the manufacturing of shrapnel shells for the British War Office. The machinery, largely automatic, has been installed and work commenced.

South Vancouver, B.C.—Mr. S. B. Bennett, municipal engineer, in his report for January, states that 10,040 feet of 6-inch and 1,020 feet of 8-inch mains were laid, 5 hydrants and a number of new services installed. The municipality has now 9,944 services and 680 hydrants.

Toronto, Ont.—The new office building now under construction on University Avenue, Toronto, for the Hydro-Electric Power Commission of Ontario, will be ready for occupation in September. At present foundation work is under way. It is being carried down 60 ft. to rock.

Victoria, B.C.—The proposal to lend $7,000,000 to the Pacific Great Eastern Railway to complete its line from Vancouver to Fort George, a distance of 450 miles, resulted in the dissolution of the provincial legislature, and a new election will shortly be held. About 120 miles of the line have been completed and it has been graded for the entire distance.

Winnipeg, Man.—Alleging an infringement of patent rights, the Bitulithic Paving and Contracting Co. has started suit in the Winnipeg courts against the National Paving Co., claiming that the latter has laid over $1,000,000 worth of paving in Winnipeg, Fort William, Port Arthur, Edmonton and other places, using a system protected by the complainants.

Morrisburg, Ont.—In the rivalry that exists between this town and Prescott with respect to the much-talked-of highway that may be constructed to Ottawa, it is pointed out that the distance between Ottawa through Dundas to the St. Lawrence is about 42 miles, and at $10,000 a mile would cost approximately $400,000. The route by Prescott which has been mooted is about 42 miles, and at the same rate would cost $620,000. The Dundas route would thus save $220,000, to be applied on the trunk line from Morrisburg to Prescott, which would almost build it.

Vancouver, B.C.—The provincial government has renewed its $400,000 subsidy toward the construction of the Second Narrows Bridge by the Burrard Inlet Tunnel and Bridge Co. The latter is now seeking a government guarantee of its bonds to the extent of $500,000, in addition. The Dominion government, it is stated, will subsidize the undertaking to the extent of $350,000.

Ottawa, Ont.—The Parliamentary Railways Committee has passed the bill allowing the amalgamation of the Toronto, Hamilton & Buffalo Railway and the Erie and Ontario Railway. The former extends from Brantford to Buffalo, and is operated by the C.P.R. The Erie and Ontario is partly built, and is to extend from a port on Lake Erie north through Brantford to join the C.P.R. main line.

St. Paul, Que.—The Canadian Rolling Mills Co. recently opened a new mill in this town, giving employment to about 200 men. Its construction was started about a year ago. Operations for the present will be confined to the manufacture of merchant bar iron and steel, the greater part of this material being used by the Canadian Tube and Iron Co. and the Colonial Wire Co., the three companies being controlled by the same management.

Edmonton, Alta.—At the end of 1914 this city had 46.793 miles of paving, 47 miles of concrete walks, 152 miles of plank walks, 29 miles of boulevards, 105 miles of graded streets, 141 miles of sewers and 156 miles of water mains. Of these amounts, practically 75,000 square yards of paving were laid last year, 4.32 miles of permanent street railway tracks, 12 miles of concrete walks, 25 miles of plank walks, 5 miles of new grading and 9 miles of boulevarding.

Princeton, B.C.—A few weeks ago construction work commenced on the Kettle Valley Railway between Osprey Lake and Princeton to afford through communication between the Okanagan sections of the line to the coast, via Merritt and the main line of the C.P.R. around by Spences Bridge. Rail-laying has been started, and the section is expected to be completed before June 1st. The other portions of the Kettle Valley Railway from Midway, near Nelson, to Penticton, were completed last autumn.

Hope, B.C.—The bridge over the Fraser River, which will afford connections between the main line of the C.P.R. and the new Hope Mountain route, has been completed, and rails have been laid on the south bank of the river as far as the crossing of the Canadian Northern Railway. The joint section of the Hope Mountain line from Hope to Coquahalla Summit will be completed by the fall, according to present estimates. Work on bridge construction has been proceeding all winter, and track-laying is now being proceeded with. The Hope-Coquahalla section is being built by the Kettle Valley road, and will be used also by the V., V. and E.

Truro, N.S.—The new Intercolonial Railway viaduct over the Folly River is practically completed. It replaces an old 6-span, lattice girder structure, and is 649½ ft. long, with rail level 91 ft. above the bed of the stream. It is supported on concrete piers extending to bed rock, and has 13 spans of deck plate girder type. The Dominion Bridge Co. erected the superstructure, while the foundations were constructed by the I.C.R., Mr. W. A. Cowan being engineer in charge. Work on the foundation was commenced September 14th, and was completed November 24th. The Dominion Bridge Company started work January 14th. The first span was put in place February 14th, and the last span was fitted into its position March 14th.

PERSONAL.

E. DUNCAN, chief engineer of the Glengarry and Stormont Railway Company, is sailing shortly for Europe.

J. G. SULLIVAN, chief engineer of western lines for the C.P.R., has been elected second vice-president of the American Railway Engineering Association.

C. D. McARTHUR, chief engineer at Halifax for Foley Bros., Welch, Stewart and Fauquier, gave an illustrated address before the Nova Scotia Engineering Society last week. His subject was "The Use of Steel Forms for Concrete."

OBITUARY.

On April 2nd Mr. Chas. Balmer, electrical engineer for the Chatham, Wallaceburg and Lake Erie Railway, was electrocuted by coming into contact with a 240-volt wire.

In the list of war casualties the name appears of J. H. Rosber, a lance-corporal in the Princess Patricias. Prior to his enlistment, the deceased had been in the employ of the Canadian Pacific Railway, and was for five years connected with the company's engineering staff on the Bassano dam.

The death has been announced of Frederick Winslow Taylor, originator of the modern scientific management movement and the author of a number of technical books and articles, among the best known being "The Principles of Scientific Management," and "Shop Management," both published in 1911. Mr. Taylor was also an inventor of considerable ability. Among his numerous inventions was the Taylor-White process of treating modern high-speed tools for which he received a personal gold medal from the Paris Exposition in 1900 and the Elliott Cresson medal of the Franklin Institute. The deceased was a member of the American Society of Mechanical Engineers, and served as its president in 1905 and 1906.

OIL REFINERY AT IOCO, B.C.

A new oil refinery was recently placed in operation by the Imperial Oil Co., at Ioco, B.C. It has a capacity of 35,000 gallons per day, and its construction involved an expenditure of $1,250,000, including a dock 700 ft. in length on Burrard Inlet. It is the complement of the company's refinery in operation at Sarnia, Ont.

Some interesting features attend the new plant, chief among which is the arrangement for unloading oil. The crude oil comes by steamer from Peru and is pumped through a 12-inch pipe line for about 5/8 of a mile to the storage tanks, by two electrically driven pumps with a capacity of 25,000 Imperial gallons per minute. One of the oil tanks has a capacity of 2½ million Imperial gallons, the largest in Canada. Others have 1½ million gallons capacity.

In refining, the oil is pumped from the storage tanks to a battery of stills each with a capacity of 45,000 gallons. The various grades derived therefrom are run into agitators with a capacity of 60,000 gallons. After this the oil is stored ready for shipment.

The power equipment includes three 200-h.p. return tubular boilers. Special fire fighting apparatus has been installed, including an electrically driven centrifugal and a duplex steam pump. Two other electrically driven centrifugal pumps furnish fresh water for the refinery through a pipe line over a mile in length. All refining apparatus is electrically driven.

HYDRO-RADIAL UNION OF ONTARIO.

The officers of this organization, at present vigorously advancing the cause of hydro-electric radial lines throughout the province, are as follows: Honorary president, Sir Adam Beck; honorary vice-presidents, Hon. I. B. Lucas and Mr. W. K. McNaught; president, Mr. J. W. Lyon, Guelph; vice-presidents, Mayor Church, Toronto; ex-Mayor Graham, London; Mr. A. F. Wilson, Markham, and Mayor Butler, Peterborough. District presidents: ex-Mayor Evans, Prescott; T. F. Mathews, Peterborough; J. H. Downey, Whitby; Controller J. O'Neill, Toronto; Peter Rae, East Flamboro; J. B. Ryan, Guelph; W. B. Johnston, St. Thomas; Mayor Clay, Windsor; R. Stirrett, Petrolea; D. M. McLaughlin, Stratford; W. C. Bush, St. Catharines; and R. Lush, Clarkson's.

ONTARIO GOOD ROADS ASSOCIATION.

The newly elected officers of this association are as follows: Honorary presidents, N. Vermilyea, Belleville, and J. A. Sanderson, Oxford Station; president, S. L. Squire, Waterford; first vice-president, K. W. McKay, St. Thomas; second vice-president, C. R. Wheelock, Orangeville; secretary-treasurer, George H. Henry, Todmorden; directors, Messrs. W. H. Pugsley, J. J. Parsons, T. L. Kennedy, S. E. Allan, F. A. Senecal and David Clow.

COMING MEETINGS.

TORONTO ELECTRICAL SHOW.—The second annual exhibition, to be held in the Arena, Toronto, April 12th to 17th. Secretary, Mr. E. M. Wilcox, 62 Temperance Street, Toronto.

AMERICAN WATERWORKS ASSOCIATION.—The 35th annual convention, to be held in Cincinnati, Ohio, May 10th to 14th, 1915. Secretary, J. M. Diven, 47 State Street, Troy, N.Y.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.—Annual meeting to be held at the Iowa State College, Ames, Iowa, June 22nd to 25th, 1915. Secretary, F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

AMERICAN FORESTRY ASSOCIATION.—Special meeting to be held on October 20th at the Panama-Pacific International Exposition, San Francisco, Cal. Secretary, P. S. Ridsdale, Washington, D.C.

St. John, N.B., has decided to adopt a town planning scheme. A plan has been prepared, including almost all the suburban lands for a radius of three miles outside the city, and the legislature will shortly be asked to give its approval.