PAGES

MISSING

# The Canadian Engineer

*A weekly paper for Canadian civil engineers and contractors*

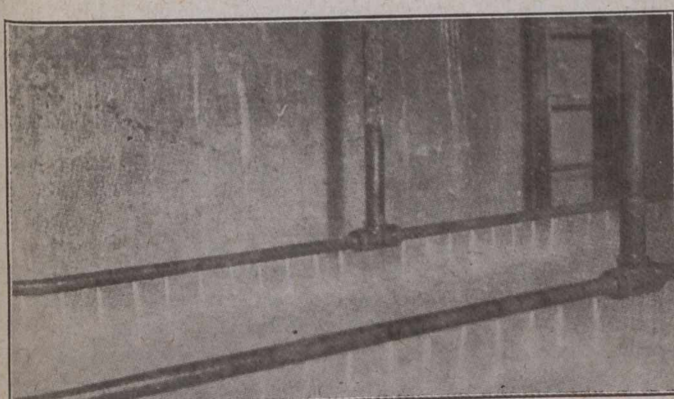

## ACTIVATED SLUDGE PLANT AT EDMONTON

### DETAILS OF AERATING CHAMBER, MOTOR EQUIPMENT, AND AIR PLANT —ACCOUNT OF EXPERIMENTAL WORK BEING DONE IN WESTERN CITY

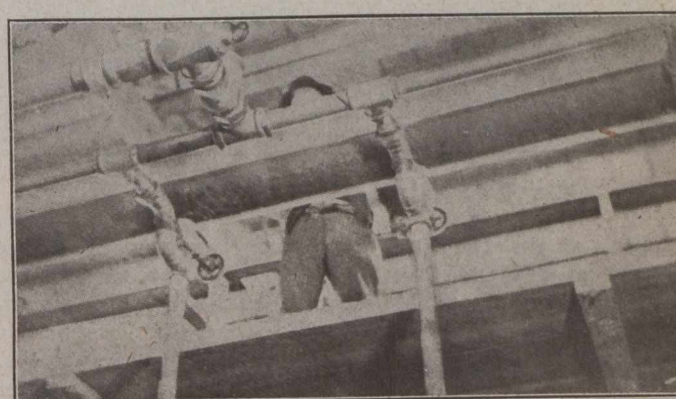
THE following facts concerning the experimental work being done at Edmonton, Alta., in connection with the activated sludge process of sewage disposal are taken from a pamphlet on the subject recently issued by Geo. T. Hammond, engineer in charge of the Sewage Experimental Station, Brooklyn, N.Y.

The plant at Edmonton was designed about two years ago when little was known about the activated sludge process, and as the plant was not solely for experimental purposes the precaution was taken of building an Imhoff tank alongside of the aerating tanks.

The following data concerning what is known in Edmonton as the Ross Flats sewage disposal plant were furnished by Mr. A. W. Haddow, acting city engineer, and used in the pamphlet referred to.



Showing Flush-water Passing Through Apertures in Bottom of Air Supply Grid.



Showing Connections at Top of Air Pipes.

The system is combined and has a contributing area of 294 acres with a population of 4,500. The dry-weather flow averages 33,600 cubic feet per day.

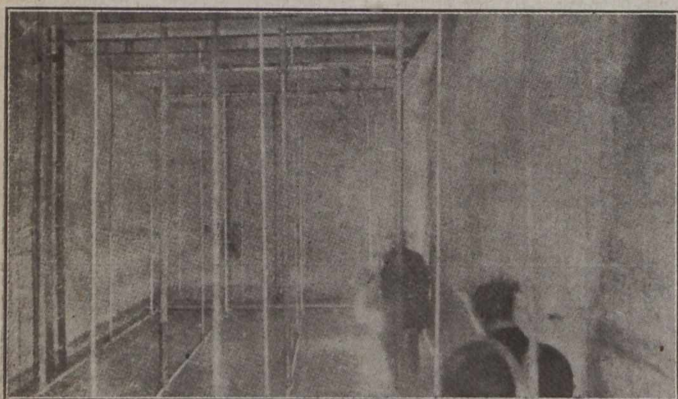
The maximum storm flow to be treated is 54,000 cu. ft. per day, equal to 75 Imperial gallons per head of population. The balance will overflow into the North Saskatchewan River through the present outlet. The nature of the sewage is non-septic with very little trade waste. All contributing sewage has to be pumped and enters the pump well through a cage for rough screening. This cage can be lifted to the floor level of the pump-house when it is necessary to be cleaned. There is no suction lift, and the maximum force lift from the bottom of the well to the baffling chamber is 45 ft. The pumping equipment consists of one 4-inch single-stage, vertical spindle, centrifugal pump, electrically driven, and automatically controlled by a float. Capacity under trial was 60 cu. ft. per minute pumping against an average head of 42 ft. plus friction. One duplicate pump complete in all respects is held ready for emergency service.

The motor equipment consists of one 11-h.p. motor directly connected to each pump. The power consumed is 4 kw. per hour, which equals 1⅓ kw.-hour per 1,000 cu. ft. pumped.

The aerating chambers, which were originally designed for live earth beds, number six. The fill-and-draw principle is used, but changes could easily be made by which the continuous-flow principle could be used. The length of these chambers is 44 ft. with a width of 10 ft. and a depth of 8 ft. The depth of sludge is about 2 ft. and capacity of each 3,420 cu. ft. The working capacity above sludge is 2,500 cu. ft.

The Imhoff tank referred to was originally designed at a suitable elevation to take effluent from what are now the aerating tanks. It is now being used for independent experiments and takes part of the raw sewage direct from the grit chamber. It could take effluent or sludge from aerating tanks if it was ever decided to try such an experiment. At present the effluent goes direct to the river. This Imhoff tank has a total depth of 21 ft. The capacity of the flowing-through chamber is 3,780 cu. ft., while the capacity of digestion chamber is 6,340 cu. ft.

**The Air Plant and Air Distribution.**—For this there is used one Connersville high-pressure blower, size No. 31. The capacity of this blower against a working pressure of 3½ pounds through a 4-inch discharge is as follows: Low speed (255 r.p.m.), 180 cu. ft. of free air per minute; high speed (330 r.p.m.), 240 cu. ft. of free air per minute. The maximum may be increased later by altering the belt drive. The blower has capacity to spare for the one tank in operation, but a blower of a larger size will be ordered if all the tanks are fitted up for aeration, when the present blower will act as a spare. The air-main along the centre of the tanks has been started off at 10-inch diameter in view of this. This 10-inch main is of cast iron, as we find it best for tapping and making tight connections for the down pipes. The tank under experiment has four 1½-inch down pipes, with a valve and a Dart union below the valve on each pipe. They are placed at 30-inch centres and branch into two 1-inch pipes at the bottom of the tank, one running towards each end, where they are plugged. Each down pipe with its two branches is an independent unit, and by unscrewing the Dart union, it can be lifted for examination without interfering with the blowing on the other three pipes. The two branches are supported from channel-irons by means of six ⅜-inch hollow rods (pipe) which, by means of a thread and nut give a slow-motion control of the air pipe. We find that after the air pipes have been set dead level that we have both to raise and to lower them by means of this nut to obtain perfect air distribution. We cannot give any reason for this. The air pipes have ⅛-inch holes drilled on the under side at 3-inch centres. We find this gives better distribution than drilling on the top or on the sides. So far the resulting air distribution is excellent. However, no sludge is yet accumulated, but we have taken precautions to obviate trouble from this source. Each down pipe is connected below the valve and above the Dart union to a branch from a 3-inch high-pressure water main (100 lbs. per sq. in.) for flushing purposes. These four water branches are controlled by a single valve. In addition, the water can be shut off by a main valve, and steam admitted through the same piping. Provision is made for expansion on this account. Then, as already stated, each air-line can be lifted independently and cleaned if the water and steam are not sufficient. A check valve is introduced on the main air feed near the blower to prevent water getting into the blower in case of carelessness in operating the valves.



**Activating Tank Showing Air Supply Grid.**

**General.**—The whole plant is housed in on account of the low temperatures experienced in winter; 10 to 20 degrees below zero is not uncommon, and we sometimes have it as low as 40 degrees below zero, usually at night. The machinery hall at least will have to be heated in winter, and we are inclined to think that this will prove a considerable added expense, on top of others necessitated by the aerating process. The North Saskatchewan River, into which all our sewage discharges, has a dry-weather flow of about 1,000 cu. ft. per second, and is rich in free oxygen. In summer the flow is very much larger.

---

The United States Consul at Barcelona states that careful estimates place the quantity of unmined iron ore in Spain at 700,000,000 tons, with an average content of about 50 per cent. of metal.

## CONSTRUCTION AND MAINTENANCE OF CATCH BASINS.

SOME few weeks ago a discussion on the subject of catch basins, their construction and maintenance, took place before the Sanitary Section of the Boston Society of Civil Engineers. The discussion was opened by Mr. George A. Carpenter, city engineer of Pawtucket, R.I.

Mr. Carpenter's introductory paper dealt largely with the method of cleaning catch basins. For several years he endeavored to discover some form of basin construction that would lend itself to better and more economical cleaning methods, or some more satisfactory way of cleaning the type of basin already in use. About four years ago employees of Pawtucket developed the idea of a power hoist on an automobile truck for lifting the material from catch basins. This has been improved upon, and the contrivance now used consists of a Standard chassis with a 32-horse-power engine, carrying a steel body, 9 feet by 4¼ by 2⅓ feet high. Cover plates two feet wide are placed over each end to prevent the load slopping out. The capacity is 3.4 cubic yards, and the average load carried has measured about 2.6 cubic yards and weighed about 3.4 tons. The tail board is hinged at the top to facilitate dumping and is provided with a rubber gasket so that it can be clamped tight against the body. Dumping is effected by a hydraulic lift.

Back of the driver's seat are mounted two 6-inch "I" beams, and on these is a 2-horse-power Fairbanks-Morse gasoline engine, cable drum and control mechanism. The cable runs to an outrigger, which can be swung over the catch basin and back over the cart. (The 2 horse-power engine is to be changed to a 4-horse-power, as the former is found lacking in power for the heaviest work.)

The bucket first used was a plain cylindrical one, 14 inches in diameter and 17 inches deep, and was filled by hand by a man in the basin. Since November, 1913, an orange-peel bucket has been used. This was operated by oil under a pressure of about 100 pounds per square inch, but recent experiments have indicated that by using compressed air in place of oil the time of loading can be materially reduced. Under the old method of cleaning basins, before the truck was used, the average time of loading was 40 minutes per cubic yard and the average time of hauling 3,500 feet was 35 minutes. When the truck was first put in operation with a bucket loaded by hand, the average output was 13 cubic yards per day of nine hours, which was increased to 23.4 cubic yards per day; and experiments with compressed air indicate that this can be increased to 31.2 cubic yards. In hauling the load, the truck has averaged eight miles or more per hour. Mr. Carpenter believes that with air in use the city will be able to average 2.6 cubic yards every 45 minutes delivered to a dump 1¼ miles distant, or an average hourly output of 3.455 cubic yards. Allowing interest at 4 per cent. on the cost of the truck ($4,200), with depreciation and repairs at 20 per cent. and a new set of rear tires every year and of front tires every two years, with labor at $12 a week, gives a cost per cubic yard of 75 cents, as compared to $1.80 under the old method.

As to the form of catch basin, the one used in Pawtucket has its bottom half practically the same as that used in most of the other cities, consisting of a circular well with a concrete or stone slab bottom, the well being

4½ to 5 feet in diameter and from 4 to 5 feet deep below the outlet. Practically all of the cities use some sort of trap over the outlet, the object of which is apparently more to keep sticks and other floating matters out of the sewer than to prevent the entrance of sewer gas; although the latter is considered, and in some cases special provision made for it. The Coleman trap was used in Pawtucket some years ago, but Mr. Carpenter finds that the inlet is small and so constructed that small sticks, leaves and other floating matter readily enter and often produce a complete stoppage; and when frozen slush enters a basin in winter, this form of trap is easily clogged and difficult to relieve. These objectionable features were partially overcome by the addition of a galvanized iron hood over the opening to the trap. Finally, the trap was removed and the hood alone used in the later manholes, the hood being made of cast-iron. Some basins have been constructed and have been in use for years without giving trouble, in which a regular "S" trap is placed just outside the basin, the inlet being protected with a cast-iron hood.

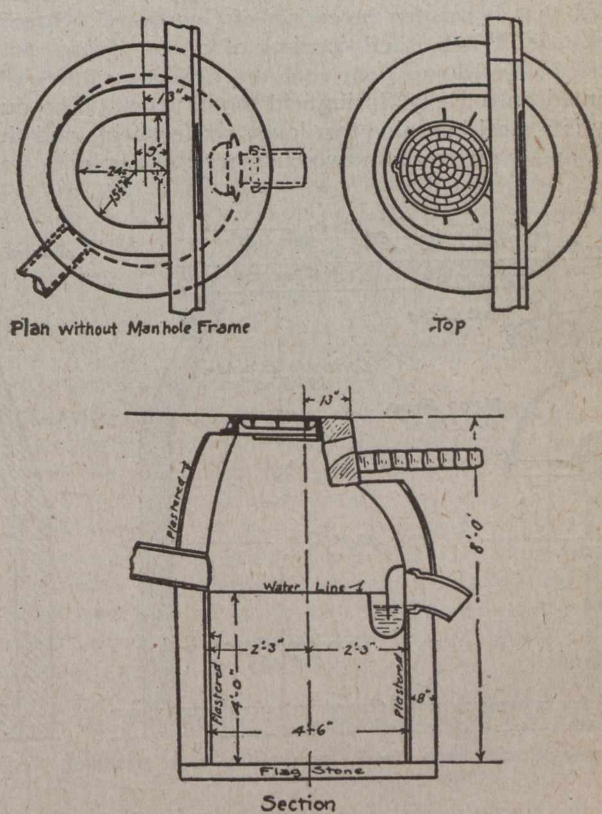
Still another device used in Pawtucket was building the lower part of the basin of two concentric rings of brick, with a 2-inch space between them, and the inner ring built of soft, porous bricks. A pipe leading to the sewer was carried through the bottom of the outer ring, thus draining the space between the rings, and causing a partial drying of the dirt in the basin, the moisture from which passes through the inner ring of brick.

Concerning the top of the basin, Mr. Carpenter believed that great improvement has been made by substituting cast-iron for the heavy stone tops used a few years ago. The heavy granite head was very expensive, and occupied a considerable space in the sidewalk, whereas, with the cast-iron head now adopted in Providence and a number of the other cities, nothing but a light iron cover about two feet in diameter shows on the surface of the sidewalk. Another improvement is in the location of the basin. Instead of placing these at the intersection of the curb lines, the basin is located above the cross walk on one street, and an additional inlet or chute is located on the other street above the other cross walk and connected with the basin. Where corner basins already exist, the old entrance to the basin can be closed and two plain inlets be constructed, one on each street, connected to the old basin.

"When planning catch basin openings and connections, the speaker has often felt the lack of sufficient data relative to the approximate amount of storm water that will pass a given opening in the curb, and also the maximum quantity that will pass the form or trap and connection used. Inlets through the curb, of the form illustrated, generally measure about 4 inches by 24 inches, 4 inches by 30 inches, or 4 inches by 36 inches, as the location seems to demand. Eight-inch, 10-inch or 12-inch pipes are used for connections between the basin and the sewer, as the engineer's judgment dictates. The speaker raises the question, Would it not be well to have more definite data than we at present possess respecting the relative capacity of various inlet openings, traps and sewer connections? Investigations along this line might be made with profit?"

Mr. Carpenter does not use or like the gutter inlet, but prefers the curb opening. He finds among other things that the gutter inlet is very apt to become clogged with leaves, stones and other matter from the streets. Most of the New England cities referred to in the discussion, however, seem to make more or less extensive use of the gutter inlet.

In Cambridge the "D" frame and grate are used, with the straight side of the "D" against the curb. The Cambridge frame and grate weigh about 65 pounds and cost about 12.50 per set. They find that these are liable to clog in time of storm, for which reason a slot or throat is cut in the face of the curb, back of the grate. The trap used is a cast-iron hood which can be lifted up for cleaning out the pipe, the entire trap costing about $5, and including a metal valve that opens outward toward the sewer to shut out sewer gas in case the water falls below the hood. One unusual feature of the Cambridge basin is the size of the outlet pipes, which were built some years ago of 10-inch pipe, then of 8-inch, and 6-inch pipe is now being used, and City



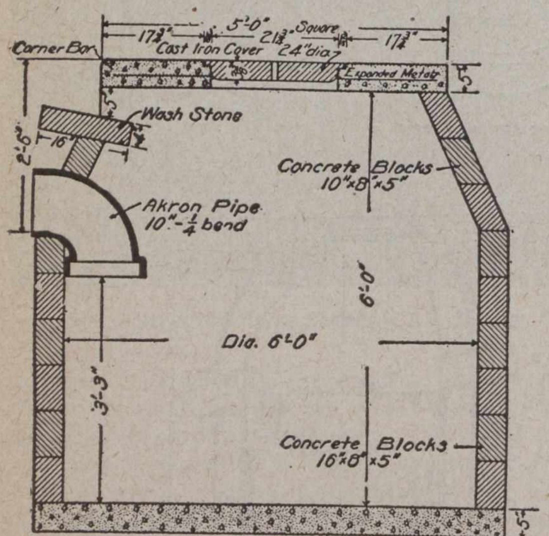

**Details of Catch Basins as used in Providence, R.I.**

Engineer Hastings states that he has never heard of one of these being stopped up on account of its small size. As stated above, although there are 2,260 basins in the city, the number of cleanings last year was only 1,128, and these averaged 2.1 cubic yards per cleaning, which is about the capacity of the catch basin. The cost of cleaning was $6.48 per basin, or $3 per cubic yard. This cost has increased during the past ten years from $2.58 per basin, or $1.44 per cubic yard, while the number of cleanings has decreased from 2,340 to 1,128.

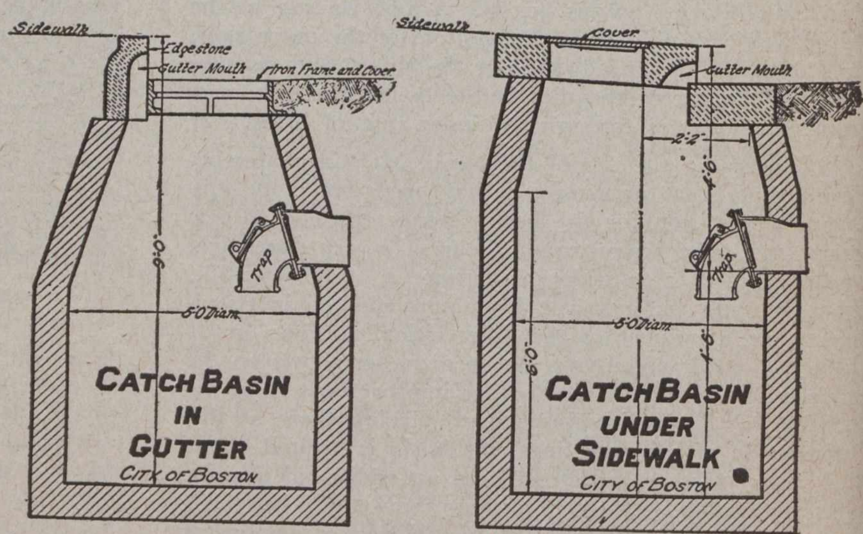
Boston, although claiming to have invented the "D" grate, has abandoned it for square grates, principally for the reason that they are much easier to pave against. Boston last year cleaned 9,907 basins, removing from each basin about 3¾ cubic yards. The cleaning is done by contract at cost of $3.01 per basin. As the basins are five feet in diameter and four feet six inches from the bottom to the level of the outlet, it is seen that in this case also the basin is in every case nearly full of dirt when it is cleaned. In fact, it is doubtful whether a basin of this size could be made to contain more than 3½ cubic yards and still permit it to carry off any street water. Since 3¼ was the average contents of the basins cleaned, it would appear that all of them, before cleaning, had reached this condition of limit of capacity, and it would, therefore, seem quite probable that in the case of many of them, they had ceased altogether to serve as catch basins some time before being cleaned.

In the Boston parks it has been specified at times that the contractors may have the choice of using either brick or concrete in constructing basins, and they have usually chosen to use brick.

In Boston they had tried to find some form of mechanical cleaner, but had not discovered any which was practicable. There, and in Cambridge as well, they had tried a suction device known as the Otterson auto eductor. This device was described by Philip W. Taylor, who stated that it was an invention of George W. Otterson, of Seattle, Wash., and consists of a centrifugal pump, sand eductor, dump body and the necessary fittings, all mounted on a Kelly Springfield motor truck. The dump body is a steel box nine feet long, six feet wide and three deep, and is divided into two chambers, one holding water




Concrete Block Catch Basins as used in New Bedford.




Two Styles of Catch Basins used in Boston.

for liquefying the dirt in the catch basin, the other for receiving the dirt so removed. The latter chamber is divided by vertical steel baffle plates, one foot less in width than the wagon body and staggered so that the water pumped from the basin must flow around the baffles as it advances to the back of the machine, the chamber thus acting as a sedimentation tank. These baffles are hung on horizontal pipes at the top of the body and are free to swing so that when the load is being dumped the material may slide under them. Between this settling chamber and the water chamber is a steel plate screen through which the water passes.

The eductor consists of an orifice and throat somewhat similar to a sand ejector. The tank having been filled with about 400 gallons of water, the truck is driven to a catch basin and the eductor let down into the basin. The pump forces this water through hose to and through the eductor. In passing through it sucks up the dirt from the basin, this dirt being made more or less liquid by discharging a part of the water through a pipe terminating in a nozzle which is operated to stir up and soften the material. The same water is used over and over again after depositing the dirt in the settling chamber. When the settling chamber is nearly full, the truck is driven to the dump and emptied. Mr. Taylor stated that the commissioner of public utilities of Portland, Ore., reported that in a test of 4½ hours' duration, 84 basins were cleaned, and that 137 basins were cleaned in an actual day's work of eight hours. The material removed from the 84 basins during the test totalled 13 cubic yards, or a little over 4 cubic yards per basin. In this connection it should be stated that "in the West the large curb openings are absent and all of the water passes through the grate openings, therefore the material is much easier to handle than in the East, where almost anything in size up to a football may be found." One criticism made by a city engineer of this and similar machines is that the entire working part of the machine is idle a large part of the day while going to and from the dump, and he suggested the advisability of having the pumping contrivance in a vehicle separated from the body or tank which receives the dirt, so that one excavating contrivance could be used with two or three dirt bodies.

In New Bedford, Mass., the type of basin which is being used at present is 6 feet inside diameter and 6 feet deep and is built up of concrete blocks 16 inches by 8 inches by 5 inches, which are manufactured by the city, the last three courses being built with specially bevelled blocks to reduce the size to 5 feet diameter. (See Fig. 1). The top is covered with a reinforced concrete slab 5 inches thick and 5 feet square, made of one part cement, one and one half peastone and one and one-half sand, with the addition of about two quarts of hydrated lime to each bag of cement. In this city, the basins are cleaned on an average of twice a year, although some are cleaned more frequently than others. The cost of cleaning is about $2.50 each.

In Fitchburg, the basin outlet is usually 8-inch pipe placed 3 feet above the bottom, giving a storage capacity of about 2¼ cubic yards. Unless the basin discharges into a strictly storm sewer, a cast-iron trap is used consisting of a flap valve to prevent odors coming from the sewer and a hood to prevent sticks or other obstructions from getting under the flap valve. On account of the many hills in that city, it is necessary to bank the grates or build a dam on the lower side in order to conduct the water into the basin. This was not considered an ideal way, and a ribbed surface grate was designed, having bars running diagonally across the gutter, the back edge of each bar being ¼ of an inch lower than the front edge of the grate. This makes a saw-tooth surface that slows down the velocity of the water and diverts it partially through the gully opening and partially down through the grate. This grate clogs with paper, leaves, sticks, etc., as do all other grates; but even though clogged, it still in most cases diverts the water toward the gully opening. Three complete rounds of the catch basins are made by the cleaning gang each year, but some basins do not need to be cleaned oftener than once in two years, while others require cleaning five to eight times a year. During 1915, 1,279 basins were cleaned, an average of 2¼ cubic yards being removed from each basin. As it was stated that the total capacity of each basin was 2¼ cubic yards, it would appear that no basin is cleaned until it is full and probably overflowing. An investigation of the operation of cleaning during May and June, 1915, showed that the teams spend 45 per cent. of the total time hauling the material. As the location of available dumps recedes from the centre of the city as the latter builds up, the length of haul is increasing, and this time will continue to increase unless some more rapid method of transportation is adopted.

Concerning gutter grates, W. L. Vennard, city engineer of Lynn, Mass., said: "Basins as sometimes built without throats, do not take the water efficiently. The grate, at the beginning of a rainstorm, becomes covered with leaves and paper or other debris and the water passes over, while those that have the throat permit the water to enter through it and the swirl of water entering generally tends to keep the grate clearer from debris than when there is no throat." In Lynn the D grates are supplemented by a throat cut in the curb-stone. The basins are cleaned through the D grate in the gutter, there being no opening in the sidewalk.

## ENGINEERS' CLUB, TORONTO, WILL MAKE ALTERATIONS—RESULT OF VOTE RE NEW CLUB QUARTERS.

The annual club dinner of the Engineers' Club of Toronto was held last Friday night, when between seventy and eighty members were present.

The result of the voting regarding new club quarters was announced.

One hundred and ten votes were cast for proposal No. 1, which was to move to the "World" Building. Twenty four votes were cast for proposition No. 2, that is, to stay in present quarters, not making any alterations. Proposal No. 3 secured five votes, while No. 4 received 118 votes. Under the plan the club will secure an additional 4,200 square feet of floor space, accommodation will be provided for five billiard tables as against three at present; the dining-room will also accommodate about 30 more members.

The total vote in favor of staying at the present address but with the changes made which will more adequately serve the purposes of the club, was 147 as against 110 in favor of moving.

---

The daily per capita consumption of water at Duluth, Minn., in 1916 was 81.86 gals. The cost of supplying the water, figured on operation, maintenance, depreciation and interest on bonds, was $86.31 per 1,000,000 gals.

## COST ACCOUNTING FOR THE CONTRACTOR AND ITS RELATION TO HIS ORGANIZATION.*

By Leslie H. Allen.

A SYSTEM of cost accounting to be of any value to a contractor must be used. Its data must be accessible to and understood by everyone in his organization who has anything to do with costs. It is valueless if it is kept a secret.

A proper system of cost accounting may be likened to an expensive tool or machine—of great value when working, but an unjustifiable expense if kept idle most of the time.

**Costs are Not Trade Secrets.**—The contractor who thinks that his unit costs are a trade secret and that the circulation of information regarding his costs will do him an irreparable injury is making a great mistake. If his costs are higher than his competitors' they will lose business if they use them. If they are lower they will lose money if they use them. It is efficiency and not cost data that makes for low costs. The cost data simply point the way to efficiency and show the failures to reach it. For this reason my firm has not hesitated to make public its costs at any time. We feel that if we make lower costs than our competitors it is because we have the men and brains needed to do it. Others cannot equal our costs simply because they know them. On the other hand, if our costs are higher than they should be no one gets from their publication any valuable information that can give them an advantage over us.

**Intelligent General Interest in Costs.**—Very many contractors have the labor costs distributed by a timekeeper and worked up in his spare time by the bookkeeper, and the results are only seen by the boss. Neither man understands his work or can show any enthusiasm for it. The opposite of this is the case on our work, and it is sometimes quite embarrassing to the writer to be called upon to adjudicate in cases where knotty points are being discussed with great earnestness by our timekeepers and foremen, such as whether repairing forms damaged by the strippers should be charged to stripping, erecting, or making—or what to do with the saw filer. The fact that such interest is shown in minor points indicates a real interest in efficient work and low costs all down the line.

It is the purpose of this paper to show how use is made of the data furnished by a cost accounting system in the organization and supervision of the jobs and the carrying on of the general business of the contractor, and to demonstrate the vital necessity of up-to-date information on costs to the various departments of his organization.

The contractor's problem in any system of cost accounting is not to so conceal the costs that no one but the boss can get them or understand them, but to make them accessible to and understood by the greatest possible number of people in his organization. The more people he can educate to understand cost analysis in his organization, the more intelligently and sensibly is his work going to be handled. Not only this, but it is very desirable that the architect or engineer should have some idea as to the costs of the work being done by the contractor under his direction.

**Immediate Value of Cuts.**—There occur to my mind many incidents on our own construction work where the

*Abstract of a paper presented to the American Concrete Institute, February 8th, 1917.

engineer's knowledge of what our work was costing has led him to allow modifications in the design which have saved much money for our clients, whereas if our cost accounts had been concealed our suggestions and arguments regarding a change in the design would have gone unheeded. For instance, on a recent job where the depth of column footings varied, owing to bad ground, the engineer desired to build all footings the same thickness and to start all columns at the same height and to make up the different depths between top of footing and bottom of column by pyramids of concrete, each one of which, of course, would need separate forms of varying shapes. Instead of arguing on a matter of opinion we were able, after building two or three, to demonstrate that this method was much more expensive than putting additional concrete into the footings, and we were allowed to make the change.

**Principal Features of Cost System.**—First, the estimate: (*a*) An estimate for each job is made, based on the costs of earlier jobs of similar nature. (*b*) This estimate should be analyzed to show first the quantities, unit costs, and total costs of each item of labor, and then the quantities and estimated prices of each item of material and each sub-contract.

Second, a daily labor cost report showing the labor costs of each day's work.

Third, a weekly labor cost report showing in parallel columns the estimated and actual quantities, unit costs, and total costs of the work performed.

Fourth, a monthly statement of the cost of materials and sub-contracts purchased or ordered, showing in parallel columns estimated and actual costs.

Fifth, a final summary made at the close of the job showing the total cost of all labor and material.

**Estimate of Cost.**—In many offices the estimate is locked up in the safe the day the contract is signed, and never sees the light of day again. The estimate is, or should be, the result of the estimator's study of cost data on preceding jobs, and is therefore the standard set for the cost of the job for which it was made. With it daily labor costs and material purchases should be compared. It contains much valuable information that is most useful to, and should be made use of by, the contractor's force.

In order that it may be of the greatest possible use it should be in sufficient detail to show in separate items the various kinds and classes of work done by different gangs, and it is best to make an analysis of the estimate into two main divisions: Labor; Material (sub-contracts and all items not classed as labor). The total of the first division, therefore, gives the estimated total payroll and shows how it is expected that this will be spent upon carpenters, masons, laborers, etc. The second division shows in detail the quantities of material, sub-contract work, etc., item by item.

**Use of Estimate.**—Who should see and use this valuable information and work to these standards?

First, the general superintendent. It gives him standard of performance by which he can measure up his job superintendents and foremen. It tells him more in a few minutes about the supply of materials and sub-contracts than would a day's studying of the plans, and in general is a big help to him in supervising the employment, supply of materials, progress, etc.

Second, the job superintendent needs more than anyone to see the estimate. From it he can see what the firm expects him to accomplish in the way of costs and his criticisms of the estimate should prove helpful to the estimator. With it he can confer with the purchasing agent of the company and with the local dealers from whom he has to buy supplies and without a lot of computation on his part he can place the orders for much of his material. From the sub-divisions of the analysis he can determine the sort of organization that should be placed upon the work, how many carpenter foremen, how many carpenters, the size of the labor gang, the number of mechanics, etc. Reading the estimate will call to his mind all the work that has to be done.

The estimate shows him the quantities of materials he has to receive and he can plan for their efficient storage.

Third, the purchasing agent. From the material section he prepares a more detailed schedule and by taking dates from the progress schedule he can prepare for his own use a list showing all materials required and the dates required in order that he may start in buying intelligently and see that everything is delivered on time. He has a valuable check on the bids received.

Fourth, the scheduling men also should receive the material section of the estimate and check their quantities by it. From the purchasing agent they receive notice of the dates these schedules are required in order that he may buy them and have them delivered at the job in time.

Fifth, the foremen of brickmasons, carpenters, concrete gangs, etc., should be told what are the estimated costs of their work, and shown from week to week how their work compares with the estimates.

**Daily Labor Costs.**—The second important feature of a cost accounting system is a daily report of the labor costs. These are best prepared on the job and should be in the job superintendent's hands by 9 o'clock the next morning.

If each carpenter foreman is told what are the estimated costs on the operations he is to do and is notified every day as to whether he is coming inside or overrunning his costs, it is sure to have its effect. We frequently plot the principal items graphically on a chart which not only the carpenter foremen but the carpenters can see as they check in and out. The lowest laborer takes a cheerful and even enthusiastic interest in the vagaries of the wandering line that shows the cost of the work he is doing.

It is best to keep the cost accounts on the job instead of in the head office. Costs to be of any use should be fresh, not stale. If the superintendent knows at 9 o'clock the very next day that concrete costs 20c. a yard more to put in than on the preceding day he can talk it over with his foreman while the matter is fresh, and investigate and remedy the fault; but if the news does not come to him until a week or ten days after the work in question is done, it is too late to do anything.

The daily costs point out to the superintendent an occasional high spot that he has missed, and are an unfailing barometer of the job.

**Weekly Labor Costs.**—The fourth essential of a cost system is a weekly labor report. This should show in parallel columns the estimated and actual quantities, unit costs, total costs, and saving or overrun. This statement should be furnished to the heads of the main office of the company as well as to the job superintendent. By the use of a simple summary, the main facts can be condensed into a very few items. This statement gives a sort of review of the job's operations to date. It should go to the general superintendent and the estimator in the head office. The latter particularly needs to know the fluctuations in costs in order that he may check up his judgment with actual facts and learn the costs of any new sort of work.

## ELECTROLYTIC CORROSION OF WATER PIPE.*

FRED B. NELSON: Tests and examinations have been recently made by the New York department of water supply on fifty meters which had been in continuous service for different periods of time, including five groups of ten each installed at five-year intervals from 1895 to 1915. It may be of interest as having a possible bearing on the subject of electrolysis that on the disc chambers of those installed in 1900 a decomposition or pitting of the bronze chambers was found which was not present in any marked degree on those installed in 1895 nor on subsequent installations. The appearance of the decomposed metal suggested electrolytic action, and analyses were made by the Central Testing Laboratory of the bronzes of the disc chambers affected and of one disc chamber not affected, from which the conclusion was drawn that the decomposition was due to a solution of the metal, the solution depending upon a number of factors, among which was the difference in composition or mechanical treatment and consequent differences of potential between adjacent portions of the meter.

The analyses showed quite marked differences of composition of the bronze, even between the two halves of the individual disc chambers, these differences being least in the analyses of the unaffected chamber. The analyses also seemed to show that the bronzes higher in zinc and lead were the most susceptible to the corrosion. Analyses of the water being used through these meters showed no chemical differences that would account for the difference in corrosion.

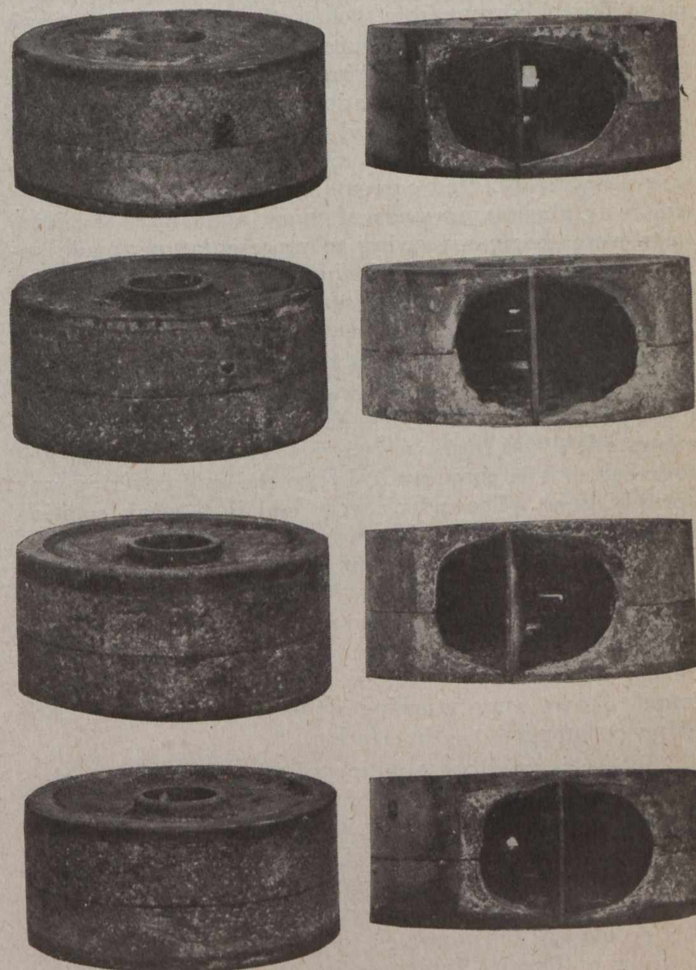
This case of corrosion of bronzes is not cited as an instance of the usual action of electrolysis, as no indication or instance could be found to indicate that any stray electric currents existed or were leaving the bronze at the affected portions. It does, however, seem to illustrate a somewhat similar decomposition of the metal that may be caused by local galvanic action due to differences in composition or treatment of the adjacent bronzes used.

The appearance of the corroded disc chambers is shown in the accompanying illustration.

H. B. Machen: A rather interesting case of what we believe was electrolysis recently appeared in the borough of The Bronx, New York City, where, as you know, the entire trolley system is of the single wire overhead type.

A leak was reported as at 132nd Street, near Lincoln Avenue. The department forces made the necessary excavations, exposing the pipe, and found that for a small portion of the pipe the iron had practically disappeared, leaving the carbon, the specific gravity of a section broken out about 6 inches square being about 2.

An examination was then made to determine if possible the cause of the local trouble and if possible prevent its recurrence. The pipe runs for about 800 feet through made ground, which at the point where the pipe was exposed consisted of a fair grade of earthfill. The trench was dry, although but 600 feet from tidewater. The nearest elevated railroad and trolley lines were about 400 feet in a straight line. There was no difference of potential between the pipe and elevated railway except when a train was passing, and but very slight at that time. No differences could be detected at any time between the pipe and the trolley road. Examination of the pipe, which had been tested to 150 pounds at the foundry where manufactured and had been in service for a number of years at approximately 35 pounds pressure, showed that the trouble was confined to one length only. The total area affected was about 4 square feet toward one end of the length, and indicated that the iron had been largely extracted, leaving carbon so soft that it marked paper easily. The pipe coating was in good condition in many places, having still the original gloss evident. To date it has not been possible to locate any source of current, either to or from the pipe, and still every fact



**Appearance of Corroded Disc Chambers.**

available after the break disclosed the weak spot points to electrolysis as its cause.

As an illustration, the reverse of the case mentioned above and located in the same borough might be cited; the 36-inch main on Jerome Avenue, where the pipe parallels a trolley line for over five miles. During a repair being made at night, just as the sleeve was being slipped over the end of the pipe, several sparks jumped the gap, which appeared from the bank to be about 1 inch, and which surely was over ½ inch. This certainly indicated that the pipe was carrying current, and still we have had no trouble appear from electrolysis, which can have been going on for twenty years.

D. F. Atkins: The department of water supply, gas and electricity of New York has received applications from electric railway companies for permission to bond their tracks to the water mains. This permission has been refused in every case, for there has been no proof offered that the city would gain anything by permitting

*A discussion of an informal address by Prof. Albert F. Ganz before the New York section of the American Works Association.

such bonding, whereas the railway companies would thereby be relieved in a measure of the necessity of bonding their tracks so as to form a proper return circuit, which they should provide.

Harry V. Allen: A water consumer in an outlying section of Brooklyn was required to pay a bill for water which was in part wasted on account of a leap in the pipe between the meter and the fixtures. The pipe had been corroded by electrolysis and he wished to recover for the loss he had sustained. A joint investigation made by the department of water supply, gas and electricity and by the public service commission indicated that the tracks in the neighborhood were poorly bonded and there was a flowof current from them to the sub-station through the intervening marshy ground. The tests indicated that the water mains were carrying heavy currents for some distance toward the sub-station, and that the currents then left the water mains and returned through the damp soil. The conditions were such that one of the lead service pipes transmitted currents which would theoretically eat away about 15 pounds of metal annually. The joint tests were suspended owing to representations made before the commission questioning its jurisdiction to order circuit changes on the part of the company, which were necessary to a conclusive test.

Nicholas S. Hill, Jr.: In 1895 were were installing in Baltimore near an electric railway power station an underground conduit system for telephone and telegraph cables. We laid lead-covered cables with their ends tied together, but in three weeks' time the lead covering was entirely gone. The cables were laid in a weak solution of sewage and everything was favorable for corrosion. The action was so rapid that it was necessary to make an electrical survey at once. We did not know then as much about electrolysis as we do now, and the first thing we thought of doing was to connect the cables with the busbar of the power station. When this was done we found that we were returning about 1,800 out of the 2,800 amperes supplied by the station.

There is but one solution of the problem of electrolysis. That is insulation of the rails so far as possible and increase in the conductivity of the track circuit back to the station within economical limits. It is unwise to attempt to force methods upon the railways, which are so expensive that they are prohibitive. I have felt, and this opinion is substantiated by the decisions in the suits brought at Peoria, Indianapolis, Dayton and elsewhere, that we gain nothing by bringing suits which attempt to force a particular kind of construction on the railways, because when the water department or water company appeals to the courts on such a basis, the construction demanded is such that it is easy to prove to the courts that such a requirement amounts to confiscation, and the courts are loath to do anything which has even the appearance of confiscation.

The attitude of this association in the matter of electrolysis should be one of co-operation and arbitration rather than one of coercion. If damage is done, we have the same methods of recovery that any person has by bringing suit to force the offender to pay for the damage he actually does, but I do not believe we can profitably use the courts in any other way than the recovery for damage sustained. We are working in the streets in conjunction with other public utilities and we all have equal rights in them. What we should do is to co-operate with engineers, who are better equipped by training to attack the problem of electrolysis, and to formulate with them remedial measures and standards of construction which will reduce this trouble to a minimum.

D. W. French: I do not think the experience the Hackensack water company has had from electrolysis is unlike that of any other water company. We have usually found that such trouble as we had was due to poor rail bonding, and when voltmeter readings exposed what was going on and the matter called to the attention of the railway officials, they were generally remedied. A number of lead service mains have been completely ruined by stray currents, and these services have been replaced by the railway company at their expense.

Hermann Rosentreter: We have found an unusual instance of the straying of return currents in New Jersey. There is an electric railway running south westerly from Paterson and paralleled by a 42-inch main supplying Jersey City. A 42 and a 48-inch main supplying Newark intersects the railway and runs directly away from the station supplying current for the cars. A leak in the Newark mains was reported in a swamp about 3½ miles from the railway crossing. Investigation showed about 20 amperes flowing in the mains at that place and several miles farther from the power station we found a current of two amperes. In order to be sure that the current came from the railway, measurements were made one night before and after the road was shut down. When the car service stopped the current flowing out over the mains stopped and a small current flowing toward the Paterson power station was observed. In other words, current from the station strayed 11 miles away from the railway on which it was supposed to remain.

Alexander Potter: At San Antonio, Texas, we found the service pipes pitted with what appeared to be electrolytic corrosion. This appeared in all parts of the city and an experiment in the way of protection is now being made. This is to cover the services with tile pipe, which has not been in use long enough to prove its usefulness.

F. T. Kemble: Our troubles with electrolysis in New Rochelle are pretty much the same as those of everybody else, though the points at which it occurs are rather localized. But there is one condition that probably differs from other plants that may be of interest to you. Along the Long Island Sound shore section much of the trolley return current is carried over the tracks of the New Haven Railroad, who have their tracks bonded directly to the busbar in the power-house of the trolley company. Professor Ganz has made a study of our section and is entirely familiar with this condition. As showing one of the channels through which the current has travelled, we have on two occasions found a 1-inch piston meter, which was set on the railroad company's own connection near its tank-house, have its piston so warped that the meter ceased to register. After the second occurrence, which was after an interval of about six weeks, we placed the meter in a vault close to our main, a distance of less than 200 feet from the original location, and since then we have had no further trouble with it.

Allen Hazen: It is well to bear in mind that punk metal is not necessarily due to electrolysis. Iron pipe has been found in a punky condition miles away from any electric railway and where there was no possibility of its being due to electrolysis. In such cases it is doubtless the result of the chemical action of the soil. The alkali in certain western soils seems to have a powerful action of this kind. Several years ago, in building a steel water pipe, at each crossing of an electric railway the pipe was covered with building paper in successive layers, each of which was heavily coated with tar. This treatment was inexpensive and seems to have been in line with the treatment suggested by Professor Ganz.

Prof. Albert F. Ganz: It is not generally possible to satisfactorily answer questions in regard to electrolysis unless complete information stating all of the conditions can be given. It is generally difficult to obtain such complete information from inquiries made in connection with discussions before meetings like this.

I am glad to hear that the department of water supply, gas and electricity of New York City has refused to permit the electric railway companies to bond their water mains to the railway tracks. Such permission should not be granted, because the bonding of water pipes to the tracks makes the water piping system part of the railway return circuit, and almost always makes the piping system carry very large currents, and these become an increasing source of serious danger. Mr. Nicholas S. Hill has well illustrated by his experience in Baltimore that it is of great advantage to railway companies to connect underground structures to their railway return circuit, as they thereby obtain the use of these underground structures for the return of current. He has also shown that these structures are made to carry very large currents by such connections.

In regard to the attempt in San Antonio to stop electrolysis by encasing the water services in tile pipes, I beg to say that this arrangement can only succeed if the joints in the tile pipe and the connection to the water service are made waterproof, so that the space between the service pipe and the tile pipe does not fill with water. If this space does fill with water, then current may continue to flow from the service pipe to the water and produce corresponding corrosion of the service pipe by electrolysis. I would suggest as an improvement that the space be filled with a compound like pitch.

The heating of the 2-inch water meter by current from the New York, New Haven and Hartford Railroad in New Rochelle is very interesting, and I am sorry that I have not more details in regard to this very important observation. Mr. Hazen's remarks emphasize the fact that it is not possible to tell from the appearance of a corroded pipe alone whether it has suffered from electrolysis or from purely chemical action. To determine this requires electrical measurements to see whether current is leaving the pipe which could produce electrolysis.

In regard to lead service pipes which are reported to be destroyed by electrolysis from current reaching the water service pipe from the gas main by way of the house service connections, I would suggest that if this is the path of the current which damages the water service pipe, the trouble can be remedied by inserting an insulating joint in the water service directly inside of the cellar wall, thereby preventing the flow of the damaging current out on the water service pipe. If, on the other hand, the current flows from the water main to the water service pipe, then an insulating joint would have to be inserted in the water service pipe close to the main. A safe precaution would be to insert an insulating joint in the water service pipe both close to the main and directly inside of the building.

In regard to the question of grounding transformer secondaries to water pipes, I would say that there is absolutely no danger in permitting such connections to be made. Transformers operate with alternating current, and the object of grounding the secondaries of transformers is to serve as a safety measure to prevent the possibility of persons obtaining a high voltage shock. Under normal operating conditions there is no flow of current to the water pipe from such transformer connections, and in my opinion such connections can be safely permitted.

## COLORIMETRIC TEST FOR ORGANIC IMPURITIES IN SAND.

UNDER the auspices of Committee C-9, on concrete and concrete aggregates, of the American Society for Testing Materials, colorimetric tests for discovering impurities in sand have recently been conducted. The methods employed as well as the data secured have now been issued in a circular, from which the following is abstracted:—

The colorimetric test may be described briefly as follows:—

A sample of sand is digested at ordinary temperature in a solution of sodium hydroxide ($NaOH$). If the sand contains certain organic materials, thought to be largely of a humus nature, the filtered solution resulting from this treatment will be found to be of a color ranging from light yellow up through the reds to that which appears almost black. The depth of color has been found to furnish a measure of the effect of the impurities on the strength of mortars made from such sands. The depth of color may be measured by comparison with proper color standards.

The colorimetric test has been applied to sands from about 40 widely distributed deposits in 20 different states. The research to date has brought out the following:—

Examinations of deposits of defective sands show that surface loam is the principal source of contamination.

All natural sands which have been found to be defective on account of the presence of organic impurities have responded to the colorimetric test with sodium hydroxide, and all sands which have given high color values have shown low values in mortar tests.

Sands which were similarly graded by screening out and recombining the different sizes to a definite sieve analysis showed a fairly definite relation between the compressive strengths of 1-3 mortars at 7 and 28 days and the color values of the sands.

The mortar-making quality of sands known to contain organic impurities has been much improved by removing the organic matter, either by repeatedly digesting them with sodium hydroxide and then washing free from alkali, or by driving off the organic impurities by ignition.

When the sodium hydroxide extracts from sands which mortar tests had shown to be defective were purified and applied as coatings on high-grade sand, that sand was made "defective" or gave much reduced mortar strength.

It is impracticable to give exact values for the relation between the color value of a sand and the strength of mortars made from the same sand. However, the tests made thus far show this relation to be about as follows:—

| Color values of sand. | Reduction in compressive strength of 1-3 mortar. Per cent. |
|---|---|
| 250 | 10-20 |
| 500 | 15-30 |
| 1,000 | 20-40 |
| 2,000 | 25-50 |
| 3,000 | 30-60 |

The reduction in strength is based on compression tests at ages of 7 days, 28 days, and 3 months, of 1-3 mortars made from the same sand, before and after coating with different per cents of organic impurities which had been extracted from defective sands and purified. Tests on mortars made from defective sands as received and after removal of the organic impurities, either by repeated extractions with sodium hydroxide or by ignition, showed that in some cases the reduction in strength for a given color value was even greater than the higher values given above. Frequently the test pieces completely disintegrated in the storage water. The higher reductions in strength for a given color value for a natural sand as compared with the same color value for an artificially coated sand is probably due to the artificial coating being more easily removed by the sodium hydroxide.

Sufficient data are not available to indicate whether or not the effect of a given quantity of organic impurities varies with the grading of the sand. The reduction in strength seems to decrease slightly with the age of the test pieces.

The concluding remarks in the circular follow:—

Impurities in sands other than organic, such as clay or similar admixtures, if present in considerable quantities, may be expected to affect the strength of the concrete. However, the examination of a large number of defective sands has shown that it is the organic impurities of a humus nature which are responsible for the abnormally low strengths of such sands.

It has been found that the colorimetric test can be made with a greater degree of uniformity by different operators than can the strength tests of mortars from the same sands.

The fact that the colors produced by digesting certain natural sands with sodium hydroxide are similar to those produced by treating tannic acid in the same manner must not be interpreted to mean that the organic matter in sands is necessarily tannic acid, or even a tannate. The chemical compounds which make up the organic material are probably numerous and complicated.

The time actually required for a single determination by the laboratory method is about one-half hour. If tests on as many as 5 samples can be made at once, the total time consumed need not exceed 1 hour. The time required from the beginning to the end of the test is about 24 hours.

Inexperienced operators without technical training or previous experience in work of this character have secured satisfactory results at their first trials.

The strength test of mortar is used as the criterion of the effect of impurities in sand. In making strength tests of sand mortars and interpreting the results of such tests, the following points require particular attention: (*a*) Sampling of sand; (*b*) grading of sand; (*c*) quantity of water used in mixing; (*d*) methods of mixing, molding and testing; (*e*) form and size of test piece.

(*a*) Great care is necessary to insure that the sample tested is representative of the larger lot of sand. Good judgment and considerable experience are necessary to secure representative samples from an undeveloped deposit. Some form of sampler should be used in the laboratory in selecting a test sample from a larger lot.

(*b*) The size and grading has an important influence on the concrete and mortar-making qualities of sands. A sand graded from coarse to fine, with the coarse particles up to about ¼ in. in diameter, is desirable for use in concrete. Fine sands, when mixed to the same plasticity, give mortar strengths much below those of coarse, well-graded sands. The influence of the grading of sand on the strength of the mortar must not be confused with the effect of impurities.

(*c*) The quantity of water used in mortar tests has just as important an influence on the strength as the amount of cement. The quantity of water required for normal consistency of mortar made from a given cement is a function of the grading of the sand.

(*d*) The methods used in mixing, molding the test pieces, storing and testing the specimens, etc., used in standard tests of cement should be followed in making strength tests of sand mortars.

(*e*) Compression tests of mortar are believed to be more significant than tension tests. A 2-in. by 4-in. cylinder has been found to give satisfactory results as a compression test piece. This is the form of test piece recommended by the American Society for Testing Materials in their proposed tentative specification for compression tests of cement.

The study of impurities in natural sands is being continued as a part of the work of the Structural Materials Research Laboratory, Lewis Institute, Chicago. Special attention will be given to further improvements in the colorimetric test, and to discovering remedial measures which can be used in a commercial way for counteracting the effects of such impurities.

---

## ETHICAL QUESTIONS ANSWERED.

In order to arrive at some approximate idea as to what attitude ethically engineers should assume under certain conditions, the American Institute of Consulting Engineers has answered certain ethical questions, these answers being based upon facts coming under the notice or practice of engineers, or upon hypothetical situations.

The first questions, along with the approved answers, have now been sent out. Some of these follow. These questions and answers are handled by a special committee appointed for the purpose.

1. *Question*—Is it proper or wise on the part of A to accept responsibility without personally investigating or verifying the accuracy or adequacy of surveys and data supplied by B?

*Answer*—It would be unwise for A to proceed without personally satisfying himself of the adequacy and accuracy of the data supplied by B, unless it were distinctly understood or stated in the terms of A's engagement that he should assume no responsibility for the correctness of the data supplied to him. Such review and verification is desirable in order to protect both the client and the engineer from the consequences of erroneous data or misunderstood conditions.

2. *Question*—Would it be unethical for an engineer to accept and act on the proposition of a patent attorney to solicit or turn over legal work to him on a fee-sharing basis?

*Answer*—The sharing of fees or profits as compensation for soliciting engagements is regarded among engineers as unethical. This does not apply to the division of fees in cases where two or more engineers are jointly employed or engaged upon the same work.

3. *Question*—Is it unethical for engineers to permit the use of their names as references in business enterprises, or for the promotion of business schemes?

*Answer*—It is regarded as at least imprudent for an engineer to permit the use of his name as a reference regarding the character and responsibility of persons or business concerns for advertising purposes. The practice might lead not only to personal embarrassment but to the discredit of the profession.

4. *Question*—Is an engineer entitled to claim and receive the whole amount of the fee which would be due him if work suspended for good reason had gone on to completion?

*Answer*—Such contingencies should be provided for in the original agreement between engineer and client. In the absence of such a provision, and unless the circumstances should warrant a different action, and particularly where the abandonment occurs through no fault or bad faith on the part of the client, settlement upon an equitable basis for the work already done, and the expenses and obligations already incurred, would be fair and just to both parties.

5. *Question*—Should engineers recognize or take part in such public competitions for services where it is to be presumed that the lowest bidder will be engaged for the services?

*Answer*—It is not regarded as ethical for reputable engineers to enter such competitions. This does not, however, apply to competitions for designs for a specific structure where such competition is properly conducted and provision is made for reasonable compensation for rejected designs.

6. *Question*—If in the course of an investigation an engineer makes discoveries which, while foreign to the subject of his specific engagement, are so related to the business of the client as to be of great importance to him and, if disclosed, might seriously affect that business, does the present ethical relation of the engineer to his former client permit him to develop these discoveries for his personal use or profit, or to publish an account of them in the interest of science?

*Answer*—The engineer should not make use of information or discoveries, or the results therefrom, obtained while in the service of a client, in any manner adverse to the interests of the client.

## WORK ON THE PANAMA CANAL.*

**By Henry Goldmark, M.Can.Soc.C.E.**

BEFORE the Canadian Society of Civil Engineers, Montreal, March 22nd, Mr. Henry Goldmark, M.Can.Soc.C.E., delivered a most interesting address dealing with the work on the famous waterway. The description which Mr. Goldmark gave was illustrated by a number of official slides of the United States Government.

At the conclusion of Mr. Goldmark's address the chairman, Mr. J. M. Robertson, invited those present to ask any questions, assuring them that Mr. Goldmark would be very glad to answer them.

The following questions were put to the speaker of the evening, which, together with his answers, will be of interest.

Q.—Would Mr. Goldmark kindly tell us if the reports of the tests on the chain fenders have been published?

A.—Mr. Goldmark: Yes, in the last report of the Panama Canal, which was published last September or November, they have given some of those tests, but I have been thinking somewhat of giving a rather fuller account of them some of these days. You could find, however, in the annual report of 1916 some of the actual figures, showing just what they found.

Q.—Could you tell us something of the question of fresh water having been mixed with the salt?

*Abstracted from notes of meeting of the Canadian Society of Civil Engineers, Montreal, March 22nd, 1917.

A.—Mr. Goldmark: Theoretically, you get a certain amount of salt water up in all these lakes. We knew there was, but it came to my attention, and I studied it in connection with the moving of lock gates under certain conditions. As a matter of fact, there is a *rise* there that has been sticking tide machinery. Some said there wasn't that it was all nonsense. It is not all nonsense; it is theoretically right, and we found that you have to press against six inches, and you get that on the heavy currents into the ocean, so it interferes slightly with navigation. There is a little lake between Pedro Miguel and Miraflores that was intended for the water supply of Panama, and the question arose that there would be a certain amount of chlorine in there. It was a question whether to run the pipe on and take the water from the upper Charges, which would cost half a million dollars, or take the water from the Miraflores Lakes. They decided on the latter course and spent $20,000 on certain foundations, and when they had a small amount of vessel traffic Miraflores Lake got so salty they couldn't drink it. This condition compelled them to carry the pipe on at a cost of $500,000. As a matter of fact, the water gets salty when the vessels go down and when they come up.

Mr. Swan: One or two points occurred to me that I would like to ask Mr. Goldmark about. One was: In testing the lock gates did you fill them with water?

Mr. Goldmark: Yes, we filled them with water. You see, the lower part was an air-chamber, and originally I didn't like the idea of using an air-chamber to fill the water from the inside, but ultimately it was proven to be the only way. At the top we moved the water from one compartment to the other, and we also tested the strength of these pockets and corrected all the leaks. The contractors thought I was very severe in testing on riveting and caulking, but after all I think it was very worth while, as in the thirty or forty thousand we had perhaps only one hundred caulked.

Mr. Swan: I might say that in other gates with which I have been associated we invariably filled them with water, and I have had the principle criticized in this way: A shipbuilder when he builds a ship doesn't fill it up with water; why should an engineer when he builds a gate go and fill it up with water? It was an argument we could not very well work against. Whether the shipbuilder is more perfect in his work and doesn't require to do so, or whether it is the engineer in that sort of work is more particular, I don't know.

Mr. Coutlee: Gentlemen, it has given me the greatest pleasure this evening to hear my old friend, Mr. Goldmark, go over in review that very great work with which he was so long connected. Having had the opportunity of seeing it after, one can appreciate the enormous effort and the tremendous development of mechanical ideas that took place on the Isthmus. A lock type was adopted that has proven absolutely satisfactory. It has set a type and size for locks the world over, and it has dictated to the marine world that they must learn to lock ships. There has been very little difficulty experienced, I understand, so far, in passing through. Of course, the captain is no longer the captain in passing through the locks.

I think that the matter Mr. Goldmark spoke of a few moments ago in connection with balancing the salt water pressure at the lower locks has not been a very great difficulty. But I would like to ask Mr. Goldmark if there was not an arrangement in the outgoing culverts of that lower lock thought of at one time?

Mr. Goldmark: It was put in. When that question came up it was referred to a committee in the Lock Department, of which I was a member, and we made a report which showed very clearly that we thought there would be that trouble, but we proposed a very foolish solution. We proposed a ballast gate or a flat valve. I have always thought it was a very incorrect solution, because that flat valve would have to have been about eight or nine feet in size. . . . We later had another committee on it, and there were two questions. One was the closing on a slow and the other a rapid rising of tide, which would reverse the pressure against the gates, and the gates were rigidly held. What they ultimately did to take care of rapid rise of tide was nothing, and they still have that risk. If the valves should be closed at the lower end of the locks and the gates also be closed and the tide rise rapidly they may have trouble.

At the close of his address the meeting passed a hearty vote of thanks to the speaker.

A pleasing function followed, namely, the presenting of the Gzowski medals. Owing to the unavoidable absence of the president, Mr. J. S. Dennis, Mr. R. A. Ross, vice-president, kindly consented to officiate at this point.

In presenting the medals, made possible by the fund which was left by Sir Casimir Gzowski for that purpose, Mr. Ross referred to the paper which it had been decided should receive the award this year, namely, the paper on the Cedars Rapids power plant, the joint authors of the paper (it being in three parts) being Messrs. Henry Holgate, R. M. Wilson and Julian C. Smith. Of the three authors only Mr. Smith was present. In accepting the medal Mr. Smith expressed his warm appreciation of the action of the committee for the honor conferred.

---

## FOURTH CANADIAN AND INTERNATIONAL GOOD ROADS CONGRESS, OTTAWA, APRIL 10-14.

THE success of the Fourth Canadian and International Good Roads Congress at Ottawa, April 10-14 inclusive, is already assured from the educational point of view, for the president (J. Duchastel, of Outremont) and the secretary (G. A. McNamee) have already received acceptances of invitations to read papers from some of the best-known highway engineers on the North American continent.

The morning and afternoon sessions of the congress will be fully occupied with papers and discussions dealing with every phase of the road question.

Many old friends of the congress will once more be found on the programme, men who may be regarded as pioneers in the making of improved roads. Such men as Col. W. D. Sohier, chairman of the Massachusetts Highway Commission of Boston, and James H. MacDonald, ex-state highway commissioner of Connecticut, whose experiences in overcoming difficulties similar to those that Canadian road builders have to face would make the congress a success alone if they were the only speakers. Then there are others coming from the United States to emphasize the international character of the congress and the universal importance of good roads. Among them are W. H. Connell, chief engineer of the Department of Public Works, Philadelphia; B. D. Sargent, chief engineer of the State Highway Commission of Maine, and Professor A. H. Blanchard, professor of highway engineering, Columbia University.

The Canadian speakers at the congress will be more than usually representative. From the Dominion Government there will be L. Reinacke, of the Geological Survey Department, who will give some useful information regarding road materials, and Thomas Adams, town-planning adviser to the Commission of Conservation.

The Ontario Government will be represented by one of Canada's leading highway engineers, W. A. McLean, the deputy minister of highways for the province.

Ontario is moving rapidly this year in its desire for good roads, and important legislation dealing with highway construction is going to be introduced at the coming session of the legislature. Mr. McLean will give a talk on the highway system of France, illustrating it with a series of fine lantern views made from actual photographs taken in what is now the war zone, and showing the world-famous highways of France which have been such an important factor in the great struggle. The Ontario Highways Department will also be represented by G. Hogarth, W. F. Huber and G. C. Parker, all of whom will contribute to the proceedings.

From the Provincial Government of Quebec there will be the deputy minister of highways, B. Michaud, who was president of the congress last year; his chief engineer, G. Henry, and A. Fraser and M. E. Fafard, also of the provincial engineering department.

In addition to these, papers will be contributed by T. Harry Jones, city engineer of Brantford; A. F. Macallum, commissioner of works, Ottawa; W. G. Yorston, assistant road commissioner, Halifax; Paul E. Mercier, chief engineer of the city of Montreal; Col. F. A. Snyder, Montreal; L. Burtubise, city engineer, Montreal East; T. Baillarge, city engineer of Quebec; Malcolm Barclay, and L. E. Schlemm, of Montreal; P. Jarman, city engineer of Westmount; A. Lalonde, Outremont; E. Drinkwater, St. Lambert, and others.

The Congress will be more than usually important this year because of the labor conditions caused by the war and by the possible return of the Canadian soldiers in the near future. Speaking on this point the president of the Dominion Good Roads Association, J. Duchastel, says: "When the war is at an end the condition in Canada will be a very serious one. We will have our returned soldiers to look after as well as a large influx of immigrants. Very little employment will be available in industrial centres because our factories which are now producing munitions of war will have to seek other fields for their product and there will necessarily be some delay while they are re-transforming their machinery to the production of the articles that will be required. There will also be little employment available on the railways because this work has been so extensively carried on in the past few years that there are not likely to be any big extensions for the next few years. Therefore, the only employment on a large scale that men will find will be road construction, which should be undertaken not only by the provincial governments, but by the Federal Government, for the country needs good roads if it is to develop properly. Well-constructed highways, properly maintained, are a benefit to all classes of the community and the rural districts will probably benefit more from them than any other section, for good roads should always be built with the idea of acting as feeders to the railway lines or to the large commercial centres, thus allowing the farmers to haul their produce to these places at a minimum cost.

---

It is reported that a group of iron and steel manufacturers in the East district of France are interested in a scheme for the establishment of a steel-making plant and a large battery of coke ovens in the Paris district.

# The Engineer's Library

**Any book reviewed in these columns may be obtained through the Book Department of The Canadian Engineer, 62 Church Street, Toronto.**

CONTENTS.



## BOOK REVIEWS.

**Economic Geology.** By Heinrich Ries, A.M., Ph.D., Professor of Geology at Cornell University. Published by John Wiley & Sons, Inc., New York; Canadian selling agents, Renouf Publishing Co., Montreal. Fourth edition, 1916. 876 pages, 291 figures, 75 plates, 6x9 ins., cloth. Price, $4.00 net. (Reviewed by J. B. Tyrrell, mining engineer, Toronto.)

The great increase in the production of mineral wealth in Canada during the past few years has raised the Dominion to the position of one of the important mining countries of the world. In many other countries in which there has been an increase in the production of the mines this increase has been in large part due to improved mechanical appliances for extracting the ore from the earth or to new or better chemical processes for extracting metals from their ores after these ores had been mined. But in Canada the increased production has been largely due to continued discoveries of the existence, or farther extent, of valuable bodies of ore of one kind or another, and on account of the vast areas of territory yet unprospected we may expect that such discoveries will continue to be made in increasing ratio for many years to come.

The work of discovering and developing bodies of ore in the rocks of the earth's crust, however we may think of it or refer to it, is simply geological work and the problems involved are problems in geology.

In order to distinguish the study of the character, extent, and value of bodies of ore or useful minerals from the study of the principles which govern the formation of rocks generally, and the relations which they bear to each other, this study is usually referred to as "Economic Geology." It will be seen, therefore, that a knowledge of our economic geology, whether we know such knowledge by that name or not, is of vital interest to us as a mining people.

We therefore welcome the fourth edition of Dr. Ries' excellent volume on economic geology of the United States and Canada, not so much for the descriptions which it gives of individual mineral fields as for the well-arranged characterizations of the ores and useful minerals that are found throughout the northern portion of the American continent and of the various ways in which these ores and minerals occur as well, as some account of the rocks with which they are usually associated.

The book is a volume of xviii. + 856 pages and is divided into two parts of 425 and 399 pages respectively, Part I. dealing with Nonmetallics and Part II. with Ore Deposits.

Under "Nonmetallics" are 13 chapters with the following headings: 1, Coal; 2, Petroleum, Natural Gas and other Hydrocarbons; 3, Building Stones; 4, Clay; 5, Limes and Calcareous Cements; 6, Saline and Associated Substances; 7, Gypsum; 8, Fertilizers; 9, Abrasions, 10-12, Minor Minerals; 13, Underground Waters.

To illustrate his mode of treatment of a subject we may take the headings in Chapter 2, on petroleums, etc. Introductory; Properties of Petroleum; Properties of Natural Gas; Origin of Oil and Gas; Inorganic Theory; Organic Theory; Mode of Occurrence; Classification of Oil and Gas Sands; Mode of Accumulation; Yield of Sands; Life of a Well; Distribution of Petroleum in United States, with brief description of the fields from the Appalachians to Alaska and also Canada and Mexico; Distribution of Natural Gas in the United States and in Canada; Uses of Petroleum and Uses of Natural Gas; Solid and Semi-solid Bitumens, including Albertite, Anthraxolite, Ozokerite, etc.; Bituminous Rocks, Oil Shales; Production; References.

From the above list it will be seen that an enquirer would be able to find here answers to all ordinary questions that would occur in dealing with petroleum, etc., and if he should wish to pursue the subject farther the references would guide him to the places where he could obtain fuller information.

Part II., "Ore Deposits," begins with a chapter on ore deposits in general, in which, after offering a useful definition for them, he discusses their origin and mode of formation, and whether they have been formed at great, intermediate or shallow depths in the earth's crust. He also describes the various forms of ore bodies, the secondary changes which may have occurred in them since their original formation, and then suggests a classification under which they may be grouped together.

The chapters that follow deal with ores of iron, copper, lead and zinc, gold and silver, and minor metals, under which are placed nickel and cobalt. Unfortunately, the silver mines at Cobalt, Ontario, have been described under these latter metals, and more unfortunately still they have been omitted from the index, though this will doubtless be corrected in a subsequent edition.

The book will be of great interest to all who are anxious to acquire a good knowledge of the useful minerals and ores of the northern portion of this continent.

It is beautifully printed on fine glazed paper, is illustrated by 75 plates and 291 illustrations, including maps and diagrams, and is furnished with an index of 28 pages, in which almost everything referred to in the book can be found.

**Hydro-Electric Power, Vol. 1, Hydraulic Development and Equipment.** By Lamar Lyndon. Published by McGraw-Hill Book Co., Inc., New York. First edition, 1916. 499 pages, 235 figures, 6x9 ins., cloth. Price, $5.00 net. (Reviewed by Arthur Surveyer, M.Can.Soc.C.E., consulting engineer, Montreal.)

In the last few years many books have been published in the United States on hydro-electric practice, and almost each new volume has been an improvement on the previous works. This new book by Mr. Lamar Lyndon, which has for companion a second volume on "Electrical Equipment and Transmission," is no exception to this rule. It is also a great improvement on the other book published on the same subject, by the author, in 1908, and entitled "Development and Electrical Distribution of Water-Power." In this new book has been included the most recent important contributions which have appeared in the technical publications with the possible exception of Robert E. Horton's new category of coefficients of roughness for use in Kutter's formula, and Mr. Schaefer's "German Studies of Uplift Pressure on Masonry Dams." In his preface, the author states that it has been his intent "to produce a work for the guidance of the engineers in the practical design of hydro-electric plant, which would have a character of accuracy, clearness and completeness." The author has thought it advisable to repeat occasionally in different parts of his book, both statements and conclusions, as well as the meaning of the symbols used in the formula. The reason given for this modification is that treatises of this character are seldom read through consecutively, but are used for reference, and that it is both an annoyance and a waste of time to search through every part of a book for data on some single subject. The writer feels sure that this feature will be much appreciated by engineers who have been compelled in the past to read half a book in order to find out what a symbol meant in a formula, or what were the previous conclusions. The value of the book is also greatly enhanced by the numerous numerical examples given in the text.

The first chapter deals with general conditions and does not contain any new matter. The second chapter treats of the flow in streams and the run-off from the basin. The author gives the following method for determining the probable high-water discharge: "If a line of levels be run which shows the slope of the level of the water surface as indicated by the marks left by the flood, and several cross-sections be taken, sufficient data will be obtained to compute, within practical limits, the flow at the time of the flood." This appears to the writer as a very doubtful method, as a very slight variation in the slope would cause the calculated flood discharge to vary within excessive limits. As noticed above, this chapter does not include Horton's values for *n* in Kutter's formula, but only the old-time table which gives nine subdivisions only. It contains, however, a very valuable method for the determination of the back-water curve caused by a dam. The formula given is much simpler than Bresse's old formula and apparently more accurate than Dupuit's, both of which have been doing service for over half a century. In the measurement of stream by floats, Mr. Lyndon refers only to the surface float method, which is not very accurate, and does not refer to the submerged float method nor to the rod float method, which are both more dependable. The Mississippi River was gauged by Abbott and Humphrey by the submerged float method, and valuable formulæ for the discharge of rivers deduced from these observations. The writer has used both the submerged and the rod float method, with good results, to measure volumes of over 100,000 cubic feet per second.

Chapter 3, entitled "Weirs and Orifices," refers to the flow over weirs of various shapes and to the discharge through sluice gates and penstock intakes. The coefficients of discharge through sluice gates given as the result of experiments made in India and at Lowell, Mass., vary from .74 to .95 and appear very high to the writer. A coefficient of 0.62 has long been considered as a fair average when contraction took place on four sides and 0.80 when contraction was entirely suppressed.

Chapter 4 deals with "Power Variation and Storage"; Chapter 5, on "Artificial Waterways," contains valuable information on the flow through canals, the limiting velocity of water for various materials, seepage losses in canals, etc. The subject of open flumes is very well handled and the analysis given of the stresses in wooden flumes includes the stresses in the trestle work. Concrete flumes are also analyzed and complete method of calculation given. This information is not easily found elsewhere and is very valuable.

Chapter 6, "Pipe Lines and Penstocks," is a very important one; it contains the calculation of the different losses in pipes, also the determination of the size of the pipe and the computation of the discharge for a system of varying cross-section. The author gives a formula for the calculation of the distance between penstock supports which he does not consider satisfactory. Mr. R. A. Wright gave one in "Engineering News" of February 10th, 1910, in an article entitled "Steel Supports," which appears to fit the problem better.

Chapter 7, on "Dams," is perhaps the most important of the whole book. The problem is very well presented and the explanations clearly given. The author considers that the effect of the uplift force (due to hydrostatic pressure under the base) is substantially negligible and that any failure of a dam, by overturning, must be assigned to other causes. He argues that the most dangerous condition that must be provided against is, full pressure at the upstream edge and no pressure at the toe. This uplift pressure applying only over 25 per cent. of the area of the base. The arguments brought forward sound convincing, but they are in contradiction with the results of some experiments made at the Oester and Neye dams in Germany to determine the uplift pressure and summed up by Mr. Schaefer in an article entitled "German Studies of Uplift Pressure on Masonry Dams," which was abstracted by Mr. Alfred W. Hoffmann in "Engineering and Contracting" of September 22nd, 1915. The two dams examined were built on rock foundation of grey wacke and slate of widely varying description. The conclusions arrived at by Mr. Schaefer are that "every dam is subjected to some uplift pressure, even if the greatest care has been exercised in the selection and preparation of the foundation." Mr. Schaefer recommends that in the designing, the full hydrostatic pressure due to the maximum head be assumed at the heel and one-half the pressure at the toe, the pressure being effective over the entire area and decreasing uniformly from the heel to the toe. A dam is to be considered safe and stable if the resultant does not pass closer to the toe than 1/6 the width of the base. Applying the methods suggested by Mr. Schaefer to the dam described and shown by Mr. Lyndon on page 198, we find that instead of having a factor of safety of about three, as is the case when the Lyndon method is followed we have a factor of safety smaller than unity and a resultant falling outside the base. This chapter also includes valuable discussion on foundations of dams on rock, on sand and on clay. A complete example of the method of calculation of a hollow reinforced concrete dam is also given. Expansion joints in dams and reinforced concrete retaining walls are also included in this chapter. Reference is also made to earth dams and hydraulic fill dams.

Chapter 8, on "Movable Crests for Dams," contains a good deal of information which is not available in the other books, and describes flash boards, automatic crest gates and their protection. Stoney roller gates, Stickney gate, automatic gates with rolling counterweight, Taintor gates and rolling dams.

Chapter 9, on "Headworks," refers to stop logs, log booms and the analysis of the forces acting upon them, trash racks, loss of head through racks, head-gates, head-gates hoists, and the Johnston valve.

In Chapter 10, on "Water Wheels," the author very wisely limits his discussion to the mixed flow reaction turbine and the curved-bucket impulse wheels which are the two kinds in use at the present time. The principal headings of this chapter are: The theory of the reaction turbine; unit quantities; relationship between speed, power, discharge and diameter; turbine characteristics; efficiency and size of wheels; wheel setting; details of turbine design; design of concrete scroll cases and draft tubes (two of the most valuable features in this chapter and due to Mr. A. G. Hillberg); the theory of the impulse wheel and details of its construction and regulation.

Chapter 11, "Speed regulation of Water Wheels and Abnormal Penstock Pressures," contains much information hitherto scattered in various publications. Its principal sections are: Speed regulation of water wheels; energy delivered by flywheels; the moment of inertia of generators; acceleration of moving column of water; effect of change in head on water wheels; time period of governor; water hammer; relief valves; surge tanks; computations for surge tanks; differential surge tanks; pipe vents; vent or air valves and water wheel governor.

The author's invitation to "criticisms from engineers who are new in the art," is probably responsible for this somewhat lengthy review of his book. In closing, the writer would like to say that, notwithstanding the few remarks made, this work compares most favorably with the half dozen or so of other American books on the same subject. The engineer engaged in the design of hydraulic plants proper, not including the design of the hydraulic machinery, will probably find Mr. Lyndon's book the most useful one yet published in English.

**Practical Sanitation.** By Dr. George Reid. Published by Charles Griffen & Co., London, Eng. 18th edition, revised. 356 pages, 5 x 7½ ins. Price 6d. (Reviewed by R. O. Wynne-Roberts, Toronto.)

The fact that this book has now reached its eighteenth edition is an indication of its value, for few books survive long enough to demand several editions. It has been written more particularly for the use of inspectors and those connected with sanitary inspection in Great Britain. The context deals with sanitation generally as it is considered in temperate climes. But there are many conditions in Canada which are peculiarly Canadian and the reader must bear this in mind when perusing the book. For example, houses are built differently in many respects, heating, ventilation or the absence thereof, drainage, insulation, and so on have to be provided in a different manner. Soil pipes are always placed outside the dwelling in temperate countries, but difficulties would ensue if that practice was observed here. Ventilation, especially in the winter time, is a problem not always easy to solve, and consequently some of the methods advocated in this book will not be practicable. Water will no doubt improve in quality by prolonged storage. Dr. Houston, one of the eminent authorities on water purification, has the greatest confidence in this factor in the treatment of water. During the winter, however, the open reservoirs will be frozen over for many weeks and the effects of the sun and the atmosphere are greatly modified, and the bacteriological improvement will no doubt be slight. Sterilization is a common method of treating doubtful waters in North America, but in other countries it is not by any means so generally carried out. Slow sand filters are the standard types in temperate countries, but rapid sand filters are probably more largely adopted in these parts.

The quantity of water used and misused on the American continent is greatly in excess of that in Europe and the standards of practice in the distribution and waste detection are somewhat different. Few cities in other parts of the world resort to the general use of meters to conserve the water, whilst many cities in North America have adopted meters as a measure for preventing waste.

Natural ventilation of large buildings in Canada is hardly feasible; mechanical means of propelling and withdrawing the air have to be installed, and the air warmed, humidified, washed and cooled according to the season and circumstances. Fire places are virtually ornaments in these parts, excepting in few instances, and yet if the matter was properly investigated it would, no doubt, be found that suitable grates and fire places would be beneficial, comfortable and economical.

Plumbing work, as a rule, is under rigid control and inspection in the larger cities, and should be in all villages and towns, for the health and amenity of the people are matters of great importance to a community.

Dr. Reid refers to the aeration of sewage by mechanical means as being too costly, and further on deals with the activation process as being in an experimental stage. Having regard to the amount of investigation which has been made and to the works which are now in operation in England and America, it would appear that this subject has not received the fullest consideration.

When treating with infection and disinfection and food, Dr. Reid presents facts which are useful in all parts of the world, and as sanitation in its general principles is international in character, this book will be found useful to those interested in the subject.

Compressed air water supplies, testing of drains by compressed air under pressure exceeding one or two pounds, and the general principles of domestic lighting are not referred to. Water testing of drains is not uniform in character, especially when regard is paid to the plumbing in higher buildings and in winter weather, whereas compressed air under, say, 5 or 10 lbs. pressure would be not only uniform but available under almost all conditions. This volume contains numerous clear illustrations and is well got up.

**Practical Oil Geology.**—By Dorsey Hager. Published by the McGraw-Hill Book Co., Inc., New York. Second edition, 1916. 187 pages, illustrated, 5 x 7½ ins., leather. Price, $2.00 net. (Reviewed by J. B. Tyrrell, mining engineer, Toronto.)

The dedication is "To the Practical Oil Man of America, with the hope that the book will bring him to a better understanding of the relation of the Geologist to the Petroleum Industry." Part of its usefulness is here

10

expressed, but in addition it will serve as a textbook for young oil geologists, and it will assist in the formation of intelligent public opinion which is so greatly needed, not only in those parts of the country where oil or gas may reasonably be expected to be found, but in all Canadian cities where the people may be urged to buy stock in companies that are endeavoring to exploit oil lands. Such intelligent public opinion would have been particularly serviceable in Calgary rather more than two years ago, when people were being so easily separated from their money.

The modes of occurrence of petroleum and gas are described in a clear and interesting way and the descriptions are assisted by a large number of plates and diagrams. The methods adopted by geologists in locating pools of oil are described so lucidly and simply that there might be a possible danger of the untechnical reader thinking that technical training was not necessary for such simple location work, but that he could do it quite well himself. Very large amounts of money have been spent by men who have thought that they could do their own geological work cheaper than trained geologists could do it for them. In legal matters, lawyers have persuaded the people that only "fools" try to do their own legal work. Those who try to do their own geological work put themselves in the same class. They usually endeavor to cover up or explain away their own mistakes by abusing the ignorant "geologists."

The book is well printed on good paper, and is of convenient size to be carried in the pocket. Unfortunately a number of errors in proof-reading mar some of the pages.

## PUBLICATIONS RECEIVED.

**Toronto Railway Company.**—Twenty-fifth annual report, 1916.

**Canadian Society of Civil Engineers.**—Transactions of the Society from October to December, 1915.

**Feldspar in Canada.**—By Hugh S. de Schmid, M.E. Published by the Department of Mines, Ottawa.

**Mines Statements for the Year 1915.**—By the Hon. W. D. S. MacDonald, Minister of Mines, New Zealand.

**London Street Railway Company.**—Forty-second annual report for the year ended December 31st, 1916.

**Why Build Fireproof?**—A 22-page illustrated pamphlet, published by the Portland Cement Association, Chicago.

**Report** of the chief engineer of the Board of Estimate and Apportionment of the city of New York, for the year 1915.

**Geology of Kingston and Vicinity.**—By M. B. Baker. Twenty-fifth annual report, issued by the Ontario Bureau of Mines, 1916.

**Onaping Map-Area.**—By W. H. Collins. Memoir 95 No. 77, Geological Series. Published by the Department of Mines, Ottawa.

**Hydrometric Surveys.**—Report of hydrometric surveys for the calendar year 1915. Issued by the Department of the Interior of Canada.

**Public Road Mileage and Revenues in the Southern States, 1914.**—Bulletin No. 387 issued by the Department of Agriculture Washington, D.C.

**Coal and Coke in Canada.**—Report of the production of coal and coke in Canada during the calendar year 1915. Issued by the Department of Mines, Ottawa.

**The Nature and Origin of Petroleum and Asphalt.**—By Clifford Richardson. Reprinted from "Metallurgical and Chemical Engineering," January 1st, 1917.

**Integral Curb for Concrete Pavement.**—An 11-page illustrated leaflet, published by the Portland Cement Association, 111 West Washington Street, Chicago.

**Highway Engineering.**—Proceedings of the second annual short course in highway engineering held at the University of Michigan, February 21st to 25th, 1916.

**Canadian Society of Civil Engineers.**—Presidential address of F. C. Gamble, delivered at the annual meeting of the Society, held in Montreal, January 26th, 1916.

**Mineral Production of Canada.**—Preliminary report of the mineral production of Canada during the calendar year 1916. Issued by the Department of Mines, Ottawa.

**Asphalt Pavements, Specifications and Properties.**—Bulletin No. 12, issued by the Kansas City Testing Laboratory, 1013 Grand Avenue, Kansas City, Mo. Price, 50 cents.

**Sun Oils: Barrels.**—Fifth of a series of pamphlets issued by the Sun Co., 1428 South Penn Square, Philadelphia, Pa., on the progress and rapid growth of the oil industry.

**Timber Import Trade of Australia.**—Report prepared by H. R. Macmillan, Canadian Special Timber Trade Commissioner. Supplement to weekly bulletin issued by the Department of Trade and Commerce, Ottawa.

**Structural Materials.**—Report of the production of cement, lime, clay products, stone and other structural materials in Canada during the calendar year 1915. Issued by the Department of Mines, Ottawa.

**Mineral Production of Canada, 1915.**—Advance chapter of the annual report on the production of copper, gold, lead, nickel, silver, zinc, and other metals in Canada for 1915. Issued by the Department of Mines, Ottawa.

**Importance of the Relation of Solid Surfaces and Liquid Films in Some Types of Engineering Construction.**—A paper read before the Western Society of Engineers at Chicago, November 20th, 1916, by Clifford Richardson.

**Cobalt Alloys with Non-Corrosive Properties.**—By Herbert T. Kalmus, B.Sc., Ph.D., and K. B. Blake, B.Sc. Report of researches on cobalt and cobalt alloys, conducted at Queen's University, Kingston, Ont., for the Mines Branch of the Department of Mines, Ottawa.

**The Thames-Victoria Embankment Pavement.**—A record of experience from which there was evolved a wearing surface to carry successfully the exceptionally heavy traffic of London's famous thoroughfare. Pamphlet issued by the Barber Asphalt Paving Company, Philadelphia, Pa.

**Sewage Treatment by Aeration and Activation.**—By George T. Hammond, Engineer of Design and in charge of the Sewage Experimental Station, Bureau of Sewers, Brooklyn, N.Y. Reprinted from the Proceedings of the American Society of Municipal Improvements, 1916. 101 pages, illustrated.

## CATALOGUE RECEIVED.

**Asphalt, Road Oils and Road Binders.**—A 29-page illustrated booklet describing the asphalt, road oils and road binders for sale by John Baker, Jr., Suite 820-822 Marine National Bank Building, Buffalo, N.Y.

# Editorial

## "WANTED—A CHEAPER ENGINEER."

Members of the Canadian Society of Civil Engineers who have been discussing the necessity of having tthe Society support its members in any disputes with municipal councils where the engineers are unfairly treated, will be interested in the following item which appeared in the Toronto "Mail and Empire" under the heading, "Kitchener Wants A Cheaper Engineer":—

"Kitchener, March 20.—Pursuing its policy of retrenchment the city council by a vote of eight to six has decided to call for applications for a city engineer, although no charges of incompetency have been preferred against the present official, Herbert Johnston, who has held the office for the last eight years. Engineer Johnston is receiving a salary of $2,250 and it is claimed by the 'retrenchment' members of the council that a capable official can be secured at a less figure. No notice has been served on City Engineer Johnston that his services are no longer required."

The rank injustice and the cold-blooded commercialism of the eight Kitchener councillors as expressed in this newspaper report are so obvious that comment is almost superfluous. Their action savors more of Berlin than of Kitchener.

The affair deserves the prompt attention of the council of the Canadian Society of Civil Engineers. The names of these eight councillors, if they do not withdraw from their position, should be made known to every engineer and to all other professional men in Canada. We cannot imagine any advantage that would accrue to professional men in dealing with individuals who would lend themselves to such contemptible tactics.

Mr. Johnston, who is a corporate member of the Canadian Society of Civil Engineers and an S.P.S. alumnus, has been in Kitchener's engineering department for fourteen years,—seven as assistant engineer and seven as city engineer. He has never previously had any serious disputes with any of the various councils, and none of his work has been under fire. He has not been asked by the councillors for his views on this subject, and in fact has not been approached by them in any way. They did not even enquire whether he would consent to a reduction in salary.

The whole affair is no doubt the result of an effort to keep the tax rate at a lower figure than can be done with efficiency in the city service. After the hospital, the school board and other Kitchener institutions had been made to suffer, it was still necessary to reduce expenses by a couple of thousand dollars more, so one alderman moved that the city engineer's salary be reduced by $1,100. As a result of the following discussion it was decided to advertise for "a cheaper engineer."

It is almost unnecessary to call to the attention of the engineering profession throughout Canada that it would be most unethical and unprofessional for any engineer to answer Kitchener's call for applications while Mr. Johnston still holds the position, or if he is discharged merely because a "cheaper" man is wanted. No self-respecting engineer will pay any attention to Kitchener's call.

## SULPHUR IN ROAD OILS.

One of the four main requirements in the Canadian Society of Civil Engineer's tentative specifications for road oils reads as follows: "It shall not contain acid nor sulphur in sufficiently large quantities to attack rubber or rubber compositions."

At first glance such a clause appears to be a praiseworthy effort to reduce the cost of high living for tire-buying motorists. But the thoughts occurred to us upon reading these specifications, "What quantity of sulphur is sufficiently large to injure rubber or rubber compositions under the conditions of contact of auto tires with road oils? and should not a fixed maximum quantity be definitely stated in the specifications? and are there any active sulphur or sulphuric acid compounds in road oils?"

With these questions in mind, the views of several chemists and tire manufacturers were obtained, resulting in the conclusion that the Society would be well advised to discuss thoroughly the wording of this clause in their official standard specification. The specification has not yet been adopted by the Society, nor is it in any way recommended by the Society for use by the Society's members. It is as yet merely a tentative specification which was laid before the Society at its last annual meeting and received but not adopted. The committee that prepared it requested that it be merely received as they wished to report further at the next annual meeting. The tentative specification was offered meanwhile practically as a progress report. The following opinions upon the sulphur and acid requirement will therefore prove timely:—

A. F. Pond, chief chemist, Goodyear Tire & Rubber Co. of Canada, Limited: "It is our opinion that sulphur in an asphaltic road oil will have no injurious effect upon automobile tires."

W. E. Campbell, chief chemist, Gutta Percha & Rubber, Limited: "I do not think that the sulphur contained in road oils would be any danger to tires. Any injurious effect that road oils have upon tires comes more from the softening action of the oil on the rubber, and any vulcanizing or hardening effect of the sulphur would be offset by this softening. But even the softening action is not great enough to be at all serious unless the auto stands for a considerable period in a pool of oil. I do not think that any active injurious compounds of sulphur would be found in the oils in view of the temperatures at which they are refined."

The chief chemist of another large rubber company requested that his name be not published, but says: "My opinion right along has been that no amount of sulphur that would be found in any road oil on the market would damage auto tires. Free sulphur already exists in tires. Almost any rubber goods has a bloom. That's sulphur. We mix in 2, 3 or 5 per cent., or whatever may be called for by the requirements, and possibly only half of this will be used in the manufacturing processes, and the other half remains in the tire as free sulphur, but it doesn't do any harm to the tire. One can scrape sulphur off the surface of almost any piece of rubber goods two or three years old. At all times there is as much free sulphur on the tires, forming a constituent part of the tire, as would be taken up off the road from a road oil. As for sulphuric acid, the refining processes tend to neutralize any such acid in the oils. But even a little sulphuric acid would not injure tires appreciably. The little bit of acid that would remain on the road after rainstorms, etc., would not 'touch' the tires."

C. A. Mullen, director of paving department, Milton Hersey Co., Limited, chemists and inspectors: "In reply to your enquiry for our opinion as to the effect that the small percentage of sulphur in asphaltic road oils might have upon the rubber in automobile tires passing over roads treated with such oils, we do not believe there would be any effect, and consider the suggestion that there might be as very far-fetched."

A. W. Dow, of Dow & Smith, chemical and paving engineers: "From long practical experience with oils containing sulphur, on roads, and also from laboratory examination, and from a theoretical consideration of the subject, we can positively state that the sulphur contained in road oils has no action whatsoever on rubber tires or rubber compounds.

"If the sulphur in the original oil was in a condition to act on rubber, this property would be entirely destroyed in the course of refining the oil. Any sulphur or sulphur compounds that will attack rubber will also attack the hydrocarbon oils when heated with them at a high temperature. In the process of manufacturing the asphalt road oils they have been heated to such a temperature that all active sulphur or sulphur compounds have been destroyed and rendered inert so that any sulphur that remains in the road oil has absolutely no action whatsoever on rubber or its compounds.

"The writer, while connected with the United States Government in Washington in 1914, made quite extensive tests on the action of road oils on rubber tires and pure gum rubber. Among the oils tested was a crude oil from Beaumont, Texas, oil field, containing considerable sulphur, some of which was evidently in a free state. After a test extending over six months he could not note that this oil had any more deleterious effect upon rubber tires and gum rubber than had oils from California and Pennsylvania, which were quite free from sulphur and sulphur compounds. In fact, he was surprised at the slight action of the heavy road oils on rubber and rubber compounds. He did find that the crude Russian oil had more action on rubber tires than any of the oils from the United States.

"Any statement to the effect that the sulphur is contained in these oils as sulphuric acid is absolutely false, as sulphuric acid can not exist at temperatures much lower than those to which the oils have been subjected in the course of their manufacture. The fact that these oils are shipped in iron receptacles and are refined in iron stills should be sufficient evidence to show that such a statement is ridiculous.

"I have just inquired of the chief chemist of the United States Rubber Company, who are large manufacturers, if he has ever noted any deleterious effects of road oil on rubber tires, and if so whether he has noted that any one oil is more deleterious than another. He has just told me that he has never noticed any difference in the action of different oils on rubber tires, and part of his work consists in the making of special mixtures for tires and studying their wear under different road conditions."

A. E. Heyes, of Thos. Heyes & Son, consulting chemists: "The sulphur or sulphonates in road oil would not affect rubber tires. There would be no active sulphuric acid in such oils after refining. The only damage road oils would cause would be a tendency gradually to rot the tire and its canvas backing through softening. This would be very gradual and hardly need be considered for any practical purposes. If a tire were to be immersed in an oil bath and stood in the sun, then the oil would no doubt have an effect upon the tire. But it would require eight per cent. of sulphur to harden or crack tires, and even if this quantity were to be in the road oil, the nature of the contact of the tire and the oil is such that we do not believe there could be any injurious results from anything of this nature."

T. Linsey Crossley, of J. T. Donald & Co., consulting chemists and paving engineers: "Unless the road oil is badly placed, the oil will not get on the tire at all except on the tread, which would not be affected by the oil. The tread is either being continually rubbed off by the stone dust and sandy matter, or else, if the road is muddy, the mixture of water with the oiled earth will dilute it so much that there is still less chance of any damage. As a matter of fact, the tire troubles so often attributed to road oils are almost always due to other causes.

"Some oils are solvent and might affect a tire somewhat, but not a high grade asphaltic or tar oil. The cheaper, carelessly-prepared road oils would affect tires, but even there the damage is not due to sulphur but to the fraudulent use of acid sludge, i.e., the mixture of sulphonated hydrocarbons resulting from the treatment of bitumens with sulphuric acid. If any of this material should be sold by mixing to form a road oil, or should find its way into a carelessly prepared road oil, it might have a bad effect. The chief effect would be upon metal surfaces rather than on rubber, however.

"Sulphuric acids in straight steam-refined road oils would no doubt be eliminated by the refining processes. The sulphur that occurs in the crude oils is present as complex sulphur compounds of these oils, and not as $H_2SO_4$, or as $H_2SO_3$, and probably not even as $H_2S$.

"Chemically, road oils are very inert substances. Any action they would have would be physical, i.e., as solvents. And I do not think that the solvent effect upon tires would be noticeable. Even if one soaked a tire in road oil, it is doubtful whether that would have much actual effect."

The opinions of these well-known paving chemists, and of the tire manufacturers (who guarantee big mileages for their tires and would be bitterly opposed to any influences tending to damage them) are authoritative. Due consideration will no doubt be given to them by the committee reporting on this specification.

## C.P.R. EXHIBIT OF HYDRO-ELECTRICS.

To emphasize the economic importance of electric products, and to show their relation to other industries is the object of the C.P.R. Hydro-Electric exhibit opened on March 12th in the Shaughnessy Building, McGill St., Montreal. The exhibit has been arranged to interest the layman as well as the specialists, and, although it is essentially technical in character, processes are explained so clearly in the accompanying placards that he who runs may read. An instance of this is the series showing the evolution of the modern incandescent electric lamp. An interesting item shown was a shell piercer punch with an actual record of having pierced 24,000 4.5-inch shells.