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The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Present Status of the Sewage Disposal Problem

Efforts to Recover Valuable Nitrogenous Contents of Sewage Made Difficult by Colloidal Nature of Activated Sludge--Cities May Have to Dissolve and Oxidize as Much of Organic Material as Possible, Turning out Smaller Quantity of Stable Residue and Making No Attempt at Conservation

By Dr. GEORGE G. NASMITH

Director of Laboratories, Department of Public Health, Toronto

WHEN an interested person with the solution of some sewage disposal problem in mind begins to make a survey of the existing installations, he is soon struck with the fact that there appears to be no perfect sewage disposal plant in existence. Some will show one good feature, some another, but after a thorough investigation the investigator will be convinced that the most notable feature about the majority of sewage disposal plants is the apparent failure to achieve the object aimed at, or some marked nuisance in connection with the operation of the plants.

It seems to me that it has been the lack of appreciation by engineers of the principles involved in sewage disposal that has chiefly been responsible for the large number of offensive sewage disposal plants in this and other countries.

One factor frequently responsible for the improper operating of sewage disposal plants has been the failure of engineers to take into consideration the large amount of silt and detritus brought down in sewage, and to provide detritus chambers of sufficient capacity. As a result silt passes over into the sedimentation tanks proper and settles out in the form of compact deposits which prevent proper sludging of the tanks. The consequence is that decomposition of the sludge sets in, large quantities of offensive gases are given off, both in the tanks and during the sludging process, and a nuisance is created.

In other cases incomplete sewage disposal systems have been installed. These frequently consist of a system of screens, grit chambers and sedimentation tanks, the effluent being allowed to flow into the nearest stream or lake. If this effluent flows into a body of water too small to handle it, all the oxygen is absorbed from the water, the organic matter in the effluent settles out, anærobic action takes place, and again a nuisance is created, to say nothing of the possible danger from contaminated water supplies.

Sludge Treatment a Nuisance

Or again, when sludge is to be treated, a nuisance is almost certain to result, because sewage sludge cannot be rapidly dewatered or dug into ground and can only be kept from undergoing offensive bacterial putrefaction with the greatest difficulty.

In many cases where nuisances have arisen, the fault has not been that of the engineer, who originally designed the plant with a full knowledge of the subject of sewage disposal held at the time of its construction. Sometimes well-designed plants have been allowed to become public nuisances through mismanagement. In other cases the growth of the municipality has resulted in the plant being overloaded, with no attempt to remedy the trouble by properly extending the system.

All of these conditions have come within the experience of anyone who has studied the problem of sewage disposal at all extensively. In England, the writer has seen numerous small installations consisting of sedimentation tanks and bacteria beds which appear to be carried on with a comparatively negligible amount of nuisance. It is only a question of degree, however. If these small installations were increased to ten or twenty times their capacity, the negligible nuisance would become marked.

At Salford I saw the original activated sludge plant operating without the slightest odor upon a most objectionable-looking sewage containing large quantities of dye products and explosive manufacturing wastes. At Devizes I examined a very excellent installation of sedimentation tanks and trickling filters. This system was considered to be one of the very finest examples of its kind in England; there was little odor and the whole process was carried on in the open air.

Operation Is Important Factor

Whether there is a nuisance or not at any disposal works depends on the operation of the plant as well as on the installation, and as plenty of labor can usually be obtained in England, the plants there are, as a rule, well looked after.

In America it has been possible for engineers to install many sewage disposal plants that looked well on paper, because the local authorities did not know enough about the problem to tell whether the plans were suitable or not, and there was no central authority, or referee, with sufficient minute knowledge of the subject to whom the plans of the proposed installation could be submitted. This central, independent expert authority, or referee, has been established in Ontario and other provinces in the person of the sanitary engineer of the Provincial Board of Health, instead of the Board itself, as was the case in Ontario at one time.

The disposal of sewage in its various stages is absolutely dependent upon bacterial action. Bacteria are the agents which are employed to carry on the series of destructive processes which finally convert the organic matter present in sewage into inert inorganic salts and a humus-like residue which can no longer undergo active putrefaction. Two classes of bacteria may be employed, according to the result wished for: Anærobic and ærobic.

The anærobic type are hydrolytic organisms, and as a rule split up complicated organic materials into simpler organic materials, frequently with the production of hydrogen sulphide and other offensive gases.

Aerobic bacteria, on the other hand, tend to directly oxidize or burn up organic compounds, or their split products, into inoffensive, inorganic stable compounds, such as carbon dioxide, nitrates, sulphates and other salts. The final result of anærobic and ærobic action combined, which is presumably the general rule, is a stable organic residue called "humus."

Because of the nuisance which results from the ordinary anærobic or hydrolytic fermentation of sewage, the tendency has been to discard this process and employ ærobic methods wherever it is possible to do so. It is a simple matter to obtain a clear, non-putrescible effluent by passing the sedimented sewage over trickling filters, or by means of the activated sludge process, without any nuisance arising. The inoffensive treatment of sludge, whether from plain sedimentation tanks or from activated sludge process, has until recently proved very difficult, because sludge is putrescible and the only method yet known of digesting it to a non-putrescible residue is by the anærobic process.

What Treatment Must Involve

The treatment of sewage by modern methods must involve:—

1. The thorough screening of coarse material from the sewage.
2. The complete separation of grit and other readily sedimented inorganic matter in suitable grit chambers before the sewage passes over into the sedimentation tanks proper.
3. The complete separation of all organic material capable of being sedimented in special tanks.
4. The treatment of the effluent from the sedimentation tank on bacteria beds to form a clear, non-putrescible effluent.
5. The treatment of the sludge without nuisance to yield a non-putrescible, easily handled residue.

Of these phases, the third and fourth may be combined, as they are in the activated sludge process, while the treatment of the sewage by efficient screening and grit chambers is absolutely essential as a preliminary to any disposal system.

The object of the chemical engineer, or sanitarian, is to convert all the contained organic matter in sewage into inorganic matter, or something which is no longer putrescible. To be ideal, there should be no nuisance connected with any part of the process, from beginning to end—an ideal which only now we are beginning to believe possible of accomplishment.

The activated sludge process would have brought us pretty close to the ideal solution were it not for the fact that activated sludge is colloidal in character, will not readily separate from its water content, and is putrescible. But because of this drawback the most difficult task remains unsolved, and we must seek elsewhere for the solution of the sludge problem. According to our experience in Toronto, continuous aeration of activated sludge for two weeks will not produce a stable residue; it still has to undergo anærobic action before it can become a stable, inoffensive material.

Public Resents Stream Pollution

With the increase in knowledge on the part of the general public on questions of public health, there is a growing objection to the pollution of water-courses by sewage, not only because of the possible danger of typhoid fever and other intestinal diseases, but also from the aesthetic standpoint.

Of course, there are occasions, during periods of heavy rainfall and storms, when the sewage of any municipality, unless it has a special system of sanitary sewers, will have to be by-passed into the nearest stream or lake. This occasional pollution is not what people object to, but rather to the principle which approves of the deliberate fouling of our water supplies and their subsequent purification.

The dwellers on streams below towns are more and more resenting the conversion of those formerly limpid streams into foul and turbid water-courses because some tanner, manufacturer or town upstream throws waste products into them. And, because of this growing hostility to the interference of what are felt to be the reasonable riparian rights of property owners by the deliberate pollution of streams by irresponsible parties, it is becoming less easy for manufacturers and towns to solve their disposal problems by the simple process of carrying a pipe line to the nearest water-course and letting their wastes empty into it.

The ideal method of sewage disposal, sought for so long and so patiently by sanitarians, is actually now appearing in sight. Gradually we have learned the basic principles involved in the disposal of sewage, and, because these are purely biological in character and could not be learned through laboratory experiments, but only from deductions based upon experiments on a very large practical scale, it has taken a long time to establish them.

What would constitute an ideal method of sewage disposal? To the writer it would mean the carrying on of the whole process without any nuisance whatever, at the minimum cost and with the production of a non-pathogenic and non-putrescible effluent which could be turned with safety into the nearest water-course. The entire process, moreover, should, if possible, be carried out in tanks of simple and economical design that would not involve an elaborate pumping plant or the construction of bacteria beds.

Leaving the small septic tank out of the question, every system of sewage disposal of any scale involves the separation of suspended material from the sewage, and treatment of the effluent and sludge independently.

Effluent Stable, Sludge Putrescible

It has hitherto proved impossible to digest sewage in tanks in such a way as to yield both a stable effluent and a non-putrescible sludge. The closest we have come to this is in the activated sludge process, where a clear, stable effluent is produced, as well as a partially stabilized sludge. If the activated sludge produced was a perfectly stable material which could be readily dewatered, we would have an ideal method, but the sludge from an activated tank is still colloidal and clings to its contained water with the greatest obstinacy; consequently, it cannot be readily dried out on any kind of filter beds, though apparently about 40% of its contained water may be readily removed by centrifugal action.

The prevailing methods of sewage disposal in America include the activated sludge system, plain sedimentation tanks alone or in combination with trickling filters, the double-tank system of Travis or Imhof, and sludge digestion tanks. The ordinary large septic or hydrolytic tank has to a large extent been superseded on account of the nuisance with which its operation is attended, and the various types of contact beds, which were common in England, but are now out of date, never gained a foothold here.

The small septic tank for household use is a very valuable method, because it is automatic, liquefies solids, and, since the whole process is carried on underground, is inoffensive. The liquefied effluent from the small underground septic tank flushes periodically into a system of underground tiles placed not far below the surface of the ground; from this tile system it soaks into the soil, and any organic matter present is destroyed by bacterial action, while any gases are absorbed by the soil.

An advance on the large septic tank was the double-chambered tank of Travis and Imhof. These types permit the sludge which settles out from the upper tank to fall through into the lower tank, where it undergoes digestion independent of the tank above it. Sometimes this kind of digestion is satisfactory and does not create bad odors; at other times the digesting sludge in the lower tank boils up into the second tank and is very offensive. Consequently, many of these double-chambered tanks have been abandoned. One very valuable fact was established by the process, namely, that it is possible under certain conditions to digest sludge anærobically without offense.

Sludge Valuable as Fertilizer

The activated sludge process, which is excellent in that it is carried out in tanks, removes all colloidal matter in suspension and turns out an excellent, clean and non-putrescible effluent, is also essentially a biological process. It depends, however, on an ærobic flora, quite different in character from that which operates in the anærobic systems mentioned above. The process produces a sludge which quickly separates from the sewage, leaving a clear and almost colorless supernatant water. Sludge presses or centrifugal action

will reduce the water content of activated sludge to about 60%.

It is interesting to note that in the further drying of activated sludge by artificial means, objectionable gases are given off which, unless carefully looked after, may create a local nuisance.

The fertilizer value of activated sludge is high, as both Bartow and Hatfield* and G. P. McKay and the writer† have pointed out. Mr. McKay and the writer have shown in actual outdoor plot experiments, subsequently confirmed by greenhouse plot experiments, that activated sludge, compared with barnyard manure, will produce yields of vegetables of extraordinary size. Results showed increases in the outdoor crop yield amounting from 100% in the case of lettuce to 290% in tomatoes, and even 550% in the case of Weatherfield onions. The results under glass, which have not yet been published, are equally remarkable.

Combination May Solve Problem

Owing to the difficulty and cost of dewatering, the trouble involved in the drying process, and certain other objections, the activated sludge method is not the last word on sewage disposal. It looks as though the solution of the sludge problem will depend upon a combination of the activated sludge process with sludge digestion or plain sedimentation tanks followed by trickling filters and sludge digestion. The latter will be controlled under definite conditions which are now fairly well established, and will be operated as a distinctly biological problem.

The practice to be followed will of necessity in small installations be more or less empirical, since expert assistants will not be available. This defect, of course, might be overcome by having the smaller sewage disposal plants placed under the indirect supervision of some qualified expert, who could keep them under proper working conditions and advise as to changes in methods of operation, additions to or modifications of the plant, from time to time as needed.

The principles underlying the activated sludge process and the trickling filter may seem to be quite different. As a matter of fact, they are identical. In the trickling filter some medium, whether it be stone or brush as in the Leaside plant, is employed, over which the sewage slowly trickles. The stone or wood after a time becomes covered with a slimy material which has the property of absorbing solids, colloidal material and other inorganic compounds from the thin sewage films flowing over it, and of converting this absorbed matter, through biological oxidation processes, into inert, non-putrescible, inorganic matter.

In the activated sludge process this same kind of slimy material which forms on the surface of a trickling filter is gradually produced by bubbling air through sewage held in tanks. When fresh sewage is agitated for some hours with this activated sludge by streams of fine air bubbles, the organic matter in the sewage is attracted to the activated sludge just as it was attracted to the slimy film on the stone or wood trickling filter, and is so altered that only inorganic, non-putrescible materials pass over in the clarified effluent.

Different Methods, Same Principle

In the one case the sewage circulates through the air over an activated biological medium; in the second case the activated biological medium is circulated through the sewage in association with large quantities of air bubbles. The combination of ærobic bacterial agent and air is identical in both methods. That this biological agent is identical in both cases was proved by the writer, who started a small activated sludge tank with ripened sludge collected from a lath trickling filter. The nitrification and clarification, which usually takes several weeks to develop, began at once, proving that the biological medium was one and the same, and that the processes were identical.

In the opinion of the writer, the complete solution of the sewage disposal problem will come about finally through a combination of the activated sludge process, or trickling filters, with sludge digestion. It may be that the activated sludge process will be the preliminary installation, followed by digestion tanks; or it may be that actual sewage digestion will be the first installation.

Brush Affords Greater Capacity

In one of the common types of sewage disposal plants, sedimentation tanks remove the larger part of the suspended organic matter, and the effluent is treated on trickling filters or oxidizing beds. These may be of stone, clinkers, brush or other material, and the general rate of treatment has been from two or two-and-a-half million gallons of sewage per acre per day on the older form, to seven million gallons per acre per day on the newer brush filter.

Where plenty of fall is available, trickling filters, particularly in small installations, will frequently be considered preferable to the activated sludge method. At the Leaside, or North Toronto, sewage disposal plant, one of the trickling filter beds, composed of stone, was at my suggestion replaced some six years ago with bundles of brush tightly packed together. Operating side by side for six years, the other old stone filters have treated from two to two-and-a-half million gallons of sewage per acre per day, while the brush filter has averaged six-and-a-half million gallons per acre per day.

The brush filter was simply the logical conclusion of experiments carefully conducted by us at our experimental plant to determine the greatest amount of filter medium which, allowing free access of air, could be packed in six feet of filter bed. This method, which was patented at the time, is free to those who wish to use it, and, since it is cheap and will reduce the amount of filter area required to one-third, there should be many places where its use should prove desirable.

It may be stated here that the brush to date shows absolutely no signs of decay, and is as sound as it was six years ago when placed in situ. With this method, of course, the sludge problem has still to be dealt with.

Can Digest Sludge Inoffensively

Though it has not been possible to digest sewage anærobically and obtain a non-putrescible residue without offense, it has proved possible to digest sludge without creating a nuisance. Watson, of Birmingham, has shown* that sewage sludge can be thoroughly digested on a huge scale without causing a nuisance. At Birmingham the fresh sludge from ordinary sedimentation tanks is drawn off and pumped into digestion tanks, receiving before it enters these tanks one-fourth its volume of old, thoroughly ripened sludge. This seeds it with the proper bacterial flora, and, provided the temperature is right, digestion will progress to a conclusion without the production of foul odors. At the end of four months the sludge is thoroughly digested, is no longer putrescible, is reduced in quantity and is readily drained on ordinary drying beds.

The action which occurs in the Birmingham sludge tanks is apparently the same as that which occurs in a properly operated Imhof tank. Dr. Carl Imhof, while on a visit to Toronto in 1913, told us that it was quite feasible to digest sewage sludge without offense. He advocated the mixing of one part of Emscher (Imhof) sludge with one part of fresh sludge, and stated that a ripened sludge would be produced in one week. One part of this could then be mixed with an equal volume of fresh sludge, and so on, ad infinitum. The Emscher sludge itself takes from nine to twelve months to prepare.

Those attempting to solve the sludge problem have in mind two definite objectives. In the first case, an attempt is being made to save the tremendous waste of valuable nitrogenous matter present in sewage, and retain it in the

*See Journal of Industrial and Engineering Chemistry, Vol. 8, No. 1, January, 1916.

†See article, "Fertilizer Value of Activated Sludge," by G. G. Nasmith and G. P. McKay, in *The Canadian Engineer*, May 2nd, 1918, page 377.

*See "The Utilization of Sewage Sludge," by John D. Watson, in *The Canadian Engineer*, October 30th, 1919, page 420.

form of fertilizer. The success of the activated sludge process would seem largely to depend upon the fact that a revenue is expected from the dried activated sludge. From the standpoint of conservation alone, particularly if a satisfactory and economical process is found for dewatering the sludge, there is everything to be said for the process, and, particularly in cities which do not possess tanneries, there are no objections to the use of this material as fertilizer. On the other hand, it is doubtful whether the activated process will be popular with small municipalities because of the expert care necessary in operating the plant. In the second case the tendency is to first dissolve and then thoroughly oxidize as much of the organic material in the sewage as possible, and turn out the smallest possible quantity of a stable residue.

In the latter case no attempt would be made to obtain any income, and the process would be worked out along lines of operation that would be, so far as possible, automatic.

Like many others, we were in favor of the conservation idea, and the saving of as much as possible of the nitrogen and other fertilizer ingredients in sewage by the activated sludge process, until our work and that done elsewhere convinced us of the as yet unsolved difficulty of rapidly and economically drying the sludge.

Even if the material could be produced economically and without nuisance, it is realized that the sale of same and consequently the economical operation of the plant would be a purely business proposition, in competition with established industries, and, in case of success, with other municipalities.

For these reasons the writer has come to the conclusion that the second process will be the one generally adopted. It appears as though the final solution of the sewage disposal problem will come about eventually through a combination of the activated sludge process or trickling filters in combination with sludge digestion tanks. It may be that the activated sludge process will be the preliminary installation, followed by digestion tanks. It may be that actual sewage digestion tanks will be the first installation, followed by the activated sludge process. Certain preliminary work, which has been carried on by us for a year, shows very promising results, and it is hoped that in the near future we will have information and data for publication as to the results obtained.

Letter to the Editor

COST-PLUS-FIXED-FEE CONTRACT

Sir,—In your issue of September 11th, the article by A. E. Wells, entitled "Cost-Plus-Fixed-Fee Contract," makes it quite clear that the method is very advantageous to the contractor who does the work.

Will you permit me to say a few words concerning what cost-plus-fixed-fee means to owners, and incidentally to touch upon the question of what it means to the small-fry contractors who are ambitious to expand?

This is what it means to the owners:—

First.—Placing themselves absolutely in the power of the contractor, who can make the work cost as much as he likes.

Second.—Placing themselves at the mercy of all the workmen on the job; for the latter cannot be induced to labor faithfully when they know that the "boss" will lose nothing by their idleness, no matter how honest may be the intentions of the contractor about keeping down the expense.

It is useless to deny the correctness of these two statements, for anyone with common sense must acknowledge it. While it is practicable to improve this method materially for the owner by substituting a sliding-scale fee for the fixed fee, even this will not protect him effectively, unless there be something in the nature of a penalty for the contractor, either to prevent him from neglecting to push the work or to make him pay for his negligence. A limit of total cost which can be increased or reduced properly, in order to provide for an increase or decrease in the estimated total quantities of materials, will prevent the owner from being excessively robbed, and still will give the contractor every opportunity to come out whole in the case of all but extraordinary hard-luck.

Such a method I expounded in a paper recently published by "Contracting," of Chicago.

[NOTE.—This article is reprinted for the reader's convenience, on page 527 of this issue of *The Canadian Engineer*. —EDITOR.]

It outlines an ideal, just, scientific and perfectly feasible method of contract-letting and profit-sharing,—one that is fair to both parties by making the owner and the contractor partners on the job, thus tending towards harmony and towards the utilization of every practicable method of legitimately keeping down the cost.

My scheme could be enlarged slightly in the interest of both the contractor and the owner by arranging in the specifications for a modification of the limiting cost by a ratio based upon the ratio of general average rise or fall of workmen's wages during the progress of the work. It would not be difficult to draft such a clause upon truly equitable lines.

Again, my method could be amended in the interests of labor by arranging that the contractor and the owner, immediately after the final settlement, shall each turn back a certain percentage of his declared profit (say, 20%) into a fund, which fund shall be divided among all the employees who have stayed on the work until its completion or until their services were no longer needed, the amount of each individual's share of the bonus being directly proportional to his total salary or wages in comparison with the sum of all salaries and wages. Such an arrangement would tend to make everyone on the job do his utmost to keep down the cost and to work faithfully and to the best of his ability.

And now a word as to how cost-plus-fixed-fee affects the small-fry contractors. Is it not evident that it will militate towards cutting them out of bidding? When an owner is willing to let any work on a cost-plus basis, he naturally wants to award it to a large contractor of means who has an established reputation for fairness and efficiency. That would practically mean letting all contract-work without competition,—and contractors as a body would object seriously to any such procedure. It is true that the owner might call for competitive bids by letting each bidder name a lump sum for his fixed fee, and awarding the contract to the competitor who names the lowest figure; but the adoption of such a method would often result in serious trouble, delay and expense.

It would be a great benefit if there were evolved and adopted, with the least possible delay, a method of contract-letting and profit-sharing that should always prove satisfactory to both parties to the agreement. By having it first discussed thoroughly in the papers, then seriously considered by a small committee representing the various organizations of engineers, architects, contractors and bankers, so as to determine tentatively some standard method for formal approval by each of the said organizations, the result desired could be attained. The benefits to be derived by the adoption of such a standard are far beyond the ability of anyone to predict.

J. A. L. WADDELL,
Consulting Engineer.

Kansas City, Mo., December 1st, 1919.

Applications are being invited by W. Foran, secretary Civil Service Commission of Canada, Ottawa, Ont., to fill the following vacancies: Instructor in mathematics, Royal Military College, Kingston, $1,800 per annum; engineering clerk, Topographical Surveys Branch, Department of Interior, $1,260 per annum; inspector of gas and electricity at St. John, N.B., $1,260 per annum. The last mentioned position is open only to residents of the province of New Brunswick.

SASKATCHEWAN'S PUBLIC FERRY SERVICE

By G. A. Palmer
Department of Highways, Regina, Sask.

THERE are 42 ferry crossings in Saskatchewan; all of these are important links in the main road system of that province. The ferries are operated by the Department of Highways and are free during daylight hours; they are accessible after dark, but a toll is then charged by the ferrymen.

In the pre-Rebellion days, a few scows were operated by the Indians and half-breeds at three or four of the main crossings, and under the government of the North-West Territories these crossings were brought under recognition and the ferrymen received licenses to operate at a fixed rate of tolls. When the provincial government assumed control in 1905, this system was superseded by establishing

Fig. 1—Standard Saskatchewan Ferry Scow

paid ferrymen at all new crossings, the old licenses being gradually eliminated, and in 1912 a system of free ferriage was established, the ferry service was unified and the scows and tackle of all crossings were brought to a government standard.

The growth of the ferry traffic from an occasional rancher's rig or pioneer's cart to the present-day heavily loaded grain tank, drawn by six horses or moved by motor power, and automobile traffic, reflects the short and rapid history of the development of the agricultural and cattle industry in Saskatchewan.

A comparison of the units of traffic carried by this ferry service for the last three years is interesting: —

Year 1916	127,677	
" 1917	465,822	"
" 1918	604,027	"

Fig. 2—South Saskatchewan River

Also the comparison between the decline of the wagon traffic and the increase of the automobile traffic:—

	Wagons.	Automobiles.
Year 1916	122,677	25,738
" 1917	107,270	60,386
" 1918	111,770	103,928

There are required for Saskatchewan's ferry service 61 standard scows and 61 rowboats; 102,000 ft. of 1¼-in. steel

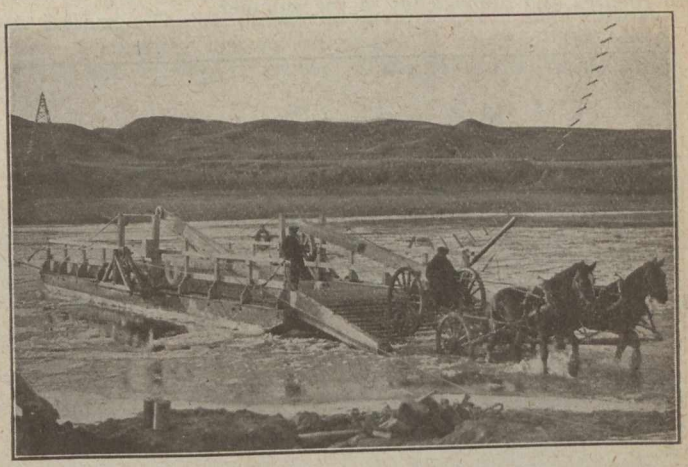


Fig. 3—Ice Makes Landing Difficult

cable for the main cables suspended from towers on the river banks, and upon which cable the scow travellers run; 48,000 ft. of ¾-in. steel cable for temporary crossings when the channel at the main cables becomes obstructed by moving sandbars; and 90,000 ft. of ⅜-in. steel cable. This small cable passes from the shore to the scow and is reeled on a winch to enable the ferryman to pass stretches of slack water in places where the current forms eddies which do not promote the progress of the scow.

The ferry season commences about the middle of April, and closes when the rivers are so choked with ice as to

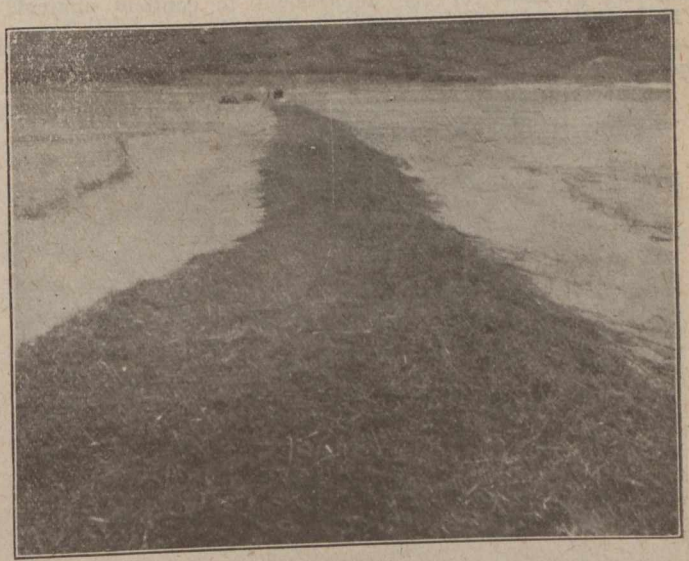


Fig. 4—Straw Road Across Sandbar

render it dangerous to cross; this occurs any time from the end of October to the first of December.

The service last season cost the government $120,000, this sum covering the ferrymen's wages, new construction, renewals of scows and cables and tackle, and the maintenance of the approaches to the ferries. In connection with the latter item, approximately 6,000 lineal yards of road were built and maintained during low water, and for the consolidation of sandbars some 350 tons of straw and litter were hauled, with an average haul of three miles.

The present standard ferry scow (see Fig. 1) is 18 ft. in width and 52 ft. in length with two 12-ft. aprons extending beyond the ends of the scow. The carrying capacity of the new boats is figured to take care of four heavy tanks of wheat at one load.

The service is managed by a small office staff at Regina, one field inspector and usually two small construction and maintenance crews who are kept constantly in the field all the year, overhauling the boats in the winter and attending to repairs and approaches in the summer.

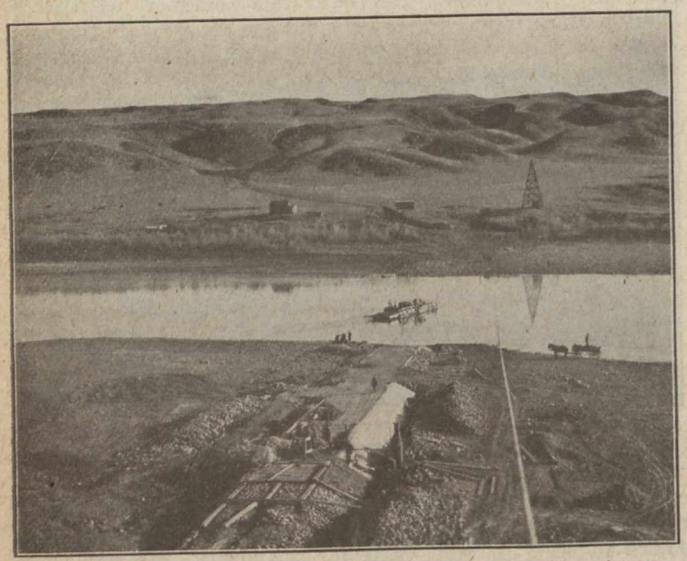


FIG. 5—CONSTRUCTING PERMANENT APPROACH TO FERRY

Fig. 2 indicates the characteristics of the South Saskatchewan river for 250 miles east of the western boundary of Saskatchewan. This view illustrates the sandbars which form at one level of the water, re-form, move and disappear at succeeding stages of the water. This natural feature of this section of the river makes the operation of ferries a difficult problem for the department to contend against. The road in the foreground is a typical road entry to an ascent from the river level to the plateau, which in some places is as high as 300 ft.

Fig. 1 is a fair-weather scene; Fig. 3 shows the difficulties of ferriage prior to the setting in of the severe

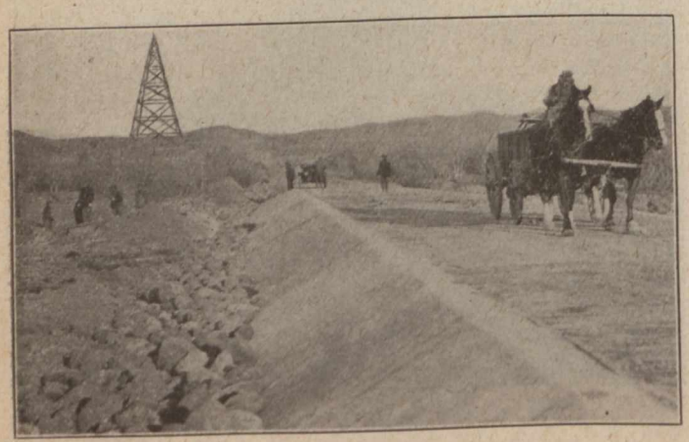


FIG. 6—PERMANENT APPROACH COMPLETED

weather. The river is full of "slush" ice, which forms on the ferry scow and obstructs the landings. The ferrymen are required to operate their boats under these conditions as long as possible consistent with safety. In Fig. 3 on the far side of the river can be seen one of the standard cable towers. At most crossings one of these towers is required at each side of the river. The cables (1¼-in. crucible cast steel cables with hemp centres) are suspended from the top of the towers and it is upon these cables that the pulleys of the travellers run. The travellers are connected with the ferry scows by ½-in. cables, which can be seen in Fig. 1.

Fig. 4 shows one method of making a solid road across the loose sand of the bars at points where the ferry scow cannot make a good natural landing. The dark material is successive layers of straw (preferably flax straw) which binds into the sand and makes a solid road for the heaviest kind of traffic.

A permanent ferry landing consists of a rampart of boulders with a concrete cover, the centre being laid with planks. Fig. 5 shows an approach road in the course of construction; also the South Saskatchewan river at its narrowest point, extreme low water. On the far bank the road can be seen entering the hills. The height of the tower on the far bank is 60 ft. The hills in the background are characteristic of the river benches in this vicinity. Fig. 6 is a "close-up" of the completed permanent approach.

TOWN PLANNING IN RELATION TO INDUSTRIAL DEVELOPMENT*

BY C. W. KIRKPATRICK
Industrial Commissioner, Hamilton, Ont.

YOU cannot get the most or the best out of a man unless he is happy and contented. High wages and short hours are not, in themselves, sufficient to make him either. He demands, and he is entitled to, the right to live, and unless you provide him with proper living conditions for himself and his family he will never prove 100% efficient.

I cannot claim originality for either the above paragraph or the thoughts it expresses. They are the words spoken to several others and myself by H. S. Firestone, head of the great Firestone Tire & Rubber Co., but they struck me with much force, and the more I have turned them over in my mind, the more have I become impressed with the idea that they have probably had much to do with Mr. Firestone's success. And they sum up briefly and concisely the few remarks that I intend to make. They may not appear to have any direct bearing on the subject, "Town Planning in Relation to Industrial Development," but when you analyse them I think you will agree with me that they tell pretty nearly the whole story.

In my comparatively brief experience as commissioner of industries for the city of Hamilton, I have found that the first concern of practically all large manufacturers is labor. The availability of a labor supply concerns him more than any one other thing, and the quality of that labor is to him of quite equal importance. In inquiring into the quality of the available labor supply, he invariably seeks a first-hand knowledge of housing conditions. If he finds that the workingmen of the city are properly housed, it does not take much more to satisfy him that the quality of the labor is good, but if on the contrary he finds that the particular class of labor in which he is interested is housed in shacks or tenements, or that the families of the workmen are surrounded by conditions that are not congenial or healthful, it takes more than the persuasive eloquence of an industrial commissioner to convince him that in that community he will find that which is most essential to the successful conduct of his business—efficient labor. In support of that statement (you will pardon me if I make another local reference), a few weeks ago H. W. Hoover, general manager of the Hoover Suction Sweeper Co., of Canton, Ohio, was asked—not by myself but by an indirect representative of the Department of Trade and Commerce—why he had selected Hamilton as the location for the company's Canadian plant, and this is what he wrote in reply:—

"First of all we were most favorably impressed with the seemingly ideal living conditions of the laboring people. The large percentage of these folks who owned their own

*Address at the Southwestern Ontario Town Planning Conference, Hamilton, Ont., November 27th and 28th, 1919.

homes impressed us with the fact that Hamilton must have an ideal labor market."

I trust that I have now successfully connected the expressed thoughts of Mr. Firestone with the subject of this paper, for it has been my aim to show that the city or town that does not give thought in the laying of its development plans to the proper housing of its working people, is badly handicapped in the race for industrial supremacy.

Living at Factory Door

It would be presumptuous on my part to suggest just what class of house is best suited to the requirements of the workingman or is most calculated to do its part toward bringing him and his family that measure of contentment necessary to his efficiency, but I have my own ideas regarding where that house, whatever the plan, should be located; or, rather, where it should not be located. Invariably when it is announced that a large new industry is about to locate in a certain district, there is a rush of builders into that district and the foundations of so-called workingmen's homes soon begin to make their appearance, usually before building operations are started on the factory itself. This, in my opinion, is a mistake. It has been my experience that the average workingman, while desirous of being fairly convenient to his place of employment, is still more desirous of being far enough away from it that it will not be staring him in the face every time he opens his front door, a constant reminder that his hours of rest and recreation are few and that the whistle will soon again be recalling him to toil.

It is quite true that houses built close to the sites of new industries invariably find ready sale or are easily rented, but that is usually because the prospective purchaser or tenant has no choice in the matter. Were they to be consulted, I believe that at least 75% of them would say that they would much prefer to be a few blocks distant but that circumstances forced them to take what they could get. In fact, provided with proper means of transportation, it is my opinion that a large majority of the workingmen would, for the sake of their families, if not for their own sakes, prefer to reside a mile or two from their places of employment, where their growing children would be far removed from the noise and grime of the workshop.

I was recently in a western city where some of the residents expressed great pride in a housing scheme that had been carried out for the benefit of the people employed in a certain factory district. "A model city," they called it. Being interested, I took time to pay the district a visit. What I found was a number of pretty houses, well paved streets and attractive boulevards, but surrounded on all sides by existing factories or factory lands. "If this is a model city, then give me the old-fashioned kind," was the thought that came to my mind, and when I afterwards had an opportunity to talk with the occupants of some of those homes, who, by the way, were not laboring men at all, I found that they were residing there because they could not find any other place to reside.

Industrial and Residential City

I have heard it said that an industrial city cannot hope to become a residential city in the sense that a residential city should be a thing of beauty. The claim that I am about to make would probably come with better grace from someone else, but I cannot refrain from saying that right here in Hamilton we have the answer to that statement, for here nature and man have combined in the building of a City Beautiful and an industrial centre. With but a few exceptions, Hamilton's larger industries are located in the northeast section of the city, on the harbor shore, where the prevailing winds blow the smoke, dust and objectionable odors out over the waters of Hamilton Harbor and Lake Ontario, where they can do no harm.

The residential sections, on the other hand, lie to the south, beneath the shelter of what we are pleased to call "Our Mountain," and where there is little, if any, possibility of their being marred by the industrial life of the

(Continued on page 531)

CORRUGATED PAPER USED TO SEPARATE WOOD BLOCK IN PAVING ST. THOMAS TRACK ALLOWANCE

By John Stanley Crandell

Consulting Engineer, General Tarvia Dept., the Barrett Co.

WOOD block pavement is being laid in the track allowance of the St. Thomas (Ont.) municipal railway by a new method. The old pavement was brick on a sand cushion. When it recently became necessary to replace the worn rails, it was decided to repave at the same time with wood block.

The concrete base which surrounds and covers the sleepers, was brought up so that when the wood blocks are

Spacer in Place Between Rows of Block—Roll of Spacer Material in Background

laid on it they are flush with the top of rail. Instead of laying the blocks on a sand cushion, the smooth concrete base is given a paint coat of paving pitch (145 degs. melting point, cube-in-water method) and the blocks are laid on this pitch paint coat as soon as it has hardened. Hardening takes only a few moments.

The rows of blocks are separated from each other by strips of corrugated paper 1¼ ins. wide by 3/16 in. thick.

Squeegeeing Pitch into Joints

The joints are therefore about 3/16 in. wide, or less if the blocks are lightly rammed. The joints so formed are then filled to about one-half their depth with coal tar pitch, and the remainder of the joint is swept full of clean sand.

The spacer of corrugated cardboard was used for the first time in June, 1919, in Bridgeport, Conn., in the track

allowance of the Connecticut Co. St. Thomas is the first Canadian city to use it. It permits the pitch filler to find its way to the bottom of every joint, thus insuring a waterproof pavement; it prevents the movement of the pitch after it settles in the joint, and therefore stops effectively any running of the pitch on hot days; and it provides a joint sufficiently wide to take care of any expansion that may take place in the blocks. As the blocks are laid in a pitch paint coat, and as the joints are waterproofed with pitch filler, five of the six faces of each block are protected with pitch.

By filling the joints only half full of pitch, much of the objectionable bleeding often associated with wood blocks is eliminated. The sand that fills the remainder of the joint eventually mixes with the pitch to form a pitch-sand mastic, and an ideal filler is the result.

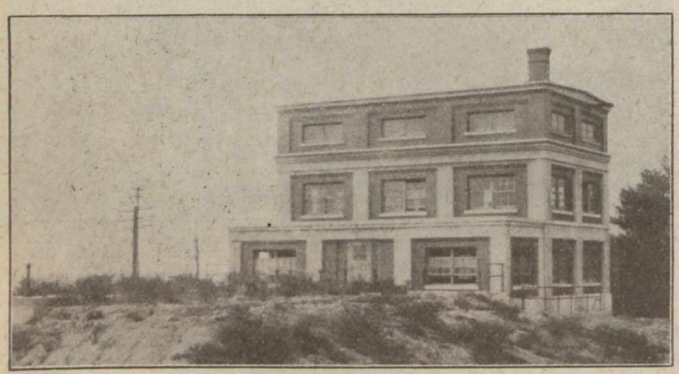
Along the web of rail a strip of bituminized felt is laid. Paving pitch is poured around this so as to waterproof the pavement from rail to rail.

The work is being done under the direction of James A. Bell, consulting municipal engineer and acting city engineer, and under the immediate supervision of W. C. Miller, assistant engineer.

AMHERSTBURG FILTER PLANT

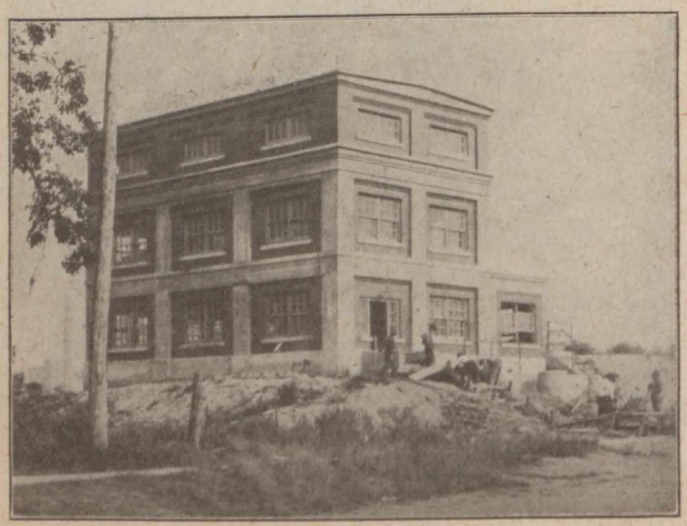
TO Charles W. Tarr, vice-president of Morris Knowles, Ltd., consulting engineers, Windsor, Ont., *The Canadian Engineer* is indebted for the two accompanying views of the recently completed water filtration plant at Amherstburg, Ont.

An article by Mr. Tarr, briefly describing this plant and relating the history of the Amherstburg waterworks,



BRUNNER-MOND CO.'S FILTRATION PLANT RECENTLY COMPLETED AT AMHERSTBURG, ONT.

appeared in *The Canadian Engineer* for June 5th, 1919. The plant was constructed by the Foundation Co., Ltd., of Montreal, for the Brunner-Mond Co., Ltd., of Amherstburg, who are largely interested in the welfare of that industrial community and decided to furnish it with pure water. The plant was designed by Morris Knowles, Ltd. The filter equipment



ANOTHER VIEW OF THE AMHERSTBURG WATER FILTRATION PLANT

was furnished by the Norwood Engineering Co., of Florence, Mass.

The Canadian channel of the Detroit river is the source of supply. The pumping plant is near the river bank. Power is supplied by the Brunner-Mond Co. and by the Hydro-Electric Power Commission to motor-driven centrifugal pumps. There are duplicate coagulating basins, each affording six hours' coagulation. A concrete tank of 35,000 gals. capacity provides wash water for the filter beds, which have a capacity of 1,500,000 gals. daily, with space for an additional unit when needed. The clear water reservoir has a capacity of 100,000 gals. There are three low-lift pumps and three high-lift pumps, each with capacity of 500 Imp. gals. per minute.

RECENT PUBLICATION

MANUFACTURE OF CHEMICALS BY ELECTROLYSIS.—By Arthur J. Hale; edited by Bertram Blount; published by Constable & Co., Ltd., London, Eng.; 80 pages and cloth cover; 5½ by 9½ ins.; price $1.50 net. The chapter headings are: Electrolytic Hydrogen and Oxygen, Ozone; Production of Per-Salts and Hydrogen Peroxide; Nitric Acid, Hydroxylamine, Hydrosulphites, Fluorine; Electrolytic Preparation of Pigments and Insoluble Substances; Electro-Osmotic and Electro-Colloidal Processes; Electrolytic Reduction of Organic Compounds; Oxidation and Substitution of Organic Compounds.

Correction.—The titles of the two illustrations on page 516 of last week's issue were accidentally transposed. The upper photograph shows the Regina warehouse of the Robert Simpson Co., Ltd., while the building shown in the lower photograph is the publishing plant of Rand, McNally & Co.

The secretary of the British Columbia Technical Association has forwarded to *The Canadian Engineer* the following report of the association's monthly meeting held November 17th, in the Board of Trade rooms, Vancouver: "Satisfactory reports were made on various phases of the association's activities and new plans for future action were outlined. The association has taken an active part in endeavoring to improve the status and salary grading of technical men in the Dominion Civil Service, and for several months past has been in constant correspondence with the authorities at Ottawa regarding the matter. Similar action has also been taken with regard to the regrading taking place under the provincial Civil Service Commission. The committee report at the meeting indicated that while the provincial association was given an opportunity of conferring through a committee with the regrading authorities, the committee chosen did not contain a representative of the technical men in the service. So while the Civil Service Association might perform valuable functions for the general clerical branches of the service, it appeared that in this instance the interests of the technical men were not being adequately presented. A delegation was appointed which left for Victoria the following day to interview the Civil Service Commissioner on the matter. A discussion took place on the hitherto inadequate part which engineers and other technical men have taken in public matters, resulting in it being left to non-technical men to occupy public positions which vested them with control over expenditure of money on engineering and other technical work. A public service committee was formed, with instructions to work to promote and encourage increased interest among technical men in municipal, provincial and national government affairs."

IDEAL CONTRACT-LETTING MADE PRACTICABLE

By Dr. J. A. L. Waddell
Consulting Engineer, Kansas City, Mo.

IS it not obvious that anyone who lets a contract on the "cost-plus" basis places himself absolutely at the mercy of the contractor and the contractor's employees? It is true that the specifications often contain restrictions which tend to lessen the contractor's power to take advantage of the client; but their enforcement would be very troublesome, and would generally involve litigation with its attendant delay and expense.

Even if the contractor has every possible desire to expedite the work in the interest of the client, he cannot prevent his men from taking life easily and "soldiering" on the job. When they feel that their indolence or negligence will cost "the boss" nothing, but, on the contrary, will probably add to his profits, they cannot be induced to labor with the same amount of energy which they would employ if they knew that upon their efforts depends his success or failure.

Most people will acknowledge that the percentage of truly conscientious contractors is not as large as one hundred, . . . but how much smaller is that of truly conscientious workmen! I do not deny that there are workmen who always give a *quid pro quo* and who are upright and honorable in all their dealings; but alas! they are sadly in the minority. Their number is so small that they are unable to induce their co-laborers to exert themselves any more than they are compelled to, unless, perchance, they are paid by the job instead of by the day or hour.

By the way, when it is practicable, such a scheme of paying the workmen is an improvement on that of time-compensation, because it provides a great incentive to effort; but, at the same time, it also serves as a strong temptation to scamp the work. With close supervision, however, and a strict enforcement of the clause in the specifications relating to the taking out and replacing of defectively built work, the employees soon learn, through the fines and penalties enforced by the contractor, that scamping does not pay, and that the old adage of honesty being the best policy is just as applicable now as it was when first enunciated.

Unsatisfactory Contract Forms

So much from the client's point of view, and now let us discuss the question from that of the contractor. In the days of hard times when contractors are willing to take work at low figures, and even below cost, in order to keep their force together, the public in general, especially as represented by companies and municipalities, is prone to take advantage of them by insisting that work be let by the lump sum, and by throwing upon the unfortunate "successful bidder" not only the risk of loss from rising prices of materials and labor and from unforeseen contingencies, but also, in many cases, from excess of quantities above those given in the specifications. This is accomplished by inserting in the latter a most unjust clause compelling each bidder to verify for himself both the quantities stated and the character of the conditions described. The bidders, hungry for work, accept this clause without comment, but with the mental reservation that, in case of hard luck, they will, by some means or other obtain extra compensation, even if they have to carry the controversy into the courts.

In nineteen cases out of twenty it is unjust to bidders to ask them to name a lump-sum compensation for doing work, unless provision be made for a variation in the quantities of materials upon which they tender. If provision be arranged for such variation, the method of letting is no longer that of the "lump sum," but reduces to a modification of that of "unit prices."

The latter method is certainly the more logical, and yet it is far from being entirely fair to the contractor; because, while it provides against loss through excess in quantities of materials, it leaves him open to the possibility of still greater loss through changing prices, onerous unanticipated conditions, and disastrous happenings beyond his control.

The client is the proper party to assume the principal risks inherent to the work, provided that the adverse happenings be really unavoidable by the contractor, and that the latter take every reasonable precaution against disaster or loss.

Principles of Satisfactory Forms

From the preceding it is evident that the "cost-plus," the "lump-sum," and the "unit-price" methods of letting contracts are not only faulty but also unjust to one or other of the two parties to the agreement; consequently, the question arises—"Is there not some method which will be just and fair to both?" That question, I claim, can truly be answered in the affirmative; and I shall now proceed to explain such a method in complete detail.

Let the specifications, which should invariably be drafted by an engineer who is acknowledged to be an expert in the class of work covered in the proposed contract, be complete and thorough in every detail, recording all that is known concerning the governing conditions; pointing out all features concerning which there is any uncertainty; tabulating

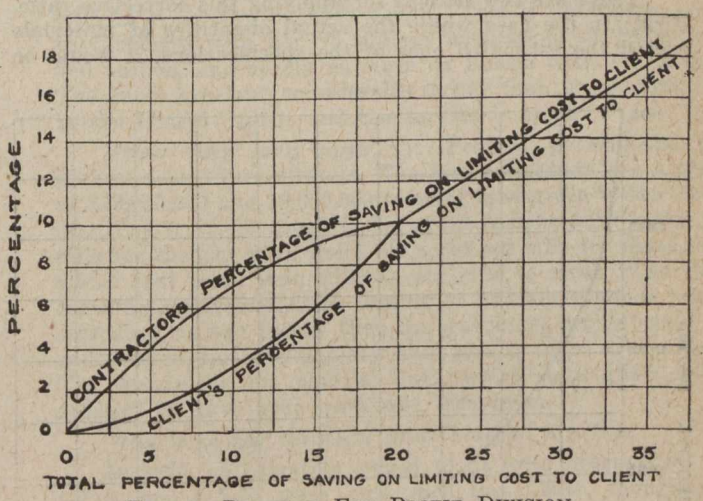


FIG. 1—DIAGRAM FOR PROFIT DIVISION

as accurately as possible the estimated quantities of all the materials that will probably enter the construction; providing a justly-drawn clause for unclassified work and the payment therefor; calling for each bidder to name a lump sum so much above his estimate of total cost that there is practically no danger of the actual cost exceeding it, which sum (after modification as hereinafter indicated) shall be the greatest that the client can be called upon to pay for the completed work; naming such properly balanced unit prices for all the materials that, when they are applied to the quantities thereof given in the specifications, the sum of the several ensuing estimates of cost shall exactly equal the limit of cost set in the contract, which unit prices are to be adopted when computing the final payment for the entire work; providing a surety-company bond for the faithful performance of the work and guaranteeing the client against having to pay more than the limiting sum agreed upon (as finally modified); and adopting the following method of profit-sharing between the contractor and the client.

Method of Profit-Sharing

An accurate estimate of cost of every detail of the work from start to finish is to be kept by the contractor and verified by an accountant in the employ of the client, so that the total profit on the job may be ascertained by deducting this total cost from the maximum figure named in the contractor's tender and afterwards embodied in the contract (modified, however, as hereinafter described). This profit is to be shared between the contractor and the client as indicated in the profit diagram. It should be clearly understood that every direct and indirect expense to which the contractor is put in doing the work, after the contract is signed, is to be included in the cost—all overhead expenses of every kind, plant deterioration, traveling expenses, supervision, and salaries, excepting only that the contractor

himself is not entitled to any salary. In the case of a firm being the contractor, the head of that firm should receive no salary; but if any of the juniors devote their time exclusively to the job, it would be legitimate to allow them reasonable salaries, equivalent to what would have to be paid to regular assistants. All such matters, however, should be stipulated in the contract.

In order to determine, after the entire job is finished, the amount due the contractor, the actual quantities of materials recorded are to be multiplied by the unit prices named in the contract, and to the sum of these is to be added the value of all unclassified work (usually denominated "extras"); then from the sum is to be subtracted the lump sum named by the bidder and incorporated in the contract. The ratio which this difference (either a positive or a negative quantity) bears to the said lump sum named by the contractor in bidding is to be figured and adopted in the employment of the diagram of "corrective ratios" for the said difference.

Application of Corrective Ratio

There are two reasons for applying this corrective ratio. First: in the case where the actual quantities of materials exceed the estimated ones of the specifications, it would be

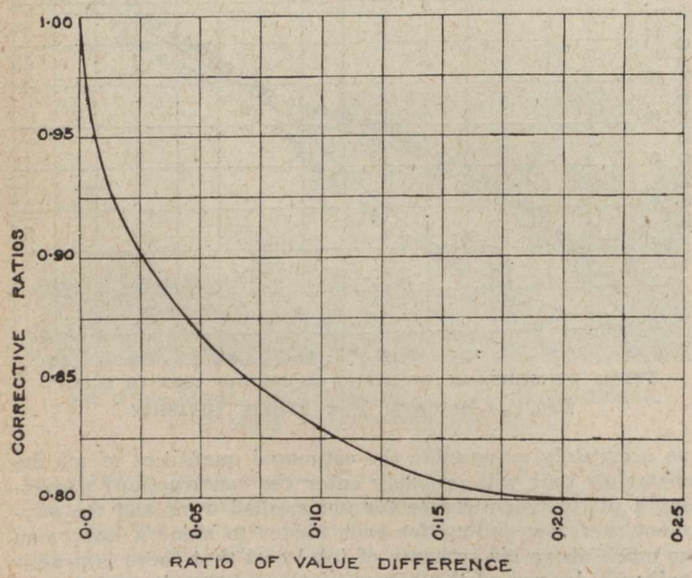


FIG. 2—DIAGRAM OF CORRECTIVE RATIOS

hardly fair to the client to apply to the excess those unit prices which produce his tentative limiting expenditure. Second: in the case where the actual quantities of materials are less than the estimated ones, it would be unjust to the contractor to use the high unit prices on the diminution quantities, not only because of the great difference between these and the unit actual-costs, but also for the reason that the total overhead charges would be about the same for the estimated total quantities as for the diminished amounts.

In the corrective-ratio diagram it will be noticed, that, after the ratio of value difference (due to increase or diminution of quantities of materials) reaches 0.2, the "corrective ratio" remains constant at 0.8, which corresponds approximately to actual cost conditions. The object of this is to provide that the contractor shall not be too much benefited by an abnormal increase in quantities, nor, on the other hand, shall he obtain too much advantage because of an abnormal diminution thereof.

To utilize the corrective-ratio diagram, look on the line of abscissae for the ratio of cost difference, pass vertically upward to the curve (or right line, as the case may be), then horizontally to the extreme left vertical, which will indicate the corrective ratio required. Next multiply the previously computed difference by this corrective ratio and add the result to or subtract it from the limit stipulated in the contract. The result will be the corrected limit, from which must be subtracted the total cost so as to determine the amount of profit to be divided between the contractor and the client, as per the profit diagram.

In order to show the *modus operandi* of this method of profit-sharing, let us assume the following case, in which the estimated quantities are exceeded.

Lump-sum limit tendered $1,700,000
Value of total work done per unit-price list and clause re unclassified work 1,855,000
Total cost of work 1,575,500
Difference = $1,855,000—$1,700,000 = $155,000.
Ratio of difference = $155,000÷$1,700,000 = 0.091.

From Fig. 2 we find the "corrective ratio" to be 0.833; then the corrected difference = $155,000×0.833 = $129,115.

Corrected limit = $1,700,000+$129,115 = $1,829,115.
Profit = $1,829,115—$1,575,500 = $253,615.
Percentage of total profit = $25,361,500÷$1,575,500 = 16.1

From Fig 1, we find the division of this profit to be as follows:—

Contractor 9.4%
Client 6.7%

Total payment to contractor = 109.4×$1,575,500 = $1,723,597.

Now let us investigate a case in which there is a diminution in the estimated quantities of materials.

Lump-sum limit tendered $1,700,000
Value of total work done per unit-price list and clause re unclassified work 1,615,000
Total cost of work 1,310,000
Difference = $1,700,000—$1,615,000 = $85,000.
Ratio of difference = $85,000÷$1,700,000 = 0.05.

From Fig. 2 we find the "corrective ratio" to be 0.87, then the corrected difference = $85,000×0.87 = $73,950.

Corrected limit = $1,700,000—$73,950 = $1,626,050.
Profit = $1,626,050—$1,310,000 = $316,050.
Percentage of total profit = $31,605,000÷$1,310,000 = 24.1.

From Fig. 1, we find the division of profit to be as follows:—

Contractor 12.05%
Client 12.05%

Total payment to contractor = 1.1205×$1,310,000 = $1,467,855.

Advantages

The advantages of this method of contract-letting are as follows:—

First.—While it is true that the client at the outset does not know exactly what the work is going to cost him, he is positive that it will *not* cost him more than a certain amount, provided that his engineer's estimate of quantities of materials is about right, as, generally speaking, it certainly ought to be.

Second.—The client has the satisfaction of feeling that, even if, in his opinion, the limit bid by the contractor is excessive, and that the profit on the job in consequence, will be too large, the said profit will be shared between them on a fifty-fifty basis.

Third.—All the advantages of competitive bidding are retained by this method of tendering, because all that a bidder has to do is to name a limiting lump sum with certain unit prices, and to make sure that the latter, when properly applied to the quantities of materials given in the specifications, will produce a total value equal to the said limiting lump sum. All bids will be upon exactly the same basis, no modification of the stipulated method of tendering being permitted, hence the selection of the bidder will be governed solely by the lowest lump sum named, provided, of course, that the one tendering it possesses the necessary experience, capital, plant, and general reputation for doing good and satisfactory work.

Fourth.—The contractor, if he was not too keen in bidding, knows that there is almost no chance whatsoever of his losing money on the job, and that the harder and the more intelligently he works the greater will be his profit.

Fifth.—The division of total profit given in the profit diagram is eminently equitable, in that, when the amount is small, nearly all of it goes to the contractor, and, as it augments, a continually increasing proportion of it goes to

the client, up to the point where the total profit amounts to 20%, after which the partition is on a fifty-fifty basis. This point was selected as being the one above which a contract is generally deemed by contractors to be good, slightly below which it is only fair, and much below which it is bad; for it corresponds to a net profit of 10%. That is as small a margin as is generally deemed safe for any bidder to tender upon, and yet it constitutes a satisfactory profit on a finished job. As for limiting the client's share of the profit to one-half—that is reasonable and just, because he would have no moral right to receive more than his partner, the contractor. If the client's share were allowed to increase beyond the point of equal division, it is conceivable that, with a very large prospective total profit, the contractor could save money for himself by making the work more expensive.

Sixth.—The contractor will feel during the progress of the construction that the client is a partner on the job, and that, therefore, he and his engineers will not be likely to be unnecessarily severe in their requirements, also that they will permit the adoption of all legitimate expense-saving expedients, and will not demand too many frills on the finishing.

Seventh.—Owing to the justice and equity involved by this method of contract-letting and profit-sharing, all concerned in the execution of the work will labor whole-heartedly and good-naturedly, avoiding petty squabbles and disagreements of all kinds; and the result will be earnest, honest effort, a satisfactory piece of construction, and the general contentment of both parties to the agreement.

Adoption of Method

If this proposed method of contract-letting and profit-sharing be received with favor by engineers, architects, contractors and builders in general, it could easily be adopted as a standard for the country by calling a small convention with a single representative from each of the leading technical and railroad societies, contracting organizations, and bankers' associations, to discuss the advisability of adopting it (or else some slight modification of it) and to report the decision of the meeting to the said bodies for their approval. If any large group of clients, such as the railroad companies, were to adopt the method as standard and use it, very soon everybody having construction contracts to let would follow their example, thus making it the universal standard of contract-letting for our country—nor would it be long before other American countries would follow our lead, thus greatly simplifying our business relations with the various American commonwealths.—From "Contracting," of Chicago.

The Asphalt Association has opened a branch, or district, office in Washington, D.C., in charge of Maj. Harry D. Williar, formerly of the Maryland Road Commission and later with the Paving Commission of Baltimore.

The following resolution was adopted last month at the Canadian Mining Institute's convention in Vancouver: "That the formation of a Canadian Association of Engineers, for the purposes of social service, mutual protection and legislation is desirable and in the best interests of the public and of the profession."

The directors of the Engineers' Club, Toronto, have decided to increase the entrance fee from $50 to $100, effective January 1st. All applications received this month will be subject to the former rate. The directors announce that they have no intention at the present time of increasing the present annual dues.

The annual election of officers of the Toronto branch of the Engineering Institute of Canada was held last Thursday night at the Engineers' Club, Toronto, with the following results: R. O. Wynne-Roberts, chairman; executive committee—Geo. T. Clark, Thos. Taylor, Prof. C. R. Young and J. C. Krumm. W. S. Harvey was re-elected secretary, but as he has moved to the United States, his successor will be appointed by the executive committee. The new officers will assume office about January 20th, 1920.

THE RAILWAY SITUATION IN CANADA TO-DAY

WILLIAM FRANCIS TYE, formerly chief engineer of the Canadian Pacific Railway, addressed the Montreal branch of the Engineering Institute of Canada last Thursday, the title of his address being "The Railway Situation in Canada To-day."

Transportation, said Mr. Tye, is a more important question in Canada than in any other part of the world on account of its geographical position. The Dominion is divided into an eastern area, comprising Ontario, Quebec and the maritime provinces, and a western area including Manitoba, Saskatchewan, Alberta and British Columbia, the two areas being separated by long stretches of barren territory. In the west the products are mainly agricultural, which have to be transported east, whilst the manufacturing products of the east are carried to the western provinces.

Government Has Always Helped

There are 39,000 miles of railroad in Canada, giving one mile to every two hundred people. This is practically equal to Germany with her 75 million population, to India with 330 million, and nearly as much as Russia with 170 million. The rates are low, considerably lower than those obtaining in the United States, and the service is good.

From very early days the Federal government has always helped the railways. The first assistance was a grant of $35,000,000 and 18,000,000 acres of land given to the Canadian Pacific. Subsequently, the grant became 3,200 acres per mile for cheaper lines and 6,400 acres per mile to build. The third scheme conceived was the issuing of guarantee bonds, which was done on the theory that the guarantee would never be called upon, but the liability has proved to be tremendous. The guarantee on parallel lines, which was given later, appears to have been especially disastrous.

Why have the railways failed? asked Mr. Tye.

In 1906, all privately owned roads were prosperous; the C.P.R. and G.T.R. were rich, and the C.N.R., though not paying dividends, was doing well. Now the C.N.R. and G.T.R. are bankrupt, and only occasionally in late years have they earned the cost of operation of their roads.

There has been keen rivalry as to which should become the second transcontinental railway. Bond guarantees given by a liberal government enabled the G.T.R. to build 3,900 miles of main and 1,200 miles of side lines. Similar guarantees by a conservative government assisted the C.N.R. to extend their system from 2,000 to 10,000 miles. This rapid construction, and the way in which it has been carried out, has resulted in the bankruptcy of both railroads.

It has been said that "Railroads were opened first and built afterwards, i.e., in advance of civilization." This meant light revenues, and, of necessity, light expenses. Steep grades, few turnings, light rails, few terminals are necessary in building a new line in virgin territory. As the revenue increases, steam shovels can be employed to make big cuts and fills at a smaller cost than would have been incurred by using light equipment, new depots and sidetracks can be constructed, and the road can be made a good one. Heavy expenditure of money in the early stages of development is not justified, as the interest amounts to large sums. At 5% money doubles itself in fourteen years.

G.T.P. Too Expensive Construction

The Grand Trunk has always been accustomed to deal with the east, with Ontario, the United States, etc., having immense traffic, and there has always been need of heavier rails, more sidetracks, and more terminals to take care of this traffic. In expanding in the west, they have built a very expensive line, giving a fine road, with better grades than those obtained on the C.P.R., but their revenue has been insufficient to pay operating expenses and fixed charges. The parent company in the east have been getting into difficulties, and finally have had to give up the western line.

The Canadian Northern have a good western line, which has been paying well, but, desiring to become transcontinental, it has built east to a country already well served with railroads. To do so, it has had to parallel other roads to Montreal and Toronto, and has found it very costly to obtain proper terminals. The C.N.R. has a small yard in Montreal, but no freight yard, while the C.P.R. has some fifteen to twenty freight terminals in the city. The C.N.R. cannot hope to compete, as the public will not haul freight a long distance in order to reach a yard.

The C.N.R. commenced by buying old, poor-paying roads in Ontario and Quebec. The company have built north from Toronto, and, where a single track would suffice, there are now three roads; it parallels the G.T.R. from Toronto to Kingston. The C.P.R. also covers this area, and there exist one double and two single tracks, when one double track is amply sufficient to take care of the traffic. It has been proved that there is not enough traffic on the expensive line in Ontario, and the company has become bankrupt.

G.T.R. and C.N.R. Mistakes

The mistake of the G.T.R. has been the building of a main line in the west, which was not justifiable, and that of the C.N.R. the extension of its line east to traffic centres already occupied.

There would be no railway problem to-day had the government adopted a policy of this nature in dealing with these railroads: "The G.T.R. has a good eastern road, the C.N.R. the beginnings of a good western road. Let them get together and connect their roads. We will give money to assist them in carrying this out, and later, in developing their line to the Pacific Coast." Instead of this, the government aided the roads in parallel.

If the solution some years ago had been consolidation, still more is that the case now, with the extra roads in Northern Ontario. Another reason which has an important bearing on this question is the future return of the railroads to private ownership. The lines must be prosperous before any company will consider taking them over, and if the lines were consolidated, they would be in good physical condition. It is the best system in the east, with the G.T.R., C.N.R. and other government lines, and is very good in the west. It has the shortest line from Winnipeg to Toronto and Montreal, good grades, reasonable curves, and the easiest route across the mountains.

The railways are in a very unfortunate position financially. Statistics for the year ending June 30th, 1918, give the following data:—

Loss on old government railways	$ 5,800,000
Loss on C.N.R.	11,675,000
Loss on G.T.R. and subsidiaries	10,250,000
Total losses	$27,725,000

The interest on the Intercolonial at 4% and on the Transcontinental at 3% amounts to $11,000,000, giving a total of losses and interest payments of $39,000,000.

Summing up costs of government railroads, and figuring interest on these at another $11,000,000, the absolute total reaches a figure of $50,000,000. The net earnings for the year 1918 of the C.P.R., acknowledged to be one of the most successful railways, amounted to $34,500,000. The other railroads have to face a possible yearly deficit of $50,000,000—one and one-half times the earnings of the C.P.R. —and the problem to-day requiring solution is, How are they to continue and be made prosperous?

Must Increase Freight Rates

"First," continued Mr. Tye, "give an immediate and decided increase in freight rates. This will have a very slight effect on the cost of living. The cost of transportation in Canada is very cheap, indeed, and, compared with Australia, the rates in Canada are about one-third those obtaining in that country."

Reference was made by Mr. Tye to an article on "The Railway Problem," by C. W. Baker, published October 23rd, 1919, in the Engineering News-Record, of New York, in which a table was given showing the increase in cost price of an article when freight rates are increased 50%. This table is reprinted herewith.

It is admitted that an appreciable increase does occur on such articles as coal and grain where transportation forms a large part of the final cost, but in the case of clothing, shoes, sugar, butter, fresh meat, etc., if the freight rates are raised 50%, nobody would notice the subsequent difference in cost. Therefore, the first step towards a solution is to raise freight rates, independent of the fact whether the railroads are run by private or government management.

The second step towards solution is to decide whether the railroads shall be privately owned or owned by the government. Mr. Tye stated he knew of no railroad which was successful under government management except in Germany, and the success there was due to the reasons that the roads were built for a large population; that they were not run as commercial enterprises, but solely for war domination; and that the workers were employees of the state, and as such could not strike.

The Intercolonial had as much business per mile as the C.P.R., yet it had never earned interest, and only for two or three years has it earned sufficient money to pay operating expenses. Sir Henry Drayton and Mr. Ackworth, who were members of the Royal Commission appointed to inquire into the railway question, have stated. "We know of no democratic state where the railways are owned by the government but where politics have a large bearing on the railways and the railways a large bearing on politics." No man works for a government as well as he will for a private concern. The margin between success and failure is very slight, and this has been emphasized by Lord Shaughnessy in a speech delivered about a year ago. C.P.R shareholders paid $112 for $100 worth of common stock, and $31 was added from sur-

How a 50% Increase in Freight Rates From Marketing Centres to Consuming Centres in U.S.A. Would Affect Cost of Products

Refined oil, Tulsa, Okla., to Cleveland, 960 miles, rate 38.5c. per 100 lbs. An increase of 50% would mean 1.3c. per gallon.

Fresh meat, Kansas City to Pittsburgh, 898 miles, rate 52c. per 100 lbs. An increase of 50% would mean ¼c. per lb.

Cattle, Dallas to Kansas City, 484 miles, rate 33.5c. per 100 lbs. An increase of 50% would mean 1/6c. per lb.

Potatoes, Houlton, Me., to New York City, 567 miles, rate 30c. per 100 lbs. An increase of 50% would mean 8c. per bushel.

Lumber, Winona, Miss., to Philadelphia, 1,160 miles, rate 33c. per 100 lbs. An increase of 50% would mean 5.37c. per 1,000 ft.

Oranges, Palatka, Fla., to Pittsburgh, 1,121 miles, rate 62c.* per 100 lbs. An increase of 50% would mean 31c. per crate.

Grain, Fargo, N.D., to Chicago, 640 miles, rate 18.5c. per 100 lbs. An increase of 50% would mean 4.6c. per bushel.

Grain products, Chicago to Baltimore, 749 miles, rate 19.5c. per 100 lbs. An increase of 50% would mean 9.7c. per 100 lbs.

Butter, St. Albans, Vt., to Boston, 315 miles, rate 65c.* per 100 lbs. An increase of 50% would mean ⅓c. per lb.

Anthracite coal, Carbondale, Penn., to Springfield, Mass., 308 miles, rate $2.75 per gross ton. An increase of 50% would mean $1.23 per net ton.

Bituminous coal, Cresson, Pa., to Chatham, N.Y., 476 miles, rate $2.40 per gross ton. An increase of 50% would mean $1.07 per net ton.

Iron ore, Ashtabula, Ohio, to Latrobe, Penn., 170 miles, rate 93c. per gross ton. An increase of 50% would mean 46c. per gross ton.

* Rates in effect January 1st, 1919.

plus revenue, making $143 for a $100 share. Last Wednesday's quotation was $138. Seven per cent., which is the highest dividend paid on railway stock, only amounts to 2¼% on the cost of the railway system, or, taking the dividend at 10%, which includes interest on other branches of the company's affairs, the amount is 2½% on the total of the company's assets. In 1895 the company paid no dividend; in 1897, 2½%; in 1901, 4%; in 1904, 6%, and only in 1907, twenty-six years after formation, was the maximum dividend of 7% reached.

The difference between government and private operation is very large, and it is difficult to realize how government operation, pure and simple, can ever be a success. Drayton and Ackworth had proposed that a company, named the Dominion Railway, be formed, with the stock vested in the company, and managed by a self-perpetuating board of men unattached to any government Mr. Tye did not think there was enough difference between this arrangement and pure government operation to make it a success. One parliament cannot prevent another parliament following it from making changes, and the dangers inherent to government operation are inherent to this system also.

Government operation has been tried in the United States for two years, but the public are now clamoring that the railroads be turned back to private ownership. The only solution for Canadian railroads is to return them also to private owners, making compensation for the irreparable damage done to the roads by government operation. A new company should be organized to take the roads over as private concerns. Possibly the government would have to aid the private companies, but that would be better than a deficit every year. The solution of Canada's railway problem, Mr. Tye claimed, is (1) Increase the freight rates; and (2) return the railroads to private ownership.

ENGINEERING INSTITUTE ELECTIONS

AT a meeting of the Engineering Institute of Canada held November 25th in Montreal, the following elections and transfers were announced:—

Members.—P. L. Allison, Peterboro, Ont.; C. W. Dill, Regina, Sask.; G. R. Langley, Peterboro, Ont.; W. R. MacDonald, St. Catharines, Ont.; W. O. Marble, Vancouver, B.C.; J. W. Morrison, Dane, Ont.; P. B. Roberts, London, Eng.; E. R. Shirley, Peterboro, Ont.; C. E. Sisson, Peterboro, Ont.; C. W. Tarr, Windsor, Ont.; P. P. Westbye, Peterboro, Ont.

Associate Members.—G. B. Anderson, Ottawa, Ont.; Capt. B. L. Barns, Peterboro, Ont.; C. B. Bate, Ottawa, Ont.; C. H. Blanchard, Winnipeg, Man.; A. F. Bookhout, Peterboro, Ont.; J. S. Brisbane, Montreal East, Que.; Lieut. C. F. Corbett, Cardston, Alta.; W. F. Coutlee, Ottawa, Ont.; John Craig, Nelson, B.C.; J. W. Crashley, Toronto, Ont.; J. B. Croly, Vancouver, B.C.; S. L. Decarteret, La Tuque, Que.; Maj. Philip Earnshaw, Toronto, Ont.; Lieut. W. J. Fletcher, Windsor, Ont.; Maj. J. H. Forbes, Smith's Falls, Ont.; C. A. De W. Fowler, Armdale, N.S.; A. B. Gates, Peterboro, Ont.; T. E. Gilchrist, Peterboro, Ont.; A. J. Gray, Toronto, Ont.; Capt. E. K. Hall, Edmonton, Alta.; P. C. B. Hervey, Edmonton, Alta.; S. A. Lanzon, Toronto, Ont.; J. O. Martineau, Quebec, Que.; D. L. McLaren, Peterboro, Ont.; H. T. Melling, Regina, Sask.; Lieut. F. H. Palmer, Halifax, N.S.; Lieut. W. G. Perks, Peterboro, Ont.; W. J. Pickrell, St. John, N.B.; Lieut. G. C. Reid, Cobalt, Ont.; Charles Robertson, Peterboro, Ont.; Capt. H. L. Roblin, Red Deer, Alta.; N. D. Seaton, Peterboro, Ont.; C. V. Stout, Winnipeg, Man.; A. L. Sutherland, Peterboro, Ont.; H. H. Tripp, Edmonton, Alta.; A. S. Weekes, Edmonton, Alta.; George Blanchard, Port Arthur, Ont.; T. M. Jones, Toronto, Ont.; S. S. Kennedy, Winnipeg, Man.; S. D. H. Pope, Victoria, B.C.; J. A. W. Waring, St. John, N.B.

Associate.—G. C. McAvity, St. John, N.B.

Juniors.—C. T. Evans, Windsor, Ont.; R. E. Hinton, Peterboro, Ont.; E. L. Holmgren, Peterboro, Ont.; Lieut. H. A. Lynch, Ottawa, Ont.; R. D. McKenzie, Winnipeg, Man.; J. F. Patterson, Montreal, Que.; J. H. Reid, Peterboro, Ont.; L. De B. Roy, Ottawa, Ont.; C. B. Shaw, Hawkesbury, Ont.; R. E. Stavert, Peterboro, Ont.; Lieut. D. C. Wills, St. Catharines, Ont.; Maurice Cossette, Montreal, Que.; J. E. Lyon, Ottawa, Ont.; Stewart Schofield, Winnipeg, Man.; Capt. R. D. Thexton, Ottawa, Ont.

Transferred, Associate Members to Members.—J. N. Finlayson, Winnipeg, Man.; S. J. Fisher, Montreal, Que.; A. R. Greig, Saskatoon, Sask.; G. H. Herriot, Winnipeg, Man.; Maj.-Gen. G. B. Hughes, Derby, Eng.; Maj. W. G. Swan, Vernon, B.C.; F. B. Tapley, Moncton, N.B.

Transferred, Juniors to Associate Members.—Capt. F. X. Amos, Corinth, Ont.; Lieut.-Col. D. S. Ellis, Kingston, Ont.; J. M. Gibson, Toronto, Ont.; F. H. Hibbard, Sherbrooke, Que.; Lieut. S. E. McColl, Winnipeg, Man.; Ernest Peden, Montreal West, Que.; Maj. G. R. Taylor, Grafton, Ont.; E. E. Wells, Toronto, Ont.; Capt. Walter Youngman, Winnipeg, Man.; J. N. Aggiman, Port Alfred, Que.; G. M. Hudson, Montreal, Que.; B. L. Nares, Montreal, Que.; P. O. Spicer, London, Eng.

Transferred, Students to Associate Members.—Capt. A. L. Cavanagh, Winnipeg, Man.; L. G. McNeice, Wallaceburg, Ont.; Charles Bruce, Ottawa, Ont.; E. V. Gage, Montreal, Que.; E. P. Muntz, St. Catharines, Ont.; E. S. Smyth, Kitchener, Ont.

Transferred, Students to Juniors.—H. H. B. Loignon, Outremont, Que.; J. A. Vance, Woodstock, Ont.; A. P. Black, Toronto, Ont.

TOWN PLANNING IN RELATION TO INDUSTRIAL DEVELOPMENT

(Continued from page 525)

city. There is no denying the presence of certain flies in the ointment, so to speak, from a town planning viewpoint, but to those who have witnessed it, I think the view from the mountain top bears out the claim I have made—that it is possible so to plan a city that it may be an industrial centre and at the same time an attractive residential city. Were it possible to go back to the beginning, I would say that, looked at from the viewpoint of both manufacturer and the dweller, it would be advisable to set apart industrial areas wherein no dwelling should be built, and residential districts the doors of which would ever remain closed to industrial and commercial enterprises, but just how far town planners should be permitted to go in disturbing existing conditions, I am not prepared to say. I can see how they might easily defeat what I understand to be their aims—the development and betterment of the community.

What I have already said has dealt almost entirely with houses and workingmen. Before I close, let me suggest that town planning should, if it does not now do so, give quite as careful consideration to the laying out of the industrial areas as it gives to the residential sections. If a city desires new industries, or if it wants to see its existing industries prosper and expand, it must provide them with the proper facilities for doing business. In every city that I know of, heretofore when a new industry came along it was permitted to acquire a tract of land and locate its buildings regardless of what effect its actions would have on the industrial development of adjacent lands. The result is that we have more railway switches crossing the streets than would have been necessary had the industrial areas been properly planned in advance, while in some cases large tracts of land otherwise suitable for industrial purposes have been cut off from railway connections altogether, rendering them unsuited for factory uses, while they are practically useless for other purposes. These are conditions that exist right here in Hamilton, and to my knowledge in some other Canadian cities.

Care should also be given to the laying out of the streets in industrial districts. They should be so arranged as to lead to the commercial and residential districts by the shortest possible routes consistent with good town planning and the general scheme for the development of the community, for it is important that it should be made as easy as possible for the working people to get from the factory to their homes and from their homes to the factory, and it is equally important that the manufacturer should be able to

deliver his finished products as quickly as possible to the railway freight sheds or local distributors.

On the extent and nature of the town planning of to-day, to a very large measure depends the extent and nature of the future industrial development of every industrial centre. It would not be difficult to show that the industrial development of to-day has been very greatly influenced by the happenings of years ago. And so it will be always. Town planning and industrial development are very closely related.

THE FUTURE DEVELOPMENT OF THE SOUTH SHORE OF THE ST. LAWRENCE RIVER, OPPOSITE THE CITY OF MONTREAL

INCLUDED in the proposals of the Harbor Commissioners of Montreal for the development of Montreal Harbor is a bridge spanning the St. Lawrence river from the docks to a point on the south shore, crossing St. Helen's Island in midstream.

Ernest Drinkwater, consulting engineer, Montreal, in a report to the South Shore Board of Trade, comments on the present stagnation of the municipalities located on the south shore, owing to lack of transportation facilities, and strongly urges the commencement of work on this bridge, in order to provide labor to many grades of workmen now unemployed, and to assist in the development of the south shore territory. It will be noticed from the sketch that Mr. Drinkwater suggests that the southern half of the bridge be diverted to a point approximately 600 ft. down the river. Subsequent to the date of the first plan of the proposed bridge, the Harbor Commissioners have secured control over some 60 acres of property, 4,100 ft. long by 700 ft. in depth, which consists of the whole of the river frontage of the ordnance lands of the federal government. The suggested diversion gives direct access to this land, and unless the change is made, the railroad traffic will have to switch back in order to get to the river from; and that this will entail considerable interference with the proposed civic development of the south shore, is claimed by Mr. Drinkwater.

It will be observed that the Quebec, Montreal and Southern Railway and the old Grand Trunk and South Eastern Railways, whose rights of way are still available for use, can very conveniently connect with the proposed location. It is the earnest desire of those interested in the natural development of the south shore, to keep the railways on the river front as far as possible, and within those areas which will be reserved for the suggested future improvement of the south-east side of Montreal Harbor. Following is an abstract of portions of Mr. Drinkwater's report:—

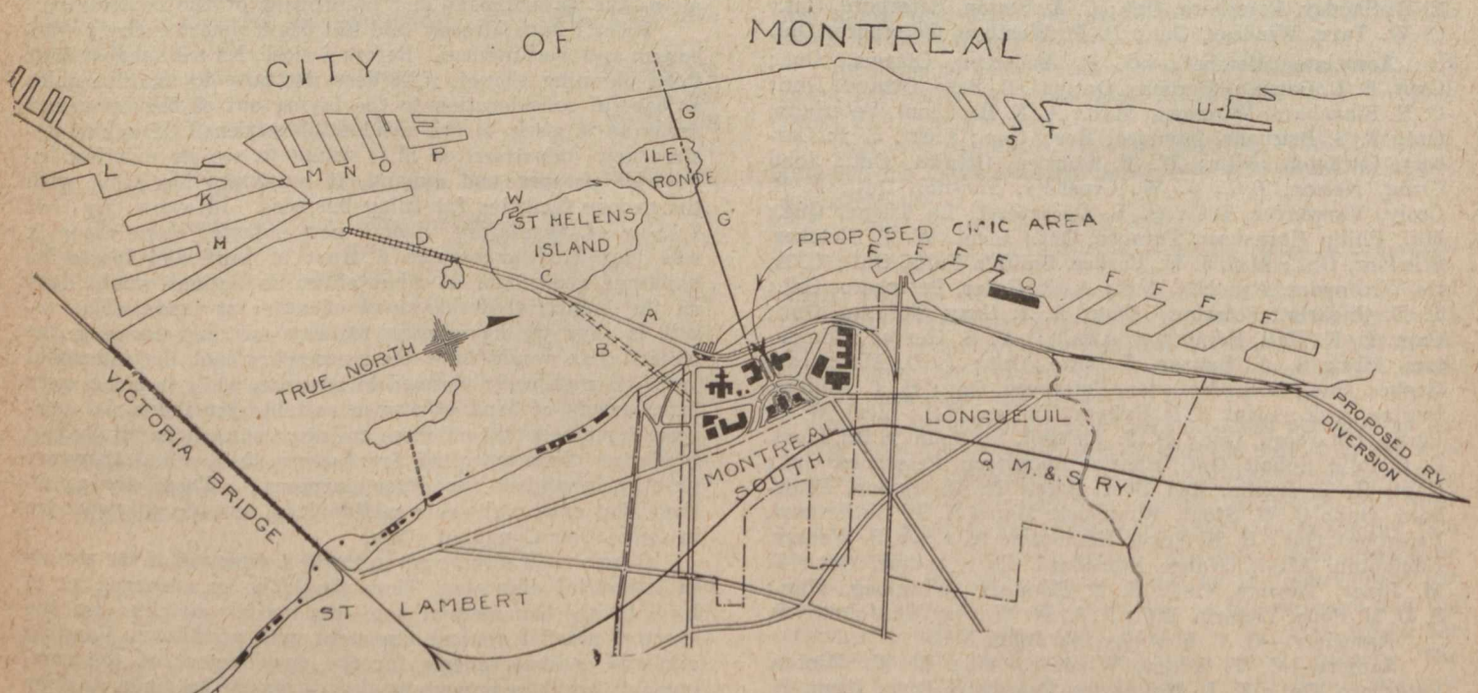
This bridge should be of sufficient width to give passage for all the public services, such as railways, tramways, driveway and footpath, electrical conductors, telephone wires and gas mains, and being built by public money, the public should be given the utmost service therefrom. Having more than a local importance, there should be organized immediately a board of engineers to direct the construction in conjunction with the Harbor Commissioners.

The condition of the south shore to-day shows that its development has been strangled by the lack of proper transportation facilities, and the exorbitant tolls charged over the Victoria Bridge by the Grand Trunk Railway. In addition to the steam railway track, this bridge only permits a single line suburban tramway service, a 3-ft. sidewalk and a 14-ft. driveway.

Vehicles must pass over the steam tracks in order to gain access to the driveway, and vehicular traffic suffers considerable delay owing to the heavy through traffic and shunting. The narrow width of this driveway is responsible for damages (from overhanging loads of other vehicles) often incurred by motor cars.

One of the objectionable tolls to be paid by the people on the south shore is $100 per year for a telephone wire passing over the mile and a quarter of bridge. This is an extra paid by the customer in addition to the service.

While these conditions exist, it is hardly possible that any general development can take place, and it is questionable if there is a parallel to this situation in any part of the world; that is to say, a district with so small a population, opposite a city approaching a million inhabitants, at the head of navigation of one of the largest rivers in the world, which has an ever-growing traffic. The whole of this district has a population of only about 12,000, with absolutely no harbor development and less river front activity than existed 70 years ago. Thirty millions have been spent to develop the Montreal side of the harbor during this period, and practically not a cent on the south shore. Seventy years ago there were three railways serving Montreal which had their terminal points on the south shore. On the building of the Victoria Bridge, the three lines were brought together, and taken over this bridge to the Island



PLAN OF MONTREAL HARBOR AND SOUTH SHORE, INDICATING SUGGESTED IMPROVEMENTS

B, C, D, Location for new bridge proposed by Harbor Commissioners; A, diversion proposed by South Shore municipalities; F, proposed docks; G, proposed tunnel (to Montreal central terminal); H, basin for inland and coasting vessels; K, Windmill Point basin; L, Lachine canal; M, N, O, P, S, T, docks; U, Vickers dry dock and shipbuilding plant; W, concrete ferry-wharf.

of Montreal. The south shore lost the advantage of these terminals, and thus the Victoria Bridge performed a two-fold purpose,—but to the detriment of the south shore.

The proposed new bridge will fulfil many functions for the general benefit of all. For the railways, it can be the means of connecting the two systems of the National Railways of Canada. The Canadian Northern section from the Mount Royal tunnel can pass over this bridge and join the Intercolonial system, the G.T.R. line to Portland the Central Vermont and the Quebec, Montreal and Southern Railway (D. & H.). All these railways could reach the business section of the city of Montreal and save a distance of five to seven miles, by making use of this bridge. The bridge would give the National, Transcontinental and Canadian Northern access to the United States, without having to go to the Quebec Bridge and come back to St. Hyacinthe, some 250 miles, and there is no doubt that the saving, to the Government railway alone, would go a long way towards payment of the cost of the bridge. To the city of Montreal it would reduce the delay on the many street crossings between Bonaventure and St. Henry.

The south shore is waiting to receive the suburban tramways service it requires in order to develop, as the distance to the centre of the populated area would be reached in seven to eight minutes from the foot of McGill St.

The people of the city of Montreal, and of the south shore, would have access every day of the year to the beautiful park in the centre of the river (St. Helen's Island), by tramway in a run of five minutes. This would save the city many thousands a year now paid for ferry service. The driveway would give vehicular traffic an entrance to the city of Montreal that would be a credit to the city and province, and obviate the present route, which the tourist traffic from the United States and the intervening part of the province have to follow to get into the city. The bridge could carry many public utilities to the advantage of the city of Montreal and the south shore.

Town Planning Needed Now

With the building of this bridge, there should be enforced upon the south municipalities a definite plan of development, as within two miles of the debouching point of this bridge, there are five municipalities, each composed of various subdivisions laid out without any regard to their neighbors, much less to the lines of communication with the adjoining municipality. There is only one direct means of communication between these municipalities, and that is the River road, which is impassable in the winter time, and, at the present time, this is the only road communicating with the site of the proposed bridge.

It is of urgent necessity that the South Shore Board of Trade should proceed with the proposition for the formation of the Town Planning Commission, in order to lay out the lines and method of rational development of the future city on the south shore. If this cannot be brought about by amalgamation, then the provincial authorities should step in and deal with the matter, as the present situation is impossible. Only one of the towns is zoned for trade, commerce and dwelling areas, and the lack of proper building regulations for the protection of the health and property of the residents exists in most parts of the district.

For the benefit of the towns themselves, and the province generally, it is urgent that immediate action be taken, before any general development occurs on the present lines of the layout of the district. If this is not done, it will cost millions in the future to do what can be better done for thousands now.

Suggested Civic Centre

With the amalgamation of these municipalities there is a site for a civic centre on the south shore end of the bridge, second to none in the Dominion. This property is owned by the Department of Militia and Defence, and has been lying idle for upwards of half a century. It has a frontage on the river of three-quarters of a mile, and an area of about 170 acres. In addition to having the largest frontage on the river of any lot in the county of Chambly, it is also one of the highest standing properties, considering its depth from the river, and on it could be grouped the city hall, court house, library, art gallery, hospital, market, armory and customs house. The whole could be given a setting that would compare favorably with the departmental buildings at Ottawa. The carrying out of a scheme as outlined and the construction of the bridge would assist in placing before the public a residential district, within a few minutes of the centre of the city of Montreal, which would have the added advantages of the country and a waterfront.

Dyke and Boulevard

If the federal government is desirous of finding work for the unemployed, there is no work that could be started of a more useful nature than on the bridge according to the adopted plans of the Harbor Commissioners. The building of this bridge will necessitate the opening of a channel, averaging approximately 2,000 ft. wide, and probably 18 ft. deep, and which is estimated to contain nearly 15 million cubic yards of material to be excavated. Half of this would build a dyke and boulevard, and form flood protection work 300 ft. wide from the Laprairie Dyke to the proposed new bridge. This material could be utilized to provide a magnificent boulevard, with areas reserved for all recreation purposes, at very little cost, as the dredging will have to be done, and the dyke is a necessity.

Opportunity for New Elevator

It has been stated that there is need in the harbor for another grain elevator, where railway cars, lake and inland navigation boats could be unloaded, and, at the same time, where ocean-going tramp and other ships could be loaded with grain in a few hours. With the railway facilities which will be available when the bridge is constructed, there is a splendid opportunity for the Harbor Commissioners to start the development of the hitherto neglected south shore by building a record-beating grain elevator of, say, ten million bushels. (See Q on sketch.) The Railway Board might consider commencing the work of preparing the existing rights of way and approaches to the new bridge. These are now available. On the development of a general city planning scheme, assistance might be received from the Provincial Department of Municipal Affairs to carry out some of the work of urgent necessity.

At a meeting of the Peterborough branch of the Engineering Institute of Canada, held last Saturday, the following officers were elected for the coming year: Honorary chairman, R. B. Rogers; chairman, Reid Munro, sales manager of the William Hamilton Co., Ltd.; vice-chairman, R. H. Parsons, city engineer; secretary, R. L. Dobbin, water works engineer; treasurer, D. L. McLaren; executive committee—E. R. Shirley, A. L. Killaly, G. R. Langely, C. E. Sisson, P. L. Allison and P. P. Westbye.

The people of the Border Cities in Ontario voted last Saturday to purchase the Sandwich, Windsor & Amherstburg railway from the Detriot United Railway, and to place it in the hands of the Hydro-Electric Power Commission of Ontario for operation and maintenance. In an interview with Sir Adam Beck last Monday at London, Ont., the "Hydro" chief pointed out that of the $23,000,000 involved in the proposed purchase of certain electric railway lines which will form the beginning of the Hydro-radial system of Ontario, the people have voted to buy or build more than $17,000,000 worth. Those which the people have voted for to date include the Toronto to St. Catharines line via Port Credit and Hamilton; the Welland and Bridgeburg line; the Toronto and Northeastern; and the Sandwich, Windsor & Amherstburg railway. The lines yet to be voted upon include the Toronto & Bowmanville railway and the line from Hamilton to Galt, Guelph and Elmira. The Sandwich, Windsor & Amherstburg railway will be the first radial to be operated by the Hydro commission, although a commission of which Sir Adam Beck is chairman and which is appointed by the London city council, operates the London & Port Stanley railway.

PIECE-WORK SYSTEM IN METER READING*

By J. A. A. Beaudin
Of Montreal Light, Heat & Power Consolidated

THE supply of public utilities involves the performance of numerous routine operations in the consumer's home by various categories of employees operating individually and without supervision.

The reading of meters in situ, the delivery of bills and collection notices, and the collection of arrears are a few of these operations.

Until recent years, and even nowadays, the general practice has been to remunerate employees engaged in these various tasks on a flat or fixed rate salary, based either on the hour, day, week or month, with additional privileges (in many cases) respecting sickness, holidays, etc.

Salaried Worker Leaves No Residue

This mode of remuneration makes possible the payment of wages for labor which has been only partially supplied, and since the actual supervision of his work is impracticable, the employee is tempted to take advantage of this condition occasionally, if not regularly, to limit his activities, and the means he may use to conceal his shortcomings are only limited by his ingenuity and his morality.

Furthermore, an employee working under this system of remuneration is inclined to complete indiscriminately each task as he encounters it, without any regard whatever to the amount of time and expense involved—i.e., he will often devote an unwarranted amount of time to straightening out a difficulty which if reported to the office could be handled much more expeditiously and economically by an expert. In other words, a worker on a fixed salary does not by-pass difficulties—he leaves no residue.

Piece-Worker Leaves a Residue

This state of affairs has led our company to devise and introduce a system of payment on a piece or commission basis as applicable to the various categories of these employees. This piece-work or commission system keeps the employee at his work, insures the full employment of his time, limits his absences from duty, prevents the payment of unearned wages, and regularizes the output—it helps get the work done regularly and systematically, but it leaves a residue.

The piece or commission worker is interested in handling a maximum of cases in a minimum of time, so naturally the tendency is to handle the straight-going jobs and by-pass difficulties whenever encountered, no matter what the employer's interest; the employee's interest is in the opposite direction, as every stop he makes to overcome difficulties limits his wages, hence while this system has removed the necessity for outdoor supervision, it has created a demand for closer indoor supervision over the work performed, and the piece-work system must be supplemented by a faithful follow-up system of by-passed jobs, without which it would prove a failure and cease to be economical and practical.

Workers Exchange Districts

The piece-work system only works advantageously in districts where the clientele is dense or semi-dense; it is not effective in districts where the clientele is scattered. The piece-worker is entitled to a supply of work commensurate with his capacity, and his work requires to be properly sorted and routed so that he may carry it on under advantageous conditions. The employer's interest also demands this in order to keep the piece-work rating at a minimum and at the same time afford the employee an opportunity of earning a fair remuneration thereunder. Failure to give proper attention to this detail would result in the establishment of a higher piece-work rating than would otherwise be necessary.

*Excerpt from paper read at the last annual meeting of the Canadian Gas Association.

Employees of the same category should all be on an equal footing and be given equal opportunities. They should permute periodically from one district to another in order that one and all may cover each district and the entire system in a given period. All districts do not afford similar or equal opportunities and no one should be allowed to work continuously in either a good, poor or medium district, but all should have their turn in each.

Activities Cannot be Limited

The piece-worker, although not a tracer, a trouble straightener or a worker fitted to operate in scattered districts, must be efficient and capable of discharging his duties in a competent manner and carrying to a satisfactory conclusion all work entrusted to his care. While he is quite within his rights in by-passing real difficulties and not spending his time in conducting long searches, etc., he must positively not be allowed to by-pass for trifling causes any of the work entrusted to him.

It is not desirable to limit the activities of a piece-worker with a view to securing work of a higher standard, as he cannot fairly be retained in service without sufficient work to keep him employed, and even if allowed to go off duty as soon as he has performed his limited task, he will work just as hastily in order to get through and go off duty, and the employer's very object—viz., to cause him to move more slowly and perform work of a better quality, will be defeated; furthermore, the resultant limitation of his earning power is likely to cause the piece-work rating to go up. An energetic piece-worker with a large working capacity will earn "record" wages when supplied with unlimited work and will indirectly contribute to the maintenance of an economical and moderate piece-work rating. Furthermore, the employee who earns large wages will have every inclination to perform his work in accordance with instructions—his very interest in his position is the best guarantee to be wished for in this connection. A proper inside supervision over the work involved in the completion of by-passed jobs, as reported by the piece-worker from time to time, affords the employer a still further protection. This inside supervision is a most important feature of the piece-work system and must be exercised with constant vigilance.

Having now dealt with the economic aspects of the piece-work system, it may be of interest to outline briefly its operation in our company, especially as applied to our meter readers.

Saturday Devoted to "Pick-Ups"

We supply "dual service" (gas and electricity) and issue part of our bills on a bi-monthly basis and part on a monthly basis. The ordinary gas and electric lighting consumers are billed bi-monthly, while the larger consumers and all electric power users are billed monthly. Our territory is divided into meter reading districts and the work distributed in accordance with schedules, so that the readings repeat themselves on about an even calendar date in each district. Twenty-two men take care of our meter reading on a piece rating per meter. These men work five days per week on regular readings; every Saturday morning is devoted to each man "picking-up" the readings which he has by-passed for various reasons during the current week. This "picking-up" work is done at the regular rating for current readings. After the completion of this "picking-up," the residue of by-passed readings reported to the office represents only such cases as present unusual obstacles. The fact that each meter reader must appropriate a certain amount of time to "picking-up" his own by-passed readings is an added protection against by-passing for trifling causes. When reading meters in a district where the clientele is scattered, the meter readers are paid an additional flat rate sum per district; this rate varies from 50c. to $2.00 per meter book. A somewhat similar system is in vogue in connection with power and special clients billed monthly, as such customers are limited in number and distributed all over the system. In addition to the regular staff two special meter readers are also employed on a combined fixed salary and piece-work basis to take care of readings by-passed by the regular readers.

The Canadian Engineer

Established 1893

A Weekly Paper for Civil Engineers and Contractors

Terms of Subscription, postpaid to any address:

One Year	Six Months	Three Months	Single Copies
$3.00	$1.75	$1.00	10c.

Published every Thursday by

The Monetary Times Printing Co. of Canada, Limited

President and General Manager JAMES J. SALMOND

Assistant General Manager ALBERT E. JENNINGS

HEAD OFFICE: 62 CHURCH STREET, TORONTO, ONT.

Telephone, Main 7404. Cable Address, "Engineer, Toronto."

Western Canada Office: 1206 McArthur Bldg., Winnipeg. G. W. Goodall, Mgr.

PRINCIPAL CONTENTS

"CLOSING" THE PROFESSION IN ENGLAND

IN view of the fact that the Engineering Institute of Canada and the Joint Committee of Technical Organizations have recently drafted proposed legislation defining the status of the engineer in Canada, it is of interest to note that a Bill will be introduced in the next session of the British House of Commons to regulate and to establish registration for the civil engineering profession. The principal provisions of the Bill are as follows:—

By "civil engineer" is meant a person competent in the art described in the Royal Charter of the Institution of Civil Engineers of 1828 and its subsequent development through the advance of science. The definition of the profession of civil engineering is generally attributed to Thomas Telford, the first president of the institution, and reads as follows:—

"The art of directing the great sources of power in nature for the use and convenience of man, as the means of production and of traffic in states both for external and internal trade, as applied in the construction of roads, bridges, aqueducts, canals, river navigation and docks for internal intercourse and exchange, and in the construction of ports, harbors, moles, breakwaters and lighthouses, and in the art of navigation by artificial power for the purposes of commerce, and in the construction and adoption of machinery, and in the drainage of cities and towns."

The register as first established would contain: (a) All corporate members of the Institution of Civil Engineers and of the Institution of Civil Engineers in Ireland; and (b) other persons who are engaged as civil engineers and are members of important engineering societies; or who, although not members of such societies, have been engaged in civil engineering practice for a substantial period.

It is proposed that there be a time limit for the application of these conditions to the formation of the register. For the purpose of determining the elegibility of engineers in the second group, a tribunal is to be established upon which the important engineering societies are to be represented, and by means of which the interests of their members who are civil engineers will be safeguarded.

ECONOMICS OF PLACING CONCRETE

MOST engineers agree that in order to use concrete towers and spout the mixed materials long distances, the mixture must be wetter than good practice would dictate. The work of Professor Abrams at the Lewis Institute, Chicago, has brought to the attention of the engineering profession more sharply than ever before the harmful effect of excessive water upon the strength of concrete. It is generally conceded that in order to use towers, from 30% to 50% more water must be used than if the materials are placed by other means. With this in mind, owing to the detrimental effect of too much water upon the strength of concrete, several construction companies have practically tabooed the use of towers.

Engineering opinion appears to have been modified somewhat upon this point during the past year, however, and it is becoming more clearly recognized that the whole problem is one of economy, and that towers are justifiable if by their use money can be saved in placing the concrete, provided that the proper cement-water ratio is adhered to at all times. Many engineers to-day are saying to their contractors:—

"Use towers if you wish, but you must keep the cement-water ratio constant. When you add more water in order to use your chutes, you must add sufficient extra cement to maintain the same cement-water ratio. If the use of your towers saves you more money than the extra cement costs, you are wise to use towers; but if the cost of extra cement is much greater than the additional cost of getting the concrete into the forms in some other way, it would pay you to abandon your towers."

PERSONALS

J. G. SULLIVAN, consulting engineer, Winnipeg, has been elected as a member of the Winnipeg city council.

C. F. GRAY, electrical engineer, Winnipeg, Man., has been re-elected mayor of that city by more than 2,500 majority.

SIR ADAM BECK, chairman of the Hydro-Electric Power Commission of Ontario, expects to sail on Saturday next for England, on personal business.

J. M. STEVENSON, of Calgary, who recently returned from overseas, has been appointed resident architect at that city for the Public Works Department of the Dominion government.

HON. LIONEL H. CLARKE, who was recently appointed lieutenant-governor of the province of Ontario, has withdrawn his resignation as chairman of the Toronto Harbor Commission and has agreed to continue in that office at the request of the other members of the commission.

ROBERT FLEMING, civil engineer, of Aberdeen, Scotland, has joined the financial firm of J. & L. M. Wood, which will hereafter be known as Wood, Fleming & Co. Mr. Fleming served with the Canadian forces overseas. For several years prior to the war he was a railway contractor in this country.

STUART S. SCOVIL, of the Dominion Water Power Branch, Ottawa, has been appointed engineer in charge of the hydrometric surveys in the province of Ontario, and JAMES R. BISSETT, of the same branch, has been appointed assistant engineer. This work in Ontario has formerly been taken care of by the Hydro-Electric Power Commission, but by arrangement with that commission it will be done in the future by the Dominion Water Power Branch, whose records will be used by the commission.

A. H. HARKNESS and R. E. W. HAGARTY, Toronto, have been appointed joint consulting engineers for the proposed

18-story addition to the King Edward Hotel, Toronto. Watt & Blackwell, of Toronto, Ont., have been retained as associate architects to prepare the plans for the United Hotel Co.'s architects, Essenwein & Johnson, of Buffalo, N.Y.

LT.-COL. DOUGALL CARMICHAEL, minister without portfolio in the recently elected Ontario cabinet, has been appointed by the provincial government as its representative upon the Hydro-Electric Power Commission of Ontario. Hon. I. B. Lucas retains his seat on the commission for the time being at least, so that at present all three positions on the commission are filled, Sir Adam Beck remaining as chairman.

CHARLES SUMNER LUND HERTZBERG, who was recently relieved of his military duties after having been in the army since December, 1915, has returned to private practice in Toronto and, in partnership with Thomas R. Loudon, has formed a new firm, Loudon & Hertzberg, consulting industrial and structural engineers. Mr. Hertzberg was born June 12th, 1886, in Toronto, and was educated at the Toronto public schools, St. Andrew's College (Toronto) and the School of Practical Science, University of Toronto, from which he graduated in 1905, taking a post-graduate course in 1905-6. Having spent his summer vacations on C.P.R. location work, he joined the staff of that railway in the fall of 1906 as a transitman on maintenance. He was employed in 1907 by the Trussed Concrete Steel Co., in their Toronto office, as a draftsman and designer. In the latter part of 1907 he joined the construction staff of the Concrete Engineering Construction Co., but returned to his previous position with the Trussed Concrete Steel Co. early in 1908. A few months spent on electric railroad maintenance with the Dominion Power & Transmission Co., Hamilton, Ont., intervened prior to his appointment, in the spring of 1909, as chief engineer of the Trussed Concrete Steel Co. at that company's office in Walkerville, Ont. In 1911 Mr. Hertzberg joined the Bishop Construction Co. as Toronto manager, and in the following year became a member of the firm of James, Loudon & Hertzberg, consulting engineers, Toronto, and was engaged in structural and municipal undertakings until he joined the Engineering Training Depot at Ottawa in December, 1915. On New Year's Day, 1916, he sailed for England as lieutenant in charge of a reinforcement draft, and in England he was assigned to the 7th Field Company, Canadian Engineers. That company crossed to France in April, 1916, and Mr. Hertzberg continued with them until he was wounded in January, 1917. In Corps Orders of December 5th, 1916, he was gazetted to receive the Military Cross for his work on the Somme. Invalided to Canada in July, 1917, he became adjutant at the Spadina Ave. Hospital, Toronto, and was promoted to captain and officer commanding casualty company. He was transferred to No. 2 Service Company in July, 1918, and in September, 1918, he joined No. 16 Field Company, Canadian Engineers, at Brockville, Ont., as second in command. Mr. Hertzberg went to Siberia with No. 16 Field Company, sailing from Vancouver October 11th, 1918, and at Vladivostok he was attached to the force commanded by Major-General Elmsley. Mr. Hertzberg's company was the only engineering unit with the force, and it was employed on water supplies, the construction and repair of barracks, the repair of roads, and other work. In April, 1919, Mr. Hertzberg was placed in command of the company, with the rank of major. Two months later he returned to Canada with the headquarters staff of the expeditionary force.

J. DUCHASTEL DE MONTROUGE, who was recently nominated for a vice-presidency of the American Road Builders' Association, has been notified that he has been elected vice-president of the Northeastern District of that association. Mr. Duchastel is a past president and director of the Canadian Good Roads Association.

WILLIAM GORE, of Gore, Nasmith & Storrie, consulting engineers, Toronto, has sailed for England on a business trip, which is to include an investigation of the latest developments in the treatment of trade wastes and sewage disposal.

J. E. MILNE, municipal engineer of Burnaby, B.C., has been selected by the Saanich municipal council, Vancouver Island, as municipal engineer for that district. Mr. Milne was in the Canadian army during the war, and since his return from overseas has been with the Burnaby municipality.

ROBERT VERITY, of Toronto, a well-known labor contractor who has supplied upwards of 100,000 men to contractors and manufacturers in Ontario during the past sixteen years, will said for England next week in order to investigate the prospects for increasing immigration during the coming year. Mr. Verity expects to return to Canada in February.

WILLIAM R. WORTHINGTON, engineer of sewers, Works Department, city of Toronto, has resigned and will enter private practice in Toronto. Mr. Worthington is a civil engineering graduate of the University of Toronto, class of 1905. During his summer vacations, while at the university, he was connected with the Roadway Department of the city of Toronto, and after graduation he was appointed assistant sewer engineer. In 1912 he was appointed engineer in charge of the sewer section. During his tenure of office the sewer section has carried out work costing nearly $8,000,000 and has made several reports on proposed schemes, including sewage disposal for the entire city and sewerage scheme for North Toronto. Besides the amount above mentioned, Mr. Worthington also supervised the expenditure of large sums annually for the maintenance of the entire sewerage system of the city. During the absence of F. A. Dallyn, provincial sanitary engineer, who went to Siberia last fall with the Canadian expeditionary force, Mr. Worthington acted as consulting engineer to the Ontario Board of Health.

OBITUARY

STEPHEN PEARSON BROWN, formerly chief engineer of the Mount Royal Tunnel & Terminal Co., Ltd., Montreal, was drowned last Sunday in Sebec Lake, Maine. Mr. Brown was pulling his nine-year-old son on a sled when the ice broke under him and he sank before the boy could summon help. Mr. Brown was about forty years of age. He was a graduate of the Massachusetts Institute of Technology, and before going to Montreal had been associated with the construction of the Pennsylvania Tunnel in New York City. He went to Montreal in 1912 in charge of the Mount Royal Tunnel project and superintended the design and construction until the work slackened in 1916, when he returned to the United States as vice-president and manager of Ford, Bacon & Davis, a well-known firm of engineering contractors of New York City. Mr. Brown continued to act in a consulting capacity in regard to the Montreal terminal work for the C.N.R., and was expected in that city this month on business in connection with the C.N.R. enterprise. From 1915 to 1917 he was a member of the council of the Canadian Society of Civil Engineers. Mr. Brown was also a member of the Institution of Civil Engineers of Great Britain, the American Society of Civil Engineers and numerous other engineering, railway and scientific societies.