THIS ISSUE CONTAINS { Railway Structures
Sanitary Review

Canadian Engineer

A WEEKLY JOURNAL

For CIVIL, MECHANICAL, ELECTRICAL and STRUCTURAL ENGINEERS and CONTRACTORS

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BUYER'S REFERENCE—PAGE 48—50.

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* Every Other Week † Once a Month

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Continued on Page 48.

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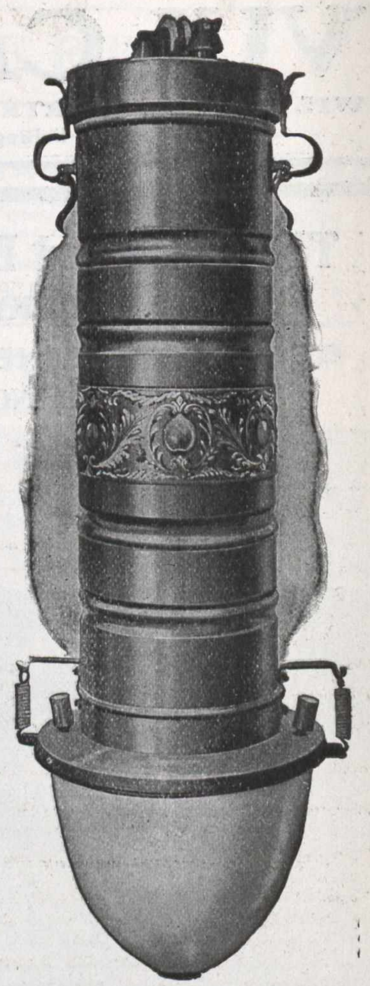

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The Canadian Engineer

WEEKLY

ESTABLISHED 1893

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The Canadian Engineer

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Issued Weekly in the interests of the

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Editor—E. A. JAMES, B.A. Sc.
Business Manager—JAMES J. SALMOND

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NOTICE TO ADVERTISERS

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TORONTO, CANADA, MAY 14, 1909.

CONTENTS OF THIS ISSUE.

HAVE WE THE MEN?

Sometimes we are told that to be practical is not professional. Professional attainments are not limited to any party, race or nationality—fortunately so. It would not be wise to place about a profession artificial walls that tend to cramp, restrict and dwarf the ideas and ideals of the professional man. Liberty is just as necessary for professional growth as for national growth—but liberty is such a relative term.

The three most important engineering works in Canada to-day, unique in their position, national in their character, and the outcome of Canadian thought and faith are the G.T.P. Railway, the building of the Quebec Bridge, and the Ontario Hydro-Electric power scheme.

Canadian credit was required to finance, Canadian money must pay the tax, but apparently Canadian brains do not possess the necessary acumen to design nor Canadian workmen the skill to build these great works.

One of the works required a man of great executive ability, combined, if possible, with engineering talent. The other two required men of outstanding professional attainments in particular lines. With the appointments we have no fault to find. Search was made for good men, and good men were found.

It is the working-out of the details that are irritating. One section of the G.T.P. employees an engineering staff of fifty-six. Of these, forty are foreigners. One hundred and forty Canadians could be found as well trained and as capable and ready for this work. Surely this is nation-building! Constructing Canadian transportation routes with outsiders while Canadian men are idle.

The appointment of a Board of Engineers to deal with the Quebec Bridge problem was a delicate task. That the selection was wise is generally conceded, but does it not seem unfortunate that the only tangible work done so far, the testing of the solidity of the river bed at the site, should be done by men from Chicago, working with imported machinery, when both the machinery and capable and experienced men could be found in Canada?

The situation in connection with the power line is little better. Months have passed since the work was supposed to be let, yet what has been done? The experienced men brought from a distance and given charge of the work, to design and plan, because of their peculiar fitness, find it necessary to trip abroad and do just what inexperienced Canadians would do—investigate the work of others and draw conclusions and prepare plans suitable for our own conditions.

We are not crying Canada for the Canadians, but we do assert this land has the men—at least the equal of men of any other country—they go abroad and make good, but do not get the opportunity to make good at home.

Development cannot be accomplished by isolation, but by close application, association and experience, and more of this would be the better for the men and—the country.

NIAGARA FALLS PARK COMMISSIONERS' REPORT.

The report for 1908 of the Commissioners for the Queen Victoria Niagara Falls Park has just been issued.

One of the most important and seasonable suggestions it contains is in reference to the training ground this park may be made.

"The commissioners think that this great park and boulevard system should not only be used for recreation and enjoyment of the public, but should also be utilized during its formative period, and for all time to come, as a provincial school of practical forestry, horticulture, floriculture and botany, and last, but not least, an object lesson in good road building."

The payments by the power companies to the Commissioners amounted to over ninety thousand dollars, an amount very little in excess of the payments for 1907.

The report also contains a review by Isham Randolph, C.E., of William Spencer's report on Falls of Niagara. Mr. Randolph takes issue with Mr. Spencer's conclusions in reference to the discharge of the Niagara River and the relation of the river discharge and Lake Erie level.

RAILWAY ACCIDENTS IN THE UNITED STATES.

The twentieth annual report on the statistics of railways in the United States, issued by the Interstate Commerce Commission, contains tables of accidents occurring during the year ending June 30th, 1907.

During the year the railways carried 873,905,133 passengers. Of these, 610 were killed, or one in every 1,432,631. There were 13,041 injured, or one in every 6,712.

Of the employees, there were 1,672,074 engaged in various capacities, and of these 4,534 were killed, or one in every 369. The total number of injured employees was 87,644, or one in every 20.

Collisions and derailments are responsible for almost one-third of the fatalities. All the blame does not rest with the employees, nor yet with the railways. Rigid discipline cannot be maintained while the men maintain their present attitude of promotion and advancement within divisions. It would be better for the men, the railways and the public if instructors and supervisors were entirely free from the unions.

The railway and highway crossings, as in this country, are responsible for a large number of fatalities. But in all cases of accidents, publicity of the facts of each killing will bring about an improvement, for the public will support, when deeply concerned, whatever steps are necessary to secure the end sought.

EDITORIAL NOTES.

The ninth session of the Summer School for Artisans of the University of Wisconsin begins June 28th, continuing for six weeks. Courses are offered in Steam and Gas Engines, Electricity, Machine Design, Mechanical Drawing and allied subjects. There are no entrance requirements, the purpose of this school being to offer practical instruction by lectures and laboratory practice to young men in the trades. Certain advanced engineering courses are offered for those having the requisite preparation, and the general University Summer Session held during the same period allows opportunity for a wide choice in subjects of instruction. A new feature of the coming session will be courses in public utilities testing and accounting for those desiring to become familiar with the requirements of the Railroad Commission of Wisconsin, which has the administration of the Wisconsin Public Utilities Law. Information may be obtained from F. E. Turneaure, Dean, College of Engineering, University of Wisconsin, Madison, Wis.

* * * *

The annual convention of the Canadian Electrical Association will be held in Quebec, Wednesday, Thursday and Friday, June 16th, 17th and 18th, 1909. Features of the programme will include: Seeing Quebec by electric cars, visit to the Chaudiere Falls, dinner at Kent House at Montmorency Falls, steamer trip around Quebec harbor, including bridge sight; band concert on Dufferin Terrace. Reports will be received from the following committees: Committees on Statistics. Theft of Current, Grounding of Secondaries, Meter Inspection and Testing.

* * * *

For many years the Bell Telephone Company have had a monopoly of telephone installations in railway stations. The late Mr. Blair, chairman of the Dominion Railway Commission, upheld the agreement between the Bell Telephone Company and the railway companies, which gave them exclusive use to this business. Under the chairmanship of Mr. Mabee the Railway Commission have reversed this decision, and henceforth independent telephone companies will have the privilege of installing instruments in railway stations. Recently, the order was given in the Sherbrooke case, and it is to be expected the new order will be made general throughout Canada.

The Monetary Times is considering the publication in pamphlet form and at a popular price, the articles of Mr. H. E. M. Kensit, Mem. Inst. E.E., Mem. A.M. Inst.. E.E., on "Uniform Municipal Accounting," which recently appeared in these colums. In view of the movement in Canada for uniform municipal accounting, these articles are of especial interest. Mr. Kensit said in concluding his articles:

" What knowledge the writer has of the subject has been gained as an official responsible, not for the actual keeping or auditing of accounts, but for seeing that they were kept on the financial principles and in the form advocated, and this experience has promoted a lively appreciation of the great importance and highly technical nature of accountants' work. An engineer often becomes so absorbed in technical details that he loses sight of financial considerations, and similarly an accountant gets such a close view of the details of the bookkeeping that he also may lose sight of important points that may greatly affect the position of the undertaking in future years; the best results are to be obtained from collaboration between the accountants and the engineers, for neither can conduct his department to the best advantage without the help of the other."

Should the demand for this valuable series prove sufficiently great, a further announcement will be made.

RAILWAY EARNINGS AND STOCK QUOTATIONS

NAME OF COMPANY	Mileage Operated	Capital in Thousands	Par Value	EARNINGS Week of May 7		STOCK QUOTATIONS — TORONTO				MONTREAL			
				1909	1908	Price May 7 '08	Price Apr. 29 '09	Price May 6 '09	Sales Week End'd May 6	Price May 6 '08	Price Apr. 29 09	Price May 6 '09	Sales Week End'd May 6
Canadian Pacific Railway	8,920.6	$150,000	$100	1,329,000	1,156,000	156¼ 156	177½	180 179¾	1950	155½ 115¼	177¼ 177	180¼ 180	7888
Canadian Northern Railway	2,986.9	....	....	159,500	156,700	....	....	....	....	....	....	....	....
*Grand Trunk Railway	3,536	226,000	100	714,028	708,320	....	*1st. pref. 108, 3rd pref. 53½, ordinary 22⅛				....	....	....
T. & N. O	334	(Gov. Road)	....	23,039	14,622	....	....	....	....	....	....	....	....
Montreal Street Railway	138 3	18,000	100	71,029	66,867	....	....	....	....	184 182¼	208¼ 208	211 209	225
Toronto Street Railway	114	8,000	100	68,244	63,008	99 98½	....	124 123	21	99 98	124 123¾	124 123¾	407
Winnipeg Electric	70	6,000	100	....	....	152 149½	168	170	100	....	167¾	167¾	28

* G.T.R. stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

STRENGTH OF TIMBER vs. REINFORCED CONCRETE.*

By Ernest McCullough, Civil Engineer.

For all beam formulae assume the form $M = Kbd^2$, in which

M = resisting moment in inch pounds.

b = breadth in inches.

d = depth in inches.

For timber d is always the total depth, but with reinforced concrete it is the depth from the top of the beam or slab, to the centre of the steel, in the bottom near the tension edge. Concrete must be placed underneath the steel for protection. For thin slabs this should not be less than three-quarters of an inch. For ordinary beams about an inch and a half. For girders and columns about two inches.

The Section Modulus for a rectangular beam of homogeneous material is $\frac{bd^2}{6}$, and when multiplied by the fibre stress of the material it can be thrown into the form $M = Kbd^2$, by dividing the fibre stress by thus $K = \frac{f}{6}$ in which f is the fibre stress in pounds per square inch.

For timber there are several classes by which the fibre stress is determined. Class A is for structures freely exposed to the weather, such as railroad trestles, etc. The fibre stresses used in this class are as follows: White pine, cedar, spruce or eastern fir, 700 lb. per square inch. Short-leaf yellow pine, 1,000 lb. White oak and long-leaf yellow pine, 1,200 lb.

Class B is for structures under roof protected from rain, but without side shelter. White pine, cedar, spruce, eastern fir, 755 lb. Short-leaf yellow pine, 1,150 lb. White oak and long-leaf yellow pine, 1,380 lb.

Class C is for structures entirely enclosed and protected from outside moisture, but not exposed to heat, so that the timber will be thoroughly dried. White pine, cedar, spruce, eastern fir, 825 lb. Short leaf yellow pine, 1,400 lb. White oak and long leaf yellow pine, 1,680 lb.

Class D is for structures entirely enclosed and heated in the winter, thus keeping the timber dry. White pine, cedar, spruce, eastern fir, 875 lb. Short-leaf yellow pine, 1,550 lb. White oak and long-leaf yellow pine, 1,870 lb.

The values of K for the above classes are as follows:—

Class A. K = 117; 167; 200.

Class B. K = 126; 192; 230.

Class C. K = 138; 234; 270.

Class D. K = 146; 258; 312.

The foregoing may appear like a wide range, and the values of K for concrete are as great, because concrete varies in strength according to the aggregates of which it is composed, and the care with which they are mixed. In making a comparison between timber and concrete it is always well to remember that white oak weighs practically 50 lb. per cubic foot; white pine about 24 lb.; yellow pine, 32 to 38 lb.; cinder concrete, about 115 lb. per cubic foot; broken brick concrete, about 135 lb. per cubic foot, and first-class rock concrete, 150 lb. per cubic foot.

Assuming a value of 16,000 lb. per square inch for the fibre stress of the steel in tension, the value of K for different values of the fibre stress in the concrete are as follows:

For a comprehensive fibre stress at the top fibre of the beam or slab, of 700 lb. per sq. inch, which we can use with first-class concrete made of one part best Portland cement, two parts clean coarse sand, four parts clean washed gravel or broken stone ,the largest pieces being about three-quarters of an inch in their largest dimension; and K = 120. Ratio of steel to concrete = 0.0087.

A similar mix in which the stones may run as large as one inch, and in which a very small per cent. of finely-divided clay or loam is in the sand, will permit of the use of a fibre stress of 600 lb. per square inch, and K = 96. Ratio of steel to concrete = 0.0068.

In the foregoing it is of course taken for granted that the material is mixed in a good concrete mixer, preferably a batch mixer.

When either of the above are mixed by hand, or when a 1 : 2½ : 5 mix is used by mixing in a machine, or we use a 1 : 5 clean ready-mixed bank gravel, mixing same in a machine, then the fibre stress should not exceed 500 lb. per square inch, and K = 72. Ratio of steel to concrete = 0.0051.

If we take the 1 : 2½ : 5 mix, or the 1 : 5 ready-mixed bank gravel, and mix them by hand, or use chats instead of broken stone, then the fibre stress should not exceed 400 lb. per square inch, and K = 49. Ratio of steel to concrete = 0.0035.

For a 1 : 2 : 5 : concrete made of broken brick, or certain kinds of slag of a porous nature, somewhat stronger than coal clinkers, the fibre stress should not exceed 300 lb. per square inch, no matter whether mixed by machine or by hand, and K = 38. Ratio of steel to concrete = 0.0027.

The ratio of steel to concrete is represented by $p = \frac{A}{bd}$ in which A = area of steel in square inches.

b = breadth of beam in inches = 12 in. for slabs

d = depth in inches from top of beam or slab to centre of the steel.

The following formulae enable us to figure the size of beams in reinforced concrete.

$$d = \sqrt{\frac{Kb}{M}}$$

$b = \frac{M}{Kd^2}$, b is the proper dimension to assume and then solve for d. The best value of b is one about one-twentieth or one twenty-fourth the span. It should be between two-thirds and three-fourths of d. Make several trials until this desirable set of conditions is secured:

$A = b \times d \times p$.

The amount of covering over the steel for fire protection has been already mentioned. When several bars or rods are used for reinforcement, the least distance between them should be one and one-half times their diameter or thickness. When using bars or rods in slabs they should never be spaced farther apart than one and one-half times d. If the smallest rods or bars that can be obtained will call for a spacing exceeding this limt, then use a fabricated mesh.

The concrete should be mixed so wet it will not be hard to get it out of the wheelbarrows. It should be sticky and pasty, rather than thin enough to run. Instead of tamping, it should be churned with rods or pipes in order to free the entrapped air and to permit the larger aggregates to move around and fit into place.

To compare wood and concrete it is necessary to remember the differences in weight per cubic foot. Then select the fibre stress for the wood and get the correct value of K. Select the K for the concrete and divide the K for the timber by the K for the concrete. The depth of the timber squared and divided by the difference between the two values of K will give the depth squared of the concrete beam, provided the same breadth is taken. To obtain the depth for the concrete beam there must be added the covering for protection of the steel.

The best way to do is to find the resisting moment for the timber, and then use this for M in the concrete formulae above given. The weight of the beam is of greater importance in the concrete designing than in the timber designing, but at the same time the deflection in a concrete beam is from one-third to one-fourth the deflection in a timber beam of equal strength.

This study is interesting, as it should enable one to make quick comparisons between timber and reinforced concrete construction, but there is nothing of a labor-saving nature

* The Mining World.

about it. The best way to figure the matter out is to find the load the floor is to carry, and get the bending moments, reactions and shear as for any structural calculation, and then the above formulae for reinforced concrete will enable one to proportion the beam.

As to the kinds of concrete. Cinder concrete is rapidly going out of use for reinforced concrete. Cinders often contain a great deal of unconsumed coal, and very often a high per cent. of sulphur. If a fire occurs, the unconsumed coal is bound to burn and the concrete will be destroyed. But it is a danger before the fire comes, for it will swell when wet for concrete and thus prevent the concrete from properly setting. Cinder concrete is often porous, and thus will admit air and moisture, which will attack the steel, and when this is combined with the sulphur present, the steel is bound to be destroyed. The only material to use for reinforced structures is a strong, dense concrete that will not permit air or moisture to attack the steel. Now that reinforced concrete design is thoroughly understood, it is known that cinder concrete is not economical, and the only advantage it possesses is in the weight as compared with rock concrete. Nowadays floors are built of small ribs of reinforced concrete between tile, which form of construction gives a much lighter floor than cinder concrete, and is as strong as an all-concrete floor.

Broken brick, porous slag and inferior chats are frequently used for concrete. It is only necessary to see that the aggregates are thoroughly wet in order that they may not absorb from the cement mortar the moisture so necessary to the proper setting of concrete. They may be used for reinforced concrete, as shown above, and are much better than cinders. The refuse from coke ovens, and the screenings of coke piles make excellent concrete. It is better than cinders, but for reinforced concrete work will be found inferior to broken brick or burnt clay ballast.

Experiments made with slag and chats of good quality show that fully as great strength can be obtained with them as with very good rock. This knowledge for the mining man is invaluable. In fact, we can make concrete of almost any hard substance that will not swell or disintegrate when exposed to moisture. In filling deep trenches we can make a cement mortar composed of one part of Portland cement and three parts of sand, mix it pretty wet and put a foot or two of it in the trench, then shovel the larger aggregates in until they are thoroughly combined with the mortar. Of course the better way is to mix the concrete by combining all the aggregates first and then putting them in the trench. We can throw in large pieces of stones and boulders until the concrete thrown in has filled all the spaces, when we can put in another layer, etc.

In mixing concrete it is best to proportion the material so that all the voids will be filled. The usual proportions are one of cement, two of sand and four of stone, for reinforced concrete work, with larger proportions of stone or large aggregates for other purposes. What proportion to use depends very much upon the judgment of the man putting in the concrete. So much depends upon the regularity of the size of the larger aggregates that it is unscientific.

One method of proportioning is to fill a box holding, say, 10 cubic feet, with the stone it is proposed to use. Then pour water slowly into the box until it is full, and care should be taken that no air is trapped. The amount of water used shows the combined sand and cement to use. Now empty the box and place the stone on a platform and cover it with the amount of sand indicated by the water test. Mix the sand and stone together and place them in the box in layers, tamping so all will go into the box. Now fill the box again with water, carefully measuring it. This will give the amount of cement to use. If the box holds just 10 cubic feet, it is seen the amounts obtained are percentages. The amount of water to use to make the best concrete will be from 8 to 10 per cent. by weight of the cement, sand and stone.

Another method is to proportion the materials by screens. The best concrete is made from aggregates that are graded. This is theoretically the best way to do it, and if one is willing to take the pains, a good concrete is obtained with very little cement. Assuming that the largest stone is one and one-quarter inches in diameter (although for reinforced concrete three-fourths of an inch is the best size except for large work), select screens of different sizes, say, for example, 0.75 in., 0.5 in., 0.25 in., 0.125 in. for stone. Divide the 0.75 by 1.25 and extract the square root. The result is the percentage of all the smaller sizes. Subtract this from 100 and we get the per cent. of stone, less than one and one-quarter inches in the largest dimension. Divide the 0.5 in. by the 1.25 in., and extract the square root. This gives the percentage under the half-inch size. Subtracting this from the first percentage obtained gives the percentage between half and three-quarters of an inch sizes. Divide 0.25 in. by 1.25 in., and extract the square root. This gives the percentage of material smaller than the one-quarter-inch size. Subtracted from the last per cent. obtained it gives the per cent. between half and one-quarter inch. Proceed in the same manner for the one-eigth-inch size. The size of sand grain to use, expressed in decimals of an inch, is 0.034, and the size of the cement grain 0.014 in. By the continual division and root extracting process the percentage of sand and cement is finally obtained.

The above example worked out gives 40 per cent. between 1.25 and 0.75 in.; 20 per cent. between 0.75 and 0.50 in.; 20 per cent. between 0.50 and 0.25 in.; 10 per cent. between 0.25 and 0.125 in.; 7 per cent. of sand and 3 per cent. of cement. This will give a very dense concrete with little cement. To make a stronger concrete, the one-eighth-inch material can be omitted and more sand put in. The way this works out is very interesting, and by having a set of screens the worker may vary his proportions to suit any particular condition. The chief value, however, comes in the use of the screens to screen a few yards of material delivered for use, and thus enables the worker to ascertain how much sand and how much cement to use. This practical method was first described by James F. Hobart in Concrete for November, 1908.

While almost any material may be used for mass concrete and in places where solidity rather than great strength is required, the best concrete is made from trap rock, and the next from granite. Trap rock stands fire better than granite. Sandstone is good, but should not be used for the construction of water tanks or reservoirs of reinforced concrete. Limestone makes as strong concrete as any stone obtainable, but is not good where liable to exposure to fire, as the heat will convert the limestone into lime, and if water ever strikes it the structure is doomed.

Round gravel cannot be surpassed as a material for concrete. The round sides enable the grains to work down into the mass and fit together better than the broken edges of stone put through a crusher. Concrete shrinks in setting, and the grip on the gravel is ideal. Broken-stone concrete generally shows up weaker than gravel concrete; one explanation is that the rock crusher starts small cracks, invisible to the eye, but nevertheless present, so that fractures may readily start when the opportunity comes.

Crusher-stone is best to use because of the gradation of sizes in the aggregates. Great care, however, should be taken to screen out all the dust. If sand is scarce, the rock dust can be screened on a No. 20 screen, and all that passes through should be rejected as being too fine. Very fine sand is bad for the reason that the grains are generally rounded and very uniform in size, thus making a great many large voids.

WATER CONSUMPTION.

The daily per capita consumption of water for the year, July, 1907, to July, 1908, six municipalities, is given in the following table:—

Place.	Gallons Per Capita Consumption Daily.					
	1902-3.	1903-4.	1904-5.	1905-6.	1906.7.	1907-8.
Detroit	160.0	182.8	172.8	162.4	169.1	167.8
River Rouge	36.0	44.1	43.3	43.6	57.0	78.4
Highland Park	83.2	93.8	71.7	61.4	65.7	59.5
Hamtramck	126.5	86.4	84.2	73.9	86.9	80.9
Ecorse	....	....	26.5	23.4	19.7	11.7
Delray	92.0	94.1	79.7	....	....	....
Woodmere	21.6	53.3	60.3	....	....	....

THE

Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

WATER SUPPLY AND INFILTRATION METHODS.

In order to obtain a supply of lake water, many Canadian towns have adopted a method which has become known as that of "Infiltration."

This is done in order to save the expense of running an intake pipe into a lake beyond the zone of turbidity.

Our lakes generally consist of large bodies of water, eminently suitable in every respect for domestic supply purposes. The water, however, at the margins of the lakes is not suitable. Under conditions of storm the shore water becomes turbid; even with gentle winds blowing landward, such water is contaminated less or more by surface drift.

On the foreshore of our lakes we find frequently stretches of sand and gravel. "Infiltration" consists of digging a hole, or well, in this sand or gravel, with the view of the lake water filtering through the material, and thus obtaining a pure supply of lake water, which can be pumped to storage at a height suitable to provide supply.

There is no reason for suspecting that this system of attempting to obtain pure water is sound or effective. There is every reason for suspecting that the system is absolutely unsound and entirely inefficient.

The conditions are: (a) A well dug at a distance of, say, fifty feet from the edge of the lake to a depth of, say, ten feet below the normal lake level. (b) A body of sand and gravel existing between the well and the lake through which the water must pass before entering the well.

With reference to (a), it is obvious that, the well being pumped empty, there is a hydraulic head of ten feet, less the amount of loss of head due to friction presented by the intervening bed of sand and gravel. Further, when the well is at five feet deep there is five feet head, less the loss due to friction, and so on.

With reference to (b), it is also obvious that the gravel and sand used as the filtering media is always under a condition of partial saturation, and that only when the well is pumped dry is half the area of sand exposed to air. This half is represented by a line drawn from the bottom of the well to the surface of the water at the lake edge. This body of sand is made to last as a continuous filter (by lateral filtration) without renewal or washing, and only subject to partial aeration. No bacteria removal could at any time be expected by such a filter. As a strainer, granted that the filtering media is clean to start with, the filter may be effective, but on continued use and collection of matter in the filter, a more impure water may be anticipated in the well than the lake provides.

The point which has not been made clear with reference to this system of filtration is one of great importance, viz.: Does the water appearing in the well really proceed from the lake or from a land source?

The fact that, when the well is not being pumped, the water maintains the same level as the lake is no proof that the lake is the source. The land water at a point so near the lake will be practically at the same level as the lake.

The fact is not always appreciated that where the land surrounding a lake is of a porous character a greater amount of water reaches the lake by invisible than by visible sources of supply. In the neighborhood of Toronto, for instance, no one pretends that the rainfall, less the amount of surface evaporation, in the watersheds of the Don and Humber is represented by the volume discharged by the rivers Don and Humber. The greater amount of the water finds its way by underground streams to the lake.

North Toronto derives its water supply from wells located alongside a stream. An bundant supply of good water is obtained, not by infiltration from the stream, but from an underground source independent of the stream, summer or winter.

What proof exists that in many of the systems of so-called infiltration the water is not supplied from some land source which is feeding the lake.

Dr. Amyot, the analyist for the Provincial Board of Health has on several occasions made analyses of the water in many of these infiltration wells, and in nearly every case found the water to be of a distinctively different character from that in the lake—in some cases as many as 20 parts of chlorine as against 2 in the lake; and generally pointing to sources of land supply.

A case in point is a town on the Georgian Bay, which has for years boasted of an infiltration plant providing pure lake water to the citizens. The question arose of enlarging the well so as to provide a greater infiltration area and obtain more lake water than at present. A by-law for $4,000 was sanctioned for this purpose. Experts were first called in, who were able to demonstrate that the water supply was not from the lake, but from an underground source, which passed under the inhabited part of the town, and into which a number of cesspools drained. On analysis the well water showed 14 parts of chlorine as against 2 in the lake. The depth of the gravel and sand at the lake edge was only about one foot, resting on hard pan, and the distance from the lake such that a simple calculation of the head and loss by friction showed conclusively that no lake water reached the well. Although dye water from certain works had at times discolored the foreshore water, and showed no appearance in the well, and the water in the well presented both summer and winter an invariable temperature, what appeared the obvious source of supply from the lake had not been doubted.

At the best, any scheme of infiltration such as the above must be inefficient as far as filtering water is concerned. The chances are (if no surface contamination is possible) that the land supply will be purer than the lake. Sand or gravel at the edge of a lake in its interior capacity contains large quantities of organic and other objectionable matter, the result of the constant wash of debris and floating matter to the shore. A simple calculation of the head and loss by friction resulting from the material intervening between the well and the lake will generally convince anyone that the lake supply must be relatively small as compared with the land underground flow supply. In all such cases it behoves a community to turn their attention from the large body of water stretching away from their feet to the horizon and pay some attenion to that unseen underground flow feeding the lake, and which may contain impurities gathered in its course.

SEWAGE DISPOSAL.

REMOVAL OF SUSPENDED MATTERS.

CHAPTER II.

Continuous Flow Sedimentation.

In our last issue, dealing more particularly with the Dortmund tank and modifications of this type, we pointed out that simple or mechanical sedimentation depended upon reducing the velocity of sewage flow, causing a consequent precipitation of matter held in suspension.

In this issue it is intended to notice some of the important points relative to shallow rectangular tanks, through which there is a continuous flow maintained from inlet to outlet.

This form of tank has been practically universally adopted, because of its economy, simple construction, low maintenance cost, and practical freedom from intricate working parts.

As previously pointed out the maximum amount of removal of solids (without the use of chemicals as aids to precipitation) is obtained by absolute quiescence, by which as much as 90 per cent. of the suspended matter can be removed, the remaining 10 per cent., consisting of very fine particles, which will not deposit without the aid of a coagulant. With continuous flow sedimentation, however, from 60 to 70 per cent. of the suspended matter can be deposited, the remaining 40 or 30 per cent. being also in comparatively fine particles and sufficiently small to cause little or no trouble when further nitrification by filtration is the object.

Efficiencies of 60 and 70 per cent. solids removal depend upon several factors, which are not always taken into consideration in designing and working the tank.

The important factor in connection with working is the length of time allowed to elapse between periods of sludge removal. At Clifton (England) where the sludge is removed every five weeks the percentage deposit of solids is 51; at Halton (England) every seven weeks, the deposit is 39 per cent.; whereas, at Sheffield (England), where the tanks are thoroughly cleaned out every week, the deposit is 78 per cent. This is readily understood when consideration is given to the disturbing action of the inflowing sewage upon the already settled solids. The settled solids tend to disintegrate into finer particles, especially if septic action takes place, and the least disturbance due to current action, or putrefactive

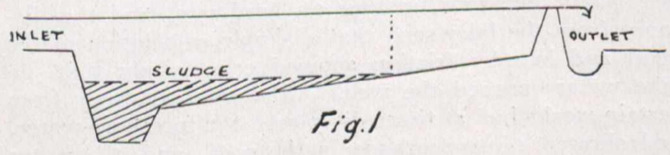


Fig. 1

effervescence, causes the solids to remix with the supernatent liquor.

It must be at once apparent from the above consideration that a continuous flow tank must provide conditions as nearly approaching quiescence as possible within certain limits.

It will also be apparent that the larger the capacity of the tanks in proportion to the flow of sewage, the nearer will be the approach to quiescence. The limit of capacity, however, is ruled by the objection to permitting a sewage liquor to remain in a tank for a sufficiently long period to allow of it becoming over septicised, as in this condition nitrification is interfered with.

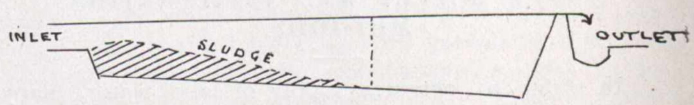
The main points in construction may be stated as follows:

(a) Inclination of tank floor to pump well.
(b) Velocity of flow relative to capacity.
(c) General construction relative to partial quiscence.

Inclination of Tank Floor.

Referring to Figs. 1 and 2, the right and the wrong methods of constructing the floor of a tank are well illustrated by Steurnagel, of Cologne. Steurnagel by his valuable and scientific experiments with rectangular tanks has done much to clear up the most important points bearing on the process of sedimentation.

The correct inclination of the base of a tank is towards the inlet (see Fig. 1) and not towards the outlet (see Fig. 2.). Many tanks, however, within our own knowledge have been constructed in the wrong principal, with a view to collecting the sludge at the outlet end, being nearer the sludge lagoons, or for some other possible reason. The point to observe is, that no matter whether the inclination of the flow is towards the outlet or inlet end, the sludge has a tendency to precipitate, immediately on the reduction of the flow velocity on



(Fig 2)

According to Steurnagel
(Good & Bad Construction)

entering the tanks. The consequence being that the sludge is piled up at the shallow entrance, forming not only an obstruction to incoming sewage, but also a possible redissolving of the solids. The floor of the tank may be given an inclination 1 in 15 from outlet to inlet. The sludge or pump pocket being constructed at the base of inclination. The grade (1 in 15) is empirically arrived at. There is no reason why the grade should not be greater, apart from the fact that the bottom of a tank is of a slippery nature, the slime collecting on the surface and presenting difficult footing.

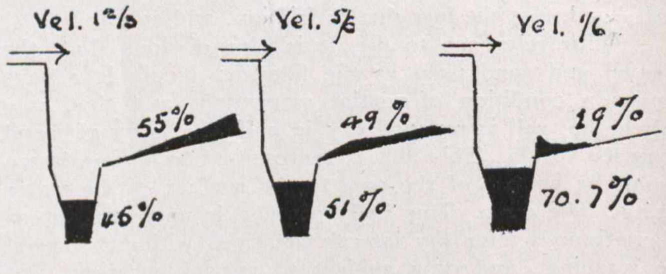
Velocity of Flow and Capacity.

The Royal Commission in sewage disposal present their general statement (paragraph 28) with reference to continuous flow sedimentation tanks. "We consider that the period of flow should be from 10 to 15 hours, and that the tanks should be cleaned out at least once a week." Nothing is stated as to velocity of flow.

The velocity of flow and capacity depend on different factors. The velocity of flow depends on the area of the cross section of the tank, while the capacity depends not only upon the cross section, but also upon the length of the tank.

This point is often not taken into consideration in designing rectangular tanks, the only consideration generally being the capacity with reference to the daily discharge.

The capacity of a tank has more value in connection with septic action than in the case of continuous flow sedi-



(Fig 3)

Cologne Experiments

mentation. In the former case it has been not only a question of sedimentation, but also of a rest period to allow of putrefaction of both solids and liquid.

With continuous flow sedimentation a period must be allowed to give effect to the lowered velocity of the sewage flow, the period, however, is relatively of short duration.

It has been held necessary to reduce the velocity current of sewage to rates of ⅛-inch and 1-12-inch per second, but the experiments made by Steurnagel at Cologne have shown that a reduction to ⅙-inch per second is sufficient, and the former belief requires modification.

Fig. 3 illustrates the effect of various velocities of flow with reference to sedimentation. At a velocity of ⅙-inch per second 72.31 per cent. of suspended matter is deposited; at 5-6-inch per second, 69.08; and 1⅔-inch per second, 58.92 per cent.

It is interesting to note that with the velocity at ⅙-inch 70.7 per cent. of the settled sludge lodges in the pocket while 29.3 per cent. is deposited on the floor; at 5-6-inch 51 per cent. in the pocket, and 49 on the floor; while at 1⅔-inch 45 and 55 per cent.

The conclusion which Steurnagel draws from this is that long tanks are necessary for high velocities and short tanks for low.

In constructing rectangular tanks one of the main features aimed at is, distributing the incoming flow as

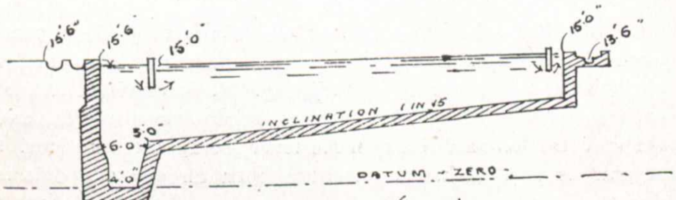


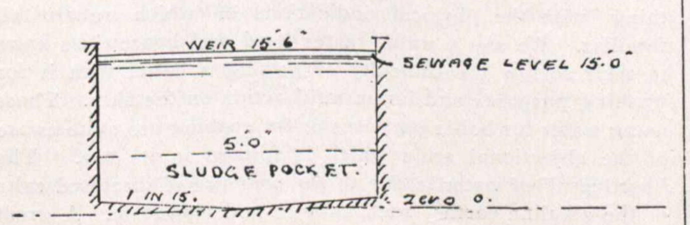
Fig. 4. (T.A.M.)

General Construction Relative to Partial Quiescence.

equally over the cross section of the tank as possible, so as to maintain an equal velocity throughout its length.

In computing the area of the cross section, the depth of tank at shallow end is taken, the lower portion is allowed for sludge deposit and at no time should the sludge be allowed to rise above this level, either in septic or fresh sewage processes.

Having arrived at the cross section necessary to provide the reduced velocity flow, the next question to consider is the length of time necessary for the maximum deposit to take. This altogether depends upon the character of the suspended matter in the sewage, and the length of time taken by the sewage in travelling through the sewers, in order to arrive at the outfall works. In every case sewage should be tested as to time required for sedimentation. In this respect Steurnagel demonstrated that an hour and a half period of passage through the tank produced practically the same result as could be obtained in three or four hours. Steurnagel



Figs 5 Arrangement of Sludge Pocket. (T.A.M.)

obtained amounts of sludge per 1,000 gallons of sewage for the following velocities:

Velocity (inches per second.)	Sludge (gals.)	Analysis of Sludge. moisture %	Dry residue %
⅙	4.040	95.57	4.43
5-6	2.474	92.87	7.13
1⅔	1.838	91.34	8.66

It will be seen that a gallon of sludge obtained at the highest velocity contains about twice as much solid matter as a gallon obtained at the lowest velocity.

The above experiments point to short periods of sedimentation for the purpose of superseding screening, which is expensive in maintenance and generally costly. In fact it is now generally being understood that screening is an unnecessary and clumsy method of removal of solids, and its application has been only due to an imperfect understanding of the principals of sedimentation. They further point to the possibility that much slower velocities have been held necessary than are actually required.

It is common to find in septic tanks as low velocities as 1-inch to ½-inch to the minute, but such velocities are not the result of actual experiments having reference to sedimentation, but are only such as may have resulted accidentally by arranging capacities for say 12 hours and 24 hours flow of sewage. The rectangular shape of the tank often being subject to the lay out of the works, independent of any velocity standards.

The knowledge that a velocity of flow of ⅙-inch per second, just ten times greater than 1-inch per minute, is sufficient to produce a deposit of over 70 per cent. of the suspended matter in sewage, may probably have a marked effect in reducing the sizes of sedimentation tank. This is more especially apt to be the case, now that it has been fully demonstrated that no benefit, but otherwise, is obtained by allowing septic action to take place as far as the tank liquor is concerned.

Fig. 4 illustrates the general structure of a continuous flow sedimentation tank, a gradient of 1 in 15 is given to the tank floor, and a sludge pocket shown at the inlet end of tank, from which the sludge may be raised by means of a chain pump.

In order to produce as little disturbance as possible by the inflowing sewage, it is not discharged by means of a pipe, but allowed to enter the tank by flowing over a weir the full cross section of the tank. Any disturbance to the surface of the tank is guarded against by placing a plate or scum board across the tank parallel with and close to the weir. The upper edge of this plate should stand 4 inches above the sewage level and the lower edge be at least 2 feet below the level of the sewage. A good plan is to have the plate made to a depth equal to the shallow end of the tank, and provide vertical openings or slits about 1½ inches wide, thus tending to distribute the inflowing sewage over the whole cross section.

A scum board must also be placed at the outlet end to prevent the discharge of floating matter with the tank liquor.

It will be observed that there are no divisions shown in the tank, the method of dividing a tank into sections either cross sectional or longitudinal is not considered good practice, the object of obtaining equal velocity, free from disturbance by eddies is best obtained by uninterrupted flow from inlet to outlet.

In our next issue we intend to deal with the question of sludge disposal.

(To be Continued.)

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Copies of these orders may be secured from the Canadian Engineer

6885—April 23—Authorizing the C.N.R. to construct standard trestle of the Niagara, St. Catharines & Toronto Railway.

6886—April 23—Authorizing the G.T.R. to construct, maintain and operate branch line to and into the premises of the Empire Manufacturing Company, Ltd., at London, Ont.

6887—April 23—Permitting the Enterprise Gas Company of Delhi, Ont., to lay gas pipes under the tracks of the G.T.R. at Main Street, Delhi, Ont.

6888—April 23—Authorizing the C.P.R. to construct steel trestle at mileage 95.7 of the Sherbrooke Section of its line.

6889—April 23—Approving tariff of the Quebec Railway Light and Power Company Tariff C.R.C. No. 7.

6890—April 23—Amending Order No. 6616, dated March 22nd, 1909, by striking out the word "west" where it occurs in the fourth line of paragraph 1 of the said Order and substituting therefor the word "east."

(Continued on Page 666.)

WATER SUPPLY.*

By Prof. Muir Edwards.

No one factor so directly affects the health, comfort and prosperity of a community as an adequate supply of pure water. The provision of a public supply to replace the individual sources of supply is one of the first indications of the urban development of a community. No problem deserves more careful consideration at the hands of those intrusted with the affairs of the commonwealth, and no other municipal investment better deserves liberal consideration. The last word in the science of water supply engineering has by no means been said, but experience has many lessons to teach us and we can with much greater certainty design and construct satisfactory works than was possible fifteen to twenty years ago. It will be the endeavor of this paper to give you in as brief form as possible an outline of the main features of the problem and in doing so your attention will be called to five subdivisions of the subject, namely,—uses, quality, quantity, sources of supply and method of distribution.

Uses.—The uses to which a public water supply are put fall naturally into three classes, namely,—domestic, commercial and public use. The **domestic** use includes water used for drinking, cooking, washing, and in furnishing the necessary flushing water for a sanitary system of drainage. The **commercial** use of water consists in its use as a motive power in elevators, water motors and hydraulic presses, as a supply for boilers in the generation of steam and directly in many manufacturing industries such as sugar-refining, brewing, in chemical and dyeing works. The most important **public** use of water is perhaps in providing fire protection. There is also its use in street sprinkling, sewer flushing and in parks and playgrounds.

Whatever may be the uses to which it is put, however, in attracting citizens and interesting capital a satisfactory water supply is a most valuable asset.

In considering the question of such a supply its **quality** is of primary importance and should not be sacrificed to any consideration. The question of quality must be considered from both a scientific and a popular view point. It is an indisputable fact that many waters which are so turbid or so discolored, that a storm of protest would follow their appearance at the taps of the consumers, are nevertheless practically harmless to public health. On the other hand there may be lurking in the clear, cool water which the public uses with expressions of appreciation, the germs of a deadly disease. Those responsible for the public water supply must, however, recognize that, not only must the public's health be safeguarded, be he ignorant of danger or not, but his senses of sight, taste and smell must not be offended.

The quality which should be obtained depends on the uses to which it is to be put. A domestic supply should be potable, free from dissolved constituents, free from disease producing bacteria, must not be unduly turbid and should not be too hard. Water for commercial purposes must have characteristics depending upon the use to which it is to be put, but for boiler purposes a hard water is not satisfactory. Water for fire purposes, if confined to its own mains, is not affected by questions of quality.

In considering the quality of water therefore we must know something about its potability, color, turbidity, dissolved constituents, hardness and bacterial content. It is well to understand just what these terms signify and what weight is to be attached to each. We shall, therefore, consider each somewhat in detail and in doing so shall endeavor to avoid technicalities as much as possible.

Potability.—A potable water is one which is pleasant to drink, cool and free from odor or objectionable tastes. These characteristics of a water are affected by the growth of algae in water when at rest, as in ponds, reservoirs or lakes, and by the dissolving in it of mineral or organic matter with which it has been brought in contact. Ground waters such as well waters and spring waters are usually cool and pleasant to the taste, but may be unduly hard and in some cases may have dissolved mineral constituents. Surface waters are in most cases not unduly hard, but due to the growth of algae or to mineral or organic constituents may be objectionable to taste or smell.

Color.—A perfectly satisfactory water should be colorless. Ground waters are for the most part free from color, but some surface waters, especially those draining swampy areas, are highly colored by the soluble organic matter dissolved in them. Color is an optical characteristic, but should not be confused with turbidity, the distinction being that color is due to dissolved constituents while turbidity is due to suspended particles. Filtering or sedimentation will remove the latter but not the former. Colors of water are estimated by comparing them with standard solutions which can be made up to stimulate very closely the natural waters.

Turbidity.—This is a characteristic affecting the appearance of the water and is due to suspended particles carried along with the water by its velocity. It is confined almost entirely to surface waters, more especially river waters, and varies with the conditions of the river, being most noticeable at periods of high water. As has been already stated it is due to the suspension of sandy or clayey particles in most cases, but organic growths may also produce this characteristic. Since turbidity is an optical characteristic we are more concerned with the effect of the transparency of the water than with the total amount of the suspended matter. A much greater amount of sandy particles as compared to clayey suspended matter is required to produce the same turbidity. The amount of turbidity is measured by the depth at which a platinum wire one millimetre in diameter is visible. Other means are employed but all should depend on the testing of the transparency of the water.

Dissolved Constituents.—Many organic and mineral compounds are soluble in water. Their degree of solubility depends on the temperature and chemical composition of the water. Many mineral springs have undoubted medicinal qualities, but would hardly do as a source of water supply. Some dissolved constituents are released by boiling, and so we have the deposit which may be noticed if some waters are boiled and allowed to stand and clarify. Certain dissolved constituents give that peculiarity to water which we term "hardness."

Hardness.—Hardness or absence of hardness is something with the physical indications of which we are all familiar. We say a water tastes hard and housewives know to their sorrow the difficulty of getting a lather with it for washing purposes and its harmful action on the skin. Those using water for boiler purposes or for cooking are quite aware of the objectional scale which is formed in its use. The "hardness" of water is due to the presence of dissolved salts of the alkaline earths, such as lime and magnesia. A great many ground waters and some surface waters have this characteristic. When soaps are added to such "hard" waters insoluble precipitates are produced, and so a much larger amount of soap is necessary. It is estimated that the city of Glasgow saves $180,000 annually in the amount of soap used since the introduction of the soft Lock Katrine water (Park's Hygiene and Public Health, page 10). Hardness is said to be temporary or permanent depending on the effect of boiling. If the salts of lime occur in certain forms the boiling will cause a precipitate and so the hardness of the water will be lessened. The scale formed by temporary hard waters is more friable and not so objectionable as that formed by the use of permanently hard water.

However objectionable or otherwise a water to be used for drinking or cooking purposes may be on account of odor, taste, turbidity or hardness, these are of much smaller moment than the question as to whether or no organisms capable of directly producing disease are present. All water has more or less bacterial content but it is highly important that a source of supply shall not be polluted with those organisms capable of producing disease. This aspect of the question

*Read at Convention of Union of Alberta Municipalities in Edmonton, Alta.

should be thoroughly gone into when considering the desirability of any particular source.

Lastly, in considering the question of quality it might be well to point out that, although it is highly desirable to obtain a source which is naturally suitable as regards potability, color, turbidity, softness and freedom from disease germs, nevertheless any source is capable of artificial treatment and much may be done along well recognized lines to improve its quality if necessary.

Quantity.—We might consider next the question of quantity, which must be obtained to serve as a satisfactory supply. Experience has shown that there is a wide variation in the quantity of water used in different cities reckoned on a basis of so many gallons per person per day. This variation does not bear any direct relationship to population, situation or character of the municipality and ranges all the way from 200 gallons per capita per day to 60 gallons per capita per day. The great majority, however, average about 100 gallons per capita per day, and that may be taken as a fair provision. It has been found that the introduction of meters has materially lessened the consumption and if the people are sufficiently informed of the benefits to be derived metering may be advisable. In this way it has been found that, by careful supervision, the supply may be reduced below the average, but since allowance must be made for waste a very large reduction is not possible.

For places having a reasonably good meter system the amount of water to be allowed for its several uses is as follows, the calculation being based on an average consumption of 75 gallons per capita per day,—Domestic 25, Commercial 20, Public 5, Loss 25. It will be noticed that the total amount of water used for fire protection is very low when averaged over the year, but it is well to remember that a large quantity may be needed at any point in the system for a short time for this purpose. To give us some actual idea of what a consumption of 100 gallons per capita per day really means, because after all that statement does not convey any concrete idea to our minds, let us see what population could be supplied by several sizes of pipes running under given conditions. It is understood, of course, that this pipe is supplying water at a uniform rate and some provision such as a reservoir is available to allow for fluctuations in consumption. We will allow a velocity of 5 feet per second to our water running in the pipe. This would carry the water vertically about half a foot when released from the mouth of the pipe.

Size of pipe in inches.	Discharge.	Population served.	Head necessary in ft. per thousand.
3	160,000	1,600	50
6	640,000	6,400	20
9	1,440,000	14,400	12 Velocity 5 feet per sec.
12	2,160,000	25,600	8.5
A fire hose stream	360,000	3,600	250 gals. per minute.
9	860,000	8,600	5.0 Velocity 3 ft. per sec.
9	280,000	2,800	0.65 Velocity 1 ft. per sec.

We see, therefore, that even a small stream of water, if flowing continuously, will serve as a source of supply for quite a large population. There must be arrangements for storage during times of minimum consumption which can be drawn upon during times of maximum use. Knowing then the quality and quantity of water necessary to serve the needs of any municipality the next consideration is naturally the source of supply.

Source of Supply.—The first source of supply for drinking water, at least when the municipality is in its infancy, is the individual well. These are admirable in most cases in their place, but as the life of the community becomes more urban, population becomes more dense, the wastes of civic life pollute the ground and it is not long until the well, the one time source of all that was beneficial, becomes a favorite breeding place for obnoxious bacteria. Under these conditions one of the most obvious and necessary municipal undertakings is the procuring of public water supply free from this contamination.

The two great sources from which supplies are drawn are the subsoil and the surface waters. Both of these it is well to remember depend for their supply on the rainfall. The moisture precipitated upon the earth's surface is either absorbed by plant life, evaporated again into the atmosphere, runs off immediately into creeks and rivers and so to the ocean, or sinks into the earth to replenish the great underground reservoir. That portion of it absorbed by plant life or evaporated into the atmosphere is not available as a source of supply but should it flow along the surface or sink down to the underground supply it may be utilized for this purpose. In the case of its sinking into the ground it is retained a correspondingly longer time in the neighborhood, and so is available long after its actual precipitation. Should it find easy access to well defined drainage channels, however, it may escape shortly after falling, if not used, and so pass out of the sphere of usefulness for a particular case.

Subsoil Water.—Many individuals and not a few municipalities are dependent upon subsoil water for their supply. As you are doubtless aware there is a wide variation in the quantity and depth of occurrence of underground water. These characteristics are affected by the topography, geology and rainfall of the district. In many cases due to geological conditions the subsoil water may have been precipitated on a surface of greater elevation and at a considerable distance from its occurrence, and so may flow from the surface as natural springs or may rise as a flowing well should the supply be tapped.

When a well is sunk at any spot and water drawn therefrom the water-surface at that point is lowered and this causes the water from the surrounding district to flow toward the well. The greater the lowering of the water-level at a given point the wider the circle of influence from which water is fed to that spot. The flow is, of course, at a much slower velocity than would occur on the surface and depends on the formation through which it must pass. The quantity of water held in the subsoil in any locality, which is available for supply purposes, is also dependent upon the formation and thus it is that a bed of gravel—affording a large proportion of voids, which may be filled with water and which offers less resistance to the flow of this water from one spot to another than a closer formation would—makes a satisfactory location for a supply well. We have in this case a satisfactory quantity available which can moreover be drawn upon rapidly in case of emergency. River or drainage channels occuring in the district serve as outlets for the subsoil water by seepage of the latter along the banks. This seepage forms the dry-weather flow of such streams and the water level in them often governs the depth of the ground water surface. Thus a succession of dryweather periods may so lower our ground-water level that it is unsatisfactory as a source of supply.

Springs.—Springs always appeal very strongly to the popular mind as a source of supply. The water having passed through the subsoil is in most cases cool, clear and an admirable drinking water. Many people also seem to think that the flow of a spring is constant. They merely are, however, outlets of the subsoil reservoir and are dependent on it for their supply. It is often the case that by clearing out a spring we may increase the flow but this is due to the fact that we have thereby induced more of the stored water to seek an outlet at that particular place. A spring is really merely a well whose depth is zero. In considering any subsoil source of supply a careful study should be made of dry weather conditions and also of the effect of rapid pumping over a considerable period of time to discover, if possible, what area is tributary to the well and at what rate water may be drawn from this area.

Surface Water.—Surface waters, where available, offer an obvious source of supply. Lakes and rivers are something of which we are all aware, whose peculiarities can be studied without difficulty and whose probable yield may be more safely decided upon than that of subsoil waters. They are exposed to much greater pollution, but should the necessary quantity be available there is no reason why proper treatment may not give us a satisfactory source of supply. As to quantity, if we could retain the total run off of our streams and distribute it throughout the year even our small streams would in most cases serve as an ample supply for all purposes. But it is the day to day flow upon which we are dependent in the majority of cases and so a careful study of dryweather flow conditions should be carried on before accepting any surface stream as a source of public supply.

The consideration of both ground water and surface water sources brings very forcefully to our minds the necessity for tabulated information regarding the rainfall throughout the province extending over a period of years. In engineering work we are more concerned with the **rate** of rainfall than with total precipitation, this being especially true in the consideration of drainage problems but it enters also into the design of impounding works for water supply and also into water-power questions. Such information to be useful must cover a sufficiently long period to include the cycle of probable climatic conditions, and if collected and available would be of inestimable benefit to all our municipalities.

Distributing System.—The question of the distributing system is one which opens up a large field and we can only deal with it rather briefly. If our source is at some distance from the municipality it is desirable to have a pipe of uniform diameter delivering water into a storage reservoir at a uniform rate all the year round. From the storage reservoir the water is pumped or flows by gravity into the distributing system. Water does not flow along a pipe without some form of energy being expended in its doing so. We may supply this energy by utilizing the difference in elevation between the inlet and outlet of the pipe giving us that ideal arrangement for which we are ever striving, i.e., a gravity supply. If our location is not favorable to a gravity supply then the energy must be supplied by the burning of coal, or from the combustion of other fuels, or from sources of electrical energy. Of course we are all aware that to lift our water supply requires the expenditure of a great deal of energy but we must also remember that merely to force it through the pipe lines consumes a large amount of power. To give some practical ideas on this subject let me say that in the case of the 9-inch pipe, transferring water at a rate sufficient to supply a population of 14,000, the difference of elevation between any two points 1 mile apart would have to be 64 ft. in order that by gravity alone this rate should be maintained. This represents a consumption of energy at the rate of about 20 horse-power. The 9-inch pipe supplying 8,600 persons would require a difference of 26 ft. per mile and would therefore consume energy at the rate of not quite 5 horse-power per mile. If the fall were not great and we still wished to use a gravity supply to our storage reservoir a 9-inch pipe supplying a population of about 3,000 would require a fall of 3½ feet per mile, and would consume energy therefore at the rate of 1 1-3 horse-power per mile. The availability of different sources of supply is something that you are all interested in and these figures will give you some comparative ideas on the subject.

When the water is transferred to a point adjacent to the municipality or should it occur at such a point it is then necessary to distribute it to the consumers. This is done by pipes of varying diameters which decrease as they approach the point of delivery. The distributing system is made up therefore of mains, submains, branches and house connections, and each problem of design has to be dealt with on its merits. It is well, however, if possible to obtain a street pressure of at least 30 to 40 lbs. per sq. in. for ordinary supply and a hydrant pressure of from 100 to 60 lbs. per sq. in. for fire protection purposes.

Fire protection is of such very great financial interest that this paper would not be complete without some discussion of this phase of the water supply problem. The essential requirement for proper fire protection is an ample supply of water delivered to the fire hose at such a pressure that it may be forced through their length and ejected from the nozzle with such a velocity that it will be carried to the required height and distance. The quantity of water delivered by a satisfactory fire hose might be taken as 200-250 gallons per minute, and is independent of the size of the town or city. The probable number required at any one time, however, bears a direct relationship to the population and Kuichlings estimates that if "x" be the population in thousands $\frac{1,000}{\text{root of } x}$ represents the number of gallons per capita per day which would represent the rate at which water should be supplied in the case of fire. We see, therefore, that for populations less than 100,000 the water necessary for fire protection would be much greater for a short time than the ordinary average flow. For a population of 1,000 it would be 1,000 per cent. greater and for a population of 5,000 it would be 447 per cent. greater. Our distributing system must therefore be capable of delivering this supply at any point and our storage reservoir must have sufficient capacity to allow for this overdraft on the average consumption. As to the obtaining of the necessary pressure this may be done by gravity, if we are fortunate, it may be supplied by the pumps or the necessary additional fire pressure may be supplied by fire engines which can be transferred to any point on the system. It is the usual practice in smaller places to obtain this additional pressure by shutting off the reservoir or standpipe and speeding up the ordinary pumps to meet fire conditions. The use of fire engines is found economical where, due to large population, fires are of more frequent occurrence and so the engine is in more constant use than would be the case in towns of smaller population.

Fire engines are sometimes kept in reserve in the latter places for extraordinary conflagrations, but for ordinary fires it is found more economical to depend on the pumps for the extra pressure required.

In conclusion I would reiterate that no question is of more importance to a community than that of an ample public supply of pure water, and in obtaining the same cost should not be unduly considered but the best possible supply within practical limits should be enjoyed by all our citizens.

PRECIPITATION FOR APRIL, 1909.

In British Columbia the precipitation was much below the average amount except in Cariboo, where there was more than usual. In Alberta and Saskatchewan there was a positive amount in some districts and a negative in others. Calgary recorded one hundred per cent. above the average, whilst Battleford experienced one hundred per cent. below the average quantity. In Manitoba the excess throughout the Province ranged from 31 to about 50 per cent. Elsewhere in the Dominion the precipitation was laregly above the average, except in the eastern portion of Quebec and in parts of Prince Edward Island and Cape Breton where the deficiency was rather marked. In the Province of Ontario the positive departure was very generally from 2 to 4 inches. Snow fell at intervals, the usual April snowfall recorded in the several provinces being, as a rule, much exceeded.

The table shows for fifteen stations included in the report of the Meteorological Office, Toronto, the total precipitation of these stations for the month.

Ten inches of snow is calculated as being the equivalent of one inch of rain.

Station.	Depth in inches.	Departure from the average of twenty years.
Calgary, Alta.	1.20	+0.57
Edmonton, Alta.	0.90	+0.10
Swift Current, Sask.	0.40	—0.45
Winnipeg, Man.	1.10	—0.45
Port Stanley, Ont.	4.64	+3.08
Toronto, Ont.	5.40	+3.31
Parry Sound, Ont.	3.97	+2.02
Ottawa, Ont.	3.86	+1.99
Kingston, Ont.	2.96	+1.01
Montreal, Que.	3.20	+0.93
Quebec, Que.	3.01	+0.90
Chatham, N.B.	4.36	+0.04
Halifax, N.S.	3.99	—0.27
Victoria, B.C.	0.60	—1.27
Kamloops, B.C.	0.30	—0.09

TEMPORARY WORK ON THE CANADIAN PACIFIC RAILWAY.

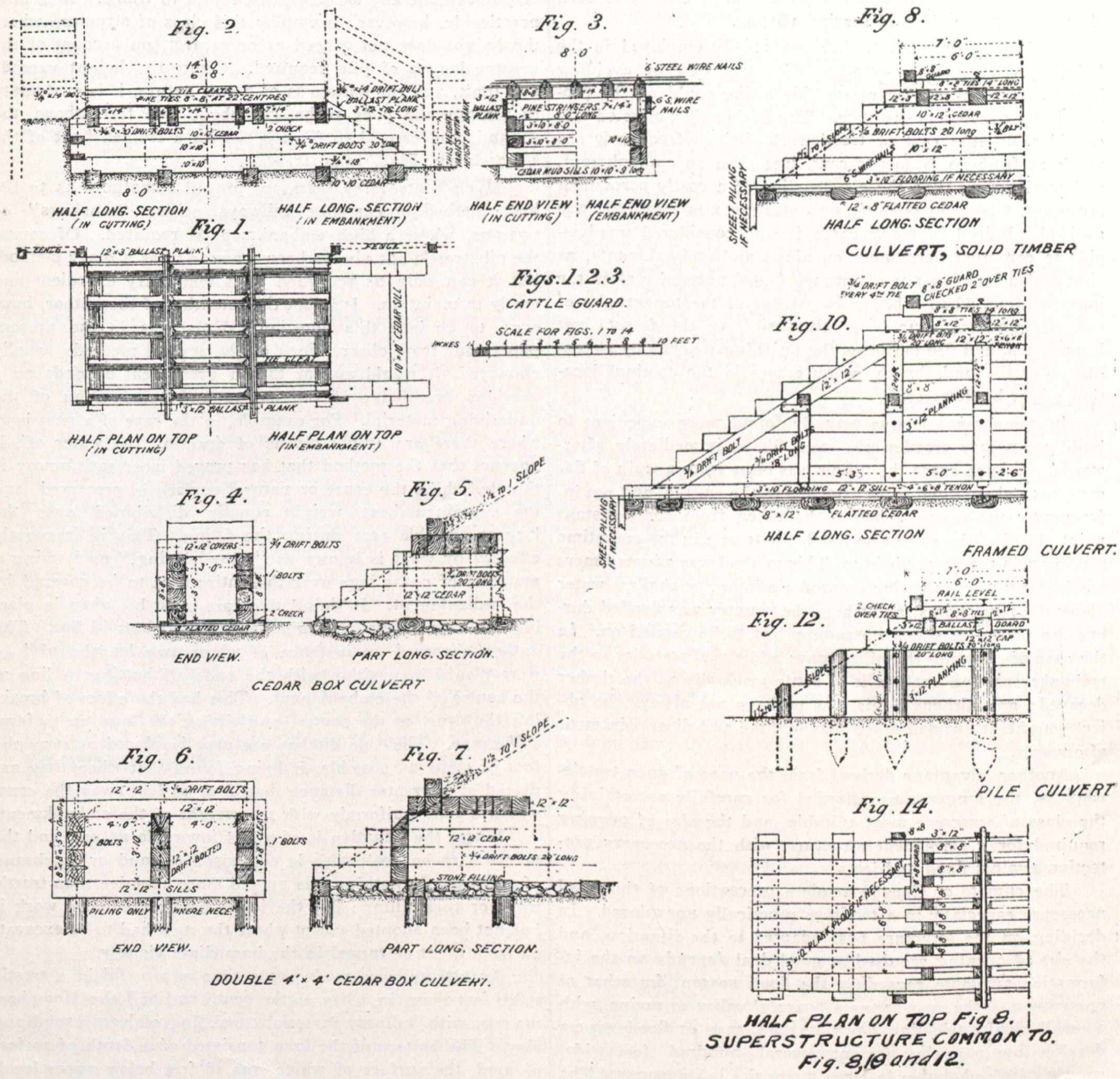
J. Grant MacGregor, Consulting Engineer.

General Remarks.

The history of the construction of the Canadian Pacific Railway has been so ably recorded by its pioneers, in various papers to kindred societies, that a review of all the characteristics of its earlier development will be unnecessary within the scope of this paper. The following notes will, therefore, be confined principally to a description of the temporary work employed during construction, and its relation to the more recent permanent work, with the view of illustrating as far as possible the conditions affecting the construction, and the operations peculiar to the maintenance, of what may be termed a pioneer railway.

The term "Pioneer," as sometimes applied to American railways, implies that the railway has been projected with the view of opening up a new territory for colonization purposes, and that in its construction all due regard has been had to economy in first cost, so that the expenditure made may be justified by the prospects of the country being speedily settled and a revenue made available to the promoters from the development of its natural resources.

The maintenance, however, of a railway built on this principle, in order to meet the requirements of increasing traffic and modern equipment, must necessarily form an important factor in its future development.



Unlike the conditions existing in countries that are fully settled, the demands of a partially settled country like Canada, necessitate the adoption of the principle of economy in first cost, a principle that proved so beneficial in the earlier days of pioneer railways in the United States, where similar conditions prevailed.

Nevertheless, it would be folly to conclude from this that the American practice of building cheap railways, where timber as a natural product is so largely introduced into their construction, could be adopted with economy in all new and undeveloped countries. So much depends on the deteriorating effects of climate, cost of transportation of material and the adaptability of the natural products available, that it is only from a careful study of these conditions—with the rate of future development and cost of maintenance in view—that the most advantageous plan can be adopted.

North America is, of course, specially favorable to the construction of cheap railways on account of the great quantity of fine timber available, which is extensively employed in the building of trestles and other temporary works. In hilly country where extensive bridging is necessary, timber, as a rule, is plentiful and the cost of haulage low. On the prairies, where timber is more difficult to procure, it is not so much required on account of the favorable nature of the ground. Natural facilities such as these, together with the large proportion of line traversing flat country, go far towards reducing the average cost of pioneer railways in North America.

The greater number, however, of the more important works carried out during the construction of the Canadian Pacific Railway, were of a more permanent character than what is usually adopted on American railways. Where circumstances were favorable it was always deemed necessary, in the interests of future economy, to build the permanent structures at the outset, and this was done in the form of many fine examples of masonry and steel bridges.

A great part of the original permanent work in British Columbia was carried out by the Government, and, as experience has since proved, much unnecessary expenditure was made on these structures where economy in design and arrangement of span were not carefully studied. This fact is admirably illustrated by Mr. P. A. Peterson, chief engineer, in his presidental address before the Canadian Society of Civil Engineers at the close of session 1894-95.

During construction timber was chiefly employed in the building of temporary trestles, with the view of avoiding heavy embankments, where suitable filling could not be procured at a convenient distance. The saving thus effected was considerable—the cost of trestlework being frequently as much as from 30 to 40 per cent. less than an embankment, and at the same time the construction of a costly permanent structure, where an opening or waterway was required, was avoided. Indeed in many cases it was considered unadvisable to construct permanent openings and embankments, as changes in location are sometimes found necessary after the lapse of time, when a better knowledge of the topography of the surrounding country is obtained. As the forests get hewn down, and fire performs the finishing touches by sweeping away the underbrush, many errors in the original location might be detected.

In some cases it was actually found more expedient to build temporary trestlework, and fill in immediately afterwards. In such cases the filling was done from a train of flat cars, with plough and cable attached to the engine, and not infrequently the material had to be taken from some distant point ahead of the site to be filled, the trestle in the meantime serving as a temporary bridge. This method was adopted more particularly where the line crossed a swamp, or shallow water along the lake shores, and where the country was flooded during the season at which operations had to be carried on. In the case of a swamp the piling gave additional stability to the embankment, and enabled it to settle gradually as the timber decayed; and although this was perhaps not always the object sought, it avoided much loss of time and disappointment afterwards.

Another advantage derived from the uses of open trestlework is, the longer time afforded for carefully ascertaining the class of structure most suitable, and the size of opening required for a permanent structure, with the necessary protection against flood and ice.

The climate of Canada renders precautions of this kind necessary especially in a territory practically unexplored. In deciding on the structure best adapted to the situation, and the size of opening required, a good deal depends on the information available regarding the flood season, for what at one season of the year seems a peaceful valley or ravine, with a small rivulet trickling down its bed, may at flood season develop into a raging torrent several hundred feet wide, carrying ice and timber in large quantities in its course. The volume of flood water during spring does not altogether depend on the amount of snow or rainfall, but is influenced more or less by the peculiar nature of the Canadian winter. The flood season following an open winter is, as a rule, the most disastrous. This is evidently brought about by a series of thaws occurring during the earlier part of spring, removing and depositing large quantities of ice along the water courses and enabling more ice to form—finally blocking up the channels, and causing abnormal ice shoves.

Observations necessary for obtaining data relative to volume of water at the flood season will consequently extend over a period of years, in the absence of information gleaned from old inhabitants or traces left by previous floods. In order that this information may be available when the question of building a permanent structure arises, the section foremen are instructed to note the highest water each year by a permanent mark on all bridges on their respective sections.

Pile trestles of the class shown Figs. 20-22, Plate II., have been known to resist the ravages of flood and ice much better than more costly structures consisting of framed bents, or even crib piers with cut-waters. The pile trestle, however, can only be adopted with advantage where the bottom is of a suitable nature for piling. Where the cost of substituting a permanent structure for this class is great, on account of the foundations, the temporary structure is maintained at a comparatively small cost for many years. New piles are driven midway between the old bents, and the superstructure replaced without any serious interruption to traffic. It is only practicable, however, to employ this class of structure where the height does not exceed 25 or 30 feet, on account of the greater length of pile required. Where the height exceeds this limit, and the bottom is of a soft nature, it is customary to arrange the piles to be cut about two feet above the ground, and capped to form a sill for a framed bent of the class shown, Figs. 15 to 17.

Much controversy seems to prevail sometimes as to the best method of carrying railways across "muskegs" or swamps, where a high embankment is required. Of course the pile trestle has always been resorted to as a ready method, but it can only be regarded as a temporary expedient and costly to maintain. It is not the intention of the author, however, to go into this question exhaustively in the present paper, but from observations of the several methods usually employed, it would appear that a great deal depends on a previous knowledge of the nature and composition of the underlying material. For example, in the case of a peat bog, where there are ample means of draining the water off, it appears that the method that has proved most satisfactory is that by which the crust or natural surface is preserved, and the superincumbent weight equally distributed over the largest possible area during the filling. This is frequently effected by what is known as "cross-logging," or forming a mattress of cedar logs over the entire area to be covered by the embankment. In doing this care must be taken in placing the logs so that the ends shall not all butt in line. The author observed an instance of where two lengths of logs were placed in position with the ends all butting in line at the centre of the embankment. This had the effect of breaking the crust at the centre, and tilting the logs up to form a **V**-shape. The side ditches are usually placed as near the foot of slope as possible, it being found that when they are placed at a greater distance than 8 or 10 feet away the crust will not yield uniformly with the weight of the embankment.

Where the situation is of a less favorable nature, and the material to be dealt with is composed of mud or quicksand of great depth, nothing has proved more effective than trestle work or rock filling; but the latter being expensive work it has not been adopted except where the rock had to be excavated from a cut or tunnel in the immediate vicinity.

An attempt was made some time ago to fill in a trestle 1,800 feet long, in a bay at the south end of Lake Memphremagog, with ordinary material consisting of loamy sand and clay. The bottom of the lake consisted of a depth of 20 feet of mud, the surface of which was 18 feet below water level. The work was carried out successfully, except that the quantity of filling was greatly in excess of the estimated quantity. Much of the material was evidently lost in floating away and combining with the yielding mass of mud. Had the material selected for the filling been of a less absorbent nature, such as pure sand and gravel, the work could, no doubt, have been done more satisfactorily and at less cost. The form which the embankment assumed when completed is shown by the cross section, Fig. 1a, which was prepared from soundings taken at various stages of the work, and borings made after completion.

From the author's observations of the progress of reconstruction and maintenance during the past eight years, not a few problems have arisen as to the effect of location on the future economical working of railways of this class. The questions usually left to the decision of the maintenance engineer are innumerable. Certainly a great many of the difficulties presented were, in the first place, unavoidable, but, unfortunately, not a few were due to bad location. This, however, was not always the fault of the engineer in charge of location, for frequently it would seem that too little time was afforded for this important part of the work, and during the hurry and excitement with which the work of construction was pushed forward, in the eagerness of the promoters to have the line opened for traffic, many of the more important problems of reconstruction were overlooked. It is evident, however, that no amount of time saved in the original work of locating a railway can compensate for errors that may have a deteriorating effect on its future reconstruction and maintenance.

The Canadian Pacific Railway, stretching as it does from the Atlantic to the Pacific, traverses a territory of a nature

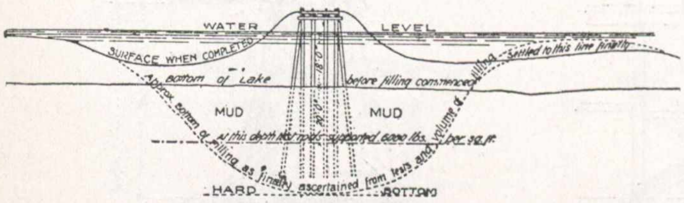


Fig. 1*a*.

so diversified that in its construction nearly every imaginable obstacle was encountered, thus affording a wide field for the ingenuity and skill of its engineers. Notwithstanding the rapidity with which the work of construction was carried on, it is remarkable how few errors were made in dealing with the various obstacles encountered and in providing for the future development of this great project. The experience attained by its engineers has been prolific of much useful data for the benefit of the profession, and has, no doubt, established certain rules to be adhered to in the work of location, peculiar to existing climatic conditions, and applicable to the variable nature of the ground traversed.

For example, in flat country or "table land," it is important that the formation level or subgrade, as it is called, should be kept as high as possible above the average level of the adjoining land, to provide for drainage, and guard against inundations which invariably occur in spring, from the melting of snow on the surface of the hard frozen ground. As the land taken for right-of-way is usually of a uniform width of 99 feet or 6 rods, sufficient material for a single track railway is procured from the side ditches, but failing this the additional filling required is taken from "borrow pits" at convenient points along the line. This class of work is usually termed "cut and cover," a cross section of which is shown Fig. 1b.

In locating over undulating grounds, the material being of a clayey or sliding nature, deep cuttings are avoided as much as possible. Not unfrequently has the removal of a small quantity of material of this peculiar nature caused the general movement of a large area of the adjoining lands. To prevent the cuttings closing in, piling at the foot of slopes had to be resorted to in many cases. In situations of this nature provision is made for draining the roadbed to prevent the track "heaving" while the frost is leaving the ground in spring.

The necessity for a properly drained roadbed in this climate is becoming more apparent now than ever to those interested in the maintenance of permanent way. Many of the recent failures in rails, that have only been in use a short time, can be traced to an uneven, badly drained, and poorly ballasted roadbed.

The location through the mountains was, on account of grade and general contour of the country, confined to a small area, which left little or no means of avoiding places exposed to land slides, snow slides, and wash-outs in spring. The snow sheds, which are an interesting feature of the construction through the mountains, have proved of great benefit in protecting the line from avalanches. Cribwork and masonry retaining walls were also constructed at the foot of slopes as a protection against land slides and erosion by floods.

Temporary Structures.

In preparing the drawings of these structures attention was given to detail as much as possible in order to avoid a lengthy description, and make the work serviceable for reference. The figures illustrate the various structures composed of timber, whether regarded as temporary structures or otherwise. Of course, on a great many American railways timber structures are in many cases considered permanent work, and are renewed from time to time in timber. Indeed, if the durability of such timber as cedar be considered in the construction of box culverts, solid timber open culverts and cattle guards, in favorable situations, it would seem almost unnecessary to employ a more expensive class of structure. In many cases, where cedar had been used on some of the older railways, it was found perfectly sound after thirty years' service. In the case of fence posts and telegraph poles it is invaluable as an exceedingly durable timber, and can be procured at a comparatively small cost. Cedar sleepers or track ties are also used where they are easily procured; but on account of their lightness, and small amount of adhesion to spiking, they have not proved as efficient as those made from tamarac. Cedar is also largely used for piling and substructural work, both above and below water, and no doubt figures prominently in the small cost of maintaining the various structures in question.

Cattle Guards.

Surface cattle guards of various kinds have been introduced indiscriminately, on account of their simplicity and comparative small cost, but so far as the writer is aware they have not proved as efficient as the open timber cattle guard, Figs. 1, 2, and 3. This structure, in some cases, serves also as an open culvert, where the water from the side ditches is intercepted and carried along the public highway. The span is invariably 6 feet and the minimum depth 3 feet. The drawings show the manner in which the structure can be adapted to either cutting or embankment. The sills and side walls are usually made from full squared cedar or tamarac. Cedar sawn on three faces is sometimes used for side walls, with the rough face towards the embankment, and placed on "flatted" cedar sills similar to those shown for box culverts, Figs. 4 and 5. The stringers, ties, and tie cleats are usually of pine.

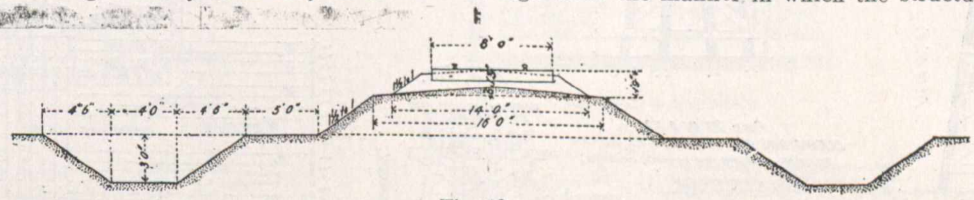


Fig. 1*b*.

Box Culverts.

The cedar box culverts, Figs. 4 and 5, are constructed of 12-inch by 12-inch cedar drift-bolted together, and braced at intervals of about 5 feet with 8-inch by 8-inch cleats bolted to the outside of the side walls. The sills are of "flatted" cedar, 8 inches thick, spaced 5 feet apart, and paved between with rough stone, hand laid. The covers are of 12-inch by 12-inch cedar, checked 1-inch over the side walls, and drift-bolted to the same.

The double 4 feet by 4 feet box culvert, Figs. 6 and 7, is usually constructed where a large waterway is required through an embankment. The number of chambers can be increased to four or six if required. This class of structure is well adapted to situations where the bottom is very soft, as for instance the bay of a shallow lake, or the channel of a slough, where the water level is subject to sudden fluctuations.

Solid Timber Open Culverts.

The construction of these culverts, Figs. 8 and 9, is somewhat similar to those already described—that is solid timber side walls drift-bolted together, and braced with 8-inch by 8-inch cleats on the outside. These structures seldom exceed 5 feet in height, and serve also as cattle passes. Where greater height is required a framed culvert, Figs. 10 and 11 is, as a rule, adopted. A planked floor and sheet piling are sometimes necessary.

Framed Culvert.

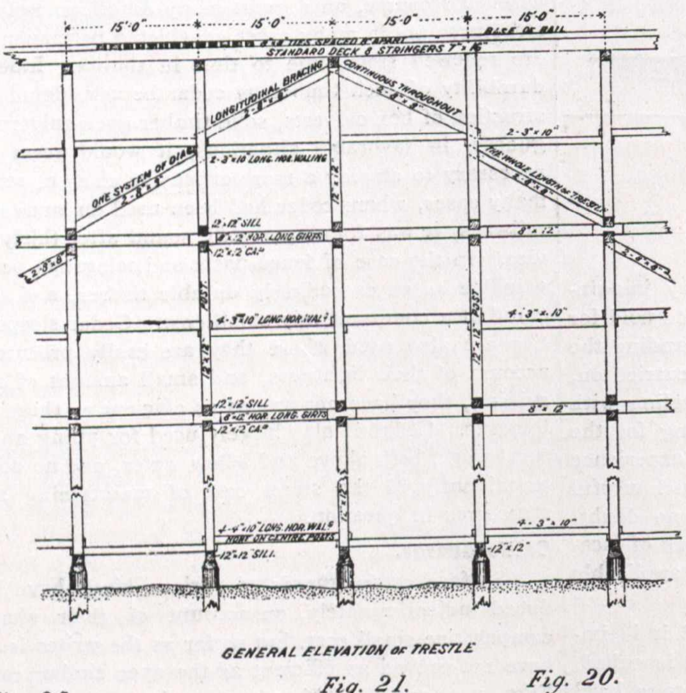
Figs. 10 and 11 represent what is termed a framed culvert. The framework is constructed of 12-inch by 12-inch

to a batter of 1 in 12, and where the height above ground will permit, the outer piles are driven to the same batter, and "sprung" to 1 in 6 at the top. The transverse bracing and longitudinal walings are of 3-inch by 10-inch timber, bolted to caps and sills and spiked to piles. The superstructure is similar to Fig. 18 prescribed for framed trestles.

Framed Trestles.

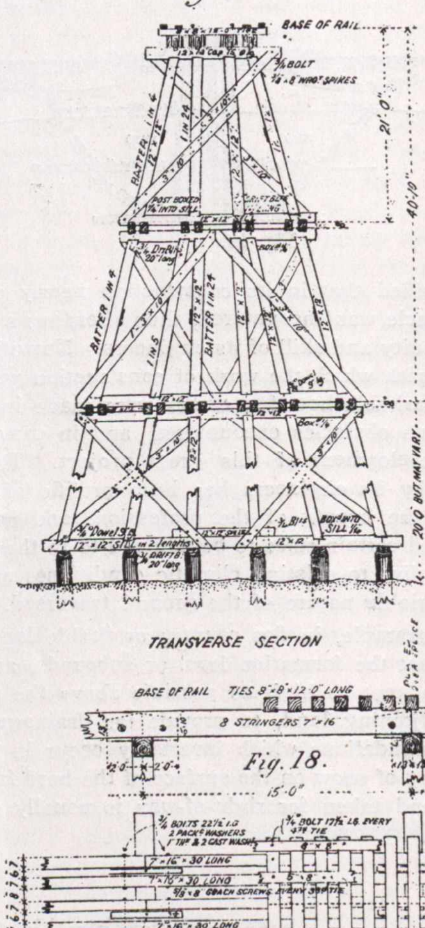
The design for framed trestles, Figs. 15, 16, and 17, was selected after a careful study of the various designs from which structures were built from time to time over the entire system. One feature of this design, which is, no doubt, a commendable one, is the absence of the usual elaborate system of longitudinal bracing, and the additional stiffness obtained from the arrangement of the horizontal longitudinal girts. There is nothing remarkable about the transverse bracing or arrangement of posts, except, perhaps, that the

Fig. 16.



GENERAL ELEVATION OF TRESTLE

Fig. 17



TRANSVERSE SECTION

Fig. 22.

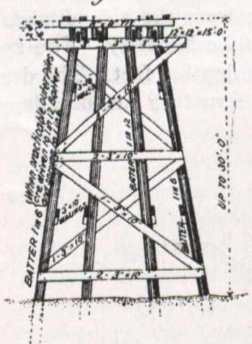


Fig. 21.

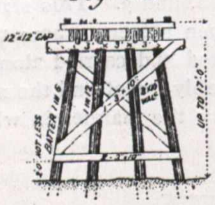
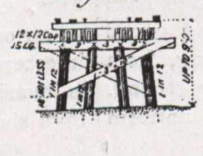


Fig. 20.



FIGS. 20, 21 & 22
ELEVATIONS OF PILE TRESTLE BENTS
SHEWING BRACING FOR VARIOUS HEIGHTS.

SCALE FOR FIGS 15 TO 17 & 19 TO 22

Fig. 19.

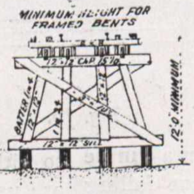
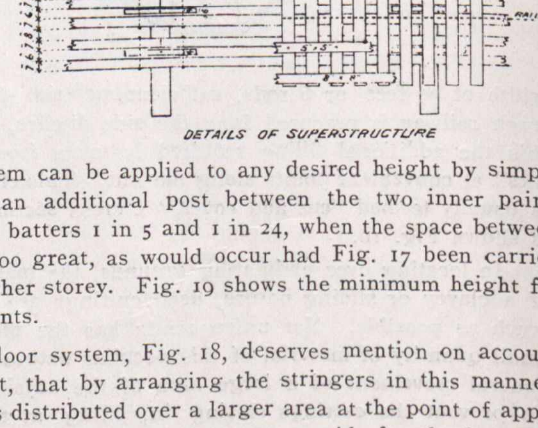


Fig. 18.



DETAILS OF SUPERSTRUCTURE

squared timber, tenoned at sills and caps, and drift-bolted. The sheathing and flooring consists of 3-inch planking. This structure is adapted to situations where the water-course has a well-defined deep channel with gravelly bottom.

Pile Culvert.

Where the situation is unfavorable for the class of structure shown in Figs. 8 and 9, a pile culvert of the class, Figs. 12 and 13, is substituted. The piles are driven to a solid bearing, and capped as shown, and sheathed behind with 3-inch planks.

The superstructure shown in Fig. 14 is common to each class of open timber culvert.

Pile Trestle Bridges.

The pile trestle bridge, Figs. 20, 21, and 22, already referred to on account of its adaptability to difficult or uncertain situations, consists of a series of 4 pile bents with their centres placed 15 feet apart. The inner piles are driven

same system can be applied to any desired height by simply inserting an additional post between the two inner pairs, those with batters 1 in 5 and 1 in 24, when the space between becomes too great, as would occur had Fig. 17 been carried down another storey. Fig. 19 shows the minimum height for framed bents.

The floor system, Fig. 18, deserves mention on account of the fact, that by arranging the stringers in this manner, the load is distributed over a larger area at the point of application. It was found necessary to provide for the load due to increased weight of engines in this way without materially increasing the weight of trestle floor. It will be observed that the outside or jack stringers usually placed directly under the ends of ties, can be omitted by this arrangement and brought into action to better advantage nearer the point of application of the load. The stringers, ties, and guard rail are usually made from clear white or red pine, or Douglas fir. The remainder of the work from "merchantable" timber of various kinds.

Crib Piers and Abutments.

Fig. 23 illustrates the manner in which crib piers and abutments for Howe truss, pony truss, and wooden lattice spans are constructed. The courses are dovetailed at all intersections, and drift-bolted together with drift bolts long enough to penetrate 2½ courses of timber. Oak trenails are used at all other points except where the timbers intersect. All intersections at cutwaters are dovetailed at the proper angle, and drift-bolted in the same manner. The nosing of cut waters is protected as a rule with a covering of sheet iron. The timber used is cedar, pine or tamarac.

Crib Retaining Walls.

Crib retaining walls are frequently introduced as a protection at the foot of slopes running out into water where

Cattle Guards and Open Culverts.

Timber in place per 1,000 ft. B.M.	$20 00
Superstructure, stringers, ties, etc.	30 00
Piling per lin. ft. left in work	30

Wrought and cast iron included in above prices.

Box Culverts.

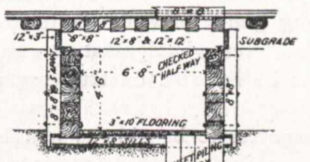
Box culverts, 2 ft. by 2 ft. per lin. ft.	$2.5
" " 3 ft. by 3 ft. " "	3.0
" " 4 ft. by 4 ft. " "	4.0

Framed Trestle Work.

Framed trestle work in place per 1,000 ft. B.M.	$22 00
Stringers, ties, guard rails per 1,000 ft. B.M..	30 00
Piling per lin. ft. left in work	30

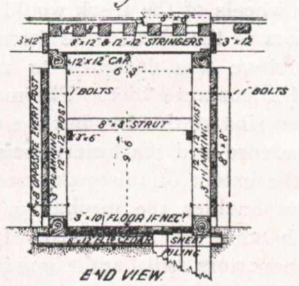
Ironwork included in price of framing above. Trestle work about 20 feet in height costs about $6.25 or say 25 shillings per lineal foot.

Fig. 9.



END VIEW.

Fig. 11.



END VIEW.

Fig. 13.

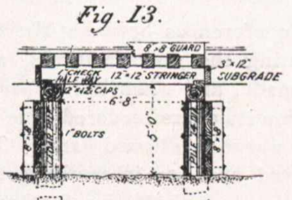
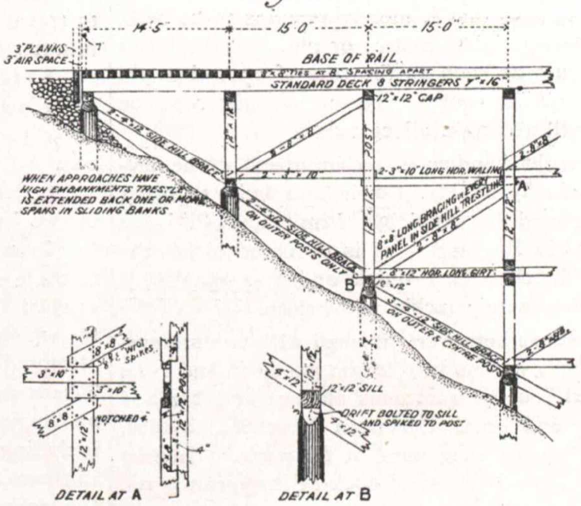
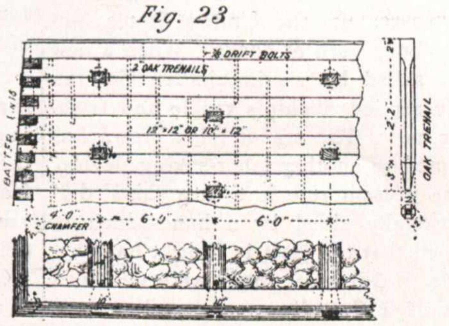


Fig. 15.



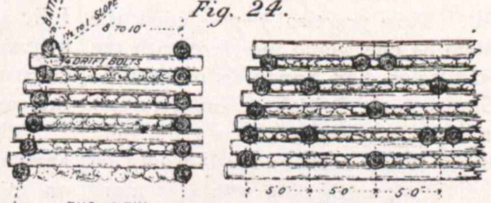
ELEVATION of SIDE HILL TRESTLING.

Fig. 23



CRIB PIERS & ABUTMENTS.

Fig. 24.



CRIB RETAINING WALL.

there is danger of erosion from currents, also at various points where otherwise masonry retaining walls would be necessary. They are constructed from rough logs, laid in the manner indicated by Fig. 24. The timbers are notched at all intersections and drift-bolted together. The timber used is chiefly cedar, spruce, and tamarac.

Approximate Cost of Structures.

The cost of the various structures referred to varies so much over so vast a territory that it is scarcely possible to give more than approximate figures. The following prices, however, may be considered a fair average, when timber can be procured at a reasonable figure, and the work done by experienced workmen, under the superintendence of men familiar with this class of work.

Crib piers and abutments cost per cub. yard, including stone filling complete $3.50. Open cribwork for retaining walls with stone filling costs per cubic yard $2.

The author had in view the idea of introducing in the present paper a few examples of the permanent work by which the temporary work is being rapidly replaced. There are many features of the construction of masonry arch culverts, piers and abutments, on Canadian railways which might be of interest by way of comparison, but in order to attain this purpose it will be necessary to deal with this division of the work apart from the present paper.

The principal object the writer had in view in preparing this paper, was to deal with the subject in a manner to be of interest to the younger members of the profession who, per-chance, may have to engage in similar work. Exchange of ideas, not necessarily new, in the arrangement and performance of works of this description may frequently be productive of much benefit. Though much remains to be accomplished by the engineer in converting the desert and the tropical swamp into a habitation for civilized races, yet public attention has also been directed to the vast wealth lying for ages underneath the perpetual snows of our northern latitudes. To this subject in future, no doubt, will the attention of the engineer be directed in solving the problems by which these regions may be made habitable and brought within the easy reach of man.

ELECTRIC FREIGHT TRANSPORTER.

Two electric freight handlers installed here for trial, by English firms, have been pronounced mechanical successes by Mr. F. W. Cowie, Chief Engineer of the Harbour Commission. Mr. Cowie says that it merely remains to be seen whether they are commercial successes or not, and the latter can be determined just as soon as the cost of operation per ton of freight handled is known. Tests that will soon be run by Mr. Cowie will ascertain all cost data.

The electric freight handler is an improved crane mechanism designed chiefly by Mr. Cowie and built to order by Stothert & Pitt and by Applebys Limited, both large manufacturing firms in England. It is designed to lift the freight from ships hatches in a quick and "seamanlike" fashion without using merely tackle and brawn.

When the steel sheds here were finished with two storeys, it was found that there was no way to get goods to and from the second storey without an enormous amount of labor and time. In England and other European countries, cranes, hoists, jiggers and chutes were used at all ports. In fact there is a crane for every fifty feet of dock at European ports. In the harbours of South America, where the docks were built and designed by British and Continental engineers, cranes are erected everywhere. In the United States and Canada, cranes have never been used at docks. When a new York harbourmaster was asked by an inquisitive German where his cranes were, he replied, "ship's tackle and Irishmen are good enough for us." The era of Irish brawn has passed; electricity is adapted to another labor-saving device.

In American ports the present rule is to use ships' derricks and winches, occasionally aided by a hand-winch in the shed. It is to be hoped that the electric freight handlers will change these methods. Our steel sheds were designed to meet the requirements of a Canadian port, grain necessarily figuring as a large portion of the freight. On the front of the roof, a carrier for grain extends from one end to the other of the sheds. This practically precluded the adoption of the crane system as one would interfere with the other. The harbour commission had hundreds of designs submitted by United States and British manufacturers. Many of these were splendid, but in order to use them here a great deal of strengthening of the harbour sheds would be imperative, and the cost of the strengthening would be more than the cost of the cranes.

In considering the question of the rapid and cheap handling of freight, the experience gained by United States harbourmasters must be taken into account. Probably freight is handled more cheaply and more expeditiously in the United States lake ports than anywhere else in the world. The method of coal handling cannot be beaten. The reason for this success is that instead of the swinging crane system, the fast-running transporter system has been adopted.

When the harbour commissioners of Montreal took these matters in hand they asked for designs to meet their requirements on a temporary transporter system. Every cranemaker sent designs of cranes with inferences that the transporter system was never tried with success in connection with dock sheds. When Major Stephens, president of the harbour commission, and Mr. F. W. Cowie, chief engineer, visited England last year, the principal crane manufacturers were communicated with, and after many discussions a design was prepared with the view of meeting the situation presented by the already-erected sheds and the character of the freight to be handled. Messrs. Applebys Limited, 58 Victoria Street, London, S.W., and Messrs. Stothert & Pitt, of Bath, agreed to work out the details of the machinery according to the given specifications. The requirements that had to be met by the transporter cranes were as follows:—

1. Capacity must be two tons.

2. The overhang from the shed to the ship's hatch must be forty-six feet.

3. Size of package to be landed on shed to be seven by eight feet.

4. Package to be landed on the middle line of the upper storey of the shed.

5. Speed of lift to be 300 feet per minute.

6. Traversing speed into shed to be 300 feet per minute.

7. Machinery to be mounted on rails to enable carriage to travel from front to back of shed at the rate of 50 feet per minute.

8. In handling goods between shore and shed, back-tail of crane to extend over wharf, past two railway tracks and allow packages to be handled on trucking platform or wagons.

9. Each transporter to be able to handle goods at either of two hatches.

In working out the details of the mechanism according to these specifications it was ascertained that the pressure on each of the front wheels of the truck would be eighteen tons, for which the floors of the sheds were fortunately sufficiently strong. The carriage was designed to run on seven-inch T-rails embedded in concrete floor. The main truck mounted on four wheels remains stationary, but the entire upper part, including the structure and machinery, revolves on a swinging carriage to the extent of thirty degrees on both sides of the normal. This enables the mechanism to handle goods in either of two hatches fifty feet apart. It is expected that four of these transporters will handle goods from all hatches of any modern ship.

After many conferences between Mr. Cowie and the engineers representing the manufacturers, a successful working design was made, and when the inspection tour was over the harbour commissioners ordered one trial "handler" from each of the above-mentioned firms. These "handlers" are already erected and are in working trim. At the first official test the machine built by Stothert & Pitt handled 5,600 pounds in a box of eighty cubic feet from every position, and the speed requirements were more than complied with. The Applebys machine will be tried out in a few days, but Mr. Cowie says that he thinks it will easily prove fully as satisfactory as the one already tested. Applebys have a number of patents recently secured on devices used in the construction of their trial machine, and which may possibly increase the speed and simplify the operator's work.

The commercial result of these machines is being anxiously watched by all the dock contractors and engineers on this continent, and if it works out well, the Montreal "handlers" may be expected to represent the new North American type of freight handlers. The model built for demonstration purposes at Montreal before the harbour commissioners is at present at Montreal and may be sent to Toronto for exhibition purposes if the freight handlers in that city show sufficient interest in it. The model was built with great care and accuracy, and is ⅛ size. It is an exact copy of the full-sized crane and works exactly like the full-sized one. It is run by electricity and controlled in every way like the large freight handlers.

The successful construction of these electric freight handlers seems to settle the difficulty of transportation advanced and unanswered at the last convention at Chicago on Maintenace of Way. A well-known speaker said that the great difficulty in shipping is the lack of terminals, and that the lack of terminals is caused by inability to handle freight quickly and properly.

SCIENCE AS THE BASIS OF COMMERCIAL SUCCESS.*

By Hon. Joseph Buffington, United States Circuit Judge, Pittsburg, Pa.

I am obliged to the chairman for interrupting the programme of the evening and giving me the opportunity to say a few words to you to-night. If he will excuse me I will remain here on the floor instead of taking the platform. I should be false to my feelings to-night if I did not say that it is a great pleasure to be present. I stopped my work down at the court of appeals in Philadelphia in order to come here, because I had such an intense interest in the movement which has culminated in turning the old arsenal of war into a home of science, that I feel to-day is not only a red-letter day for humanity and Pittsburg locally, but that it is also an epoch day for our government, one of signal significance in the development of the future of our country. I have long felt that the civilized nations of the world were stripping to the waist for a great commercial struggle, and I have feared that in this great country of ours, owing to its very greatness and its division into many States, that what was everybody's business was nobody's duty; and that dear old Uncle Sam and these States of ours were losing sight of the strategic vantage points in that titanic commercial struggle. And that strategic base to my view is in the turning of the minds of the scientific men of this country from pure science to applied science and in the nation's taking advantage of this applied scientific knowledge, and what commercially flows therefrom, as the great dynamic force which shall lead us to the heights of international commercial supremacy. Germany has grasped and gripped this fact. Her astounding commercial growth to-day is not the result of chance, not the fortuitous development of commerce or the work of individual men, but it is the outcome of resultant result from causing cause. It is because the great minds that were building the greatness of Greater Germany a generation ago grasped the significance of the laboratory, the chemist, of pure science in the ultimate outcome of applied science. These great minds unified, centralized and localized this great economic-scientific policy into German scientific and commercial life and hand in hand the twin sisters—laboratory and factory—knowledge and practice—the head of science and the hand of toil, have led Germany in half a generation to the forefront of commercial development. In that time, for example, Germany had quietly had to work a great central governmental institute of testing material, of fuel economics, of analyses, combination and quantities, where the great underlying questions of manufacturing have been intelligently and scientifically studied out. From this foresight she is reaping to-day the rich first-fruits in an aggressive, surging commercial advance that is at once a lesson and a warning to her sister nations. To-day she is a generation ahead of us in this march of scientific forethought. She is reaping harvest where we are just beginning to plow our fields. Seeing which, I for one am deeply interested in this work which you have seen officially installed here to-day. This work which you have been privileged to-day to see begun; the starting of these testing places, these places looking to the conservation of material, these bringings of the theoretical chemistry of the past into the practical work of the present have immensely to do with the commercial future of the country. And I feel, gentlemen, and we of Pittsburg feel, glad that this work has taken but a tentative form here, because we feel that the development from this day forward will be such that in a few years we will wonder that some former generation had not begun it. We do not want to look on it as an enterprise merely for the benefit of this community. It has a far wider range and deeper significance. The mere accident of its location is one of locality because we realize there is no place save Pittsburg on the map of the United States which is at once within a night's ride of the City of Washington and also within a night's ride of so many sister cities.

I have every faith, as this work goes on and develops, that the co-relation of other things, other industries, other sources or means of scientific development will bring other scientific branches of the government to this point where they may be concentrated, and where we can as a whole country get the advantage which Germany is now getting from her scientific station at Charlottenburg.

With these few thoughts in mind, I feel to-night that we are on the eve of a great movement in this country and we have been participating to-day in that which is pregnant with a great future. I want to add my conviction of the substantial value of this together-coming of practical, strong, level-headed men in such a gathering as this Mining Congress. The mining man who fails to come to such gathering loses tremendously to my mind in the development of himself and his work. I attended your sessions this morning and I was struck not only with this thought, but (after Dr. Holmes called for volunteers to speak) of the suggestions that a convention of this kind must bring to the men who are engaged in purely scientific work. Think of these lamentable accidents, the terrible catastrophes in the coal mining industry! What a flood of thought was brought out to the scientists by the simple statements of operators as to the variations in the atmosphere and the humidity of such atmosphere, and the proneness of those accidents to occur at certain seasons of the year. I am no prophet, and I am not a scientist, but I venture to say that this suggestion of the relation of the humidity and conditions of the atmosphere to these explosions will be taken up by these scientific men of the government, by the schools of mines by scientists everywhere, and worked out to some solution that will lead us to see the connection between the cause and the effect. I was struck with the fact of the open lamp as a cause of these disasters, and I said in my own homely way, if the open lamp is one of the causes of these disasters, these scientific men will get at the root of this thing, for true science always goes to bed-rock fact—and they will see that the use of the open lamp comes from that quality of human nature which leads the miner to disregard danger in use of the open lamp because he gets more light from the open than he does from the closed lamp. It is natural, therefore, for him to want to use it, and he will use it because by its light he will get out more coal. And the way to stop him from using it is not by legislation, but by removing the cause which causes him to use it. How shall this be done? Why, this body of scientists will get down deep and they will say that if there is any cause that leads the miner to use the open lamp, the way to beat that is to produce a closed lamp that will be so much better than the open lamp that the temptation to use the latter will be taken away. (Applause.)

Mr. Chairman, the experience I have had with scientific men in the disposition of patent cases for a great many years has led me to the profound conviction that science is at the bottom of commercial success. I feel that this convention should take this thought home with it, and hammer home to their members of Congress and Senate the necessity of sustaining these men of science by liberal appropriations to carry on the great scientific work of this nation. (Applause.) If the news goes out from this convention, as I believe it will, to our representatives and our senators that these men are not carrying on something high up in the air in the way of scientific theoretical investigations, but are coming down to practical questions of modern industrial life, it will do much to aid the development that has been started here to-day.

I thank you, ladies and gentlemen, for your kind attention. (Applause.)

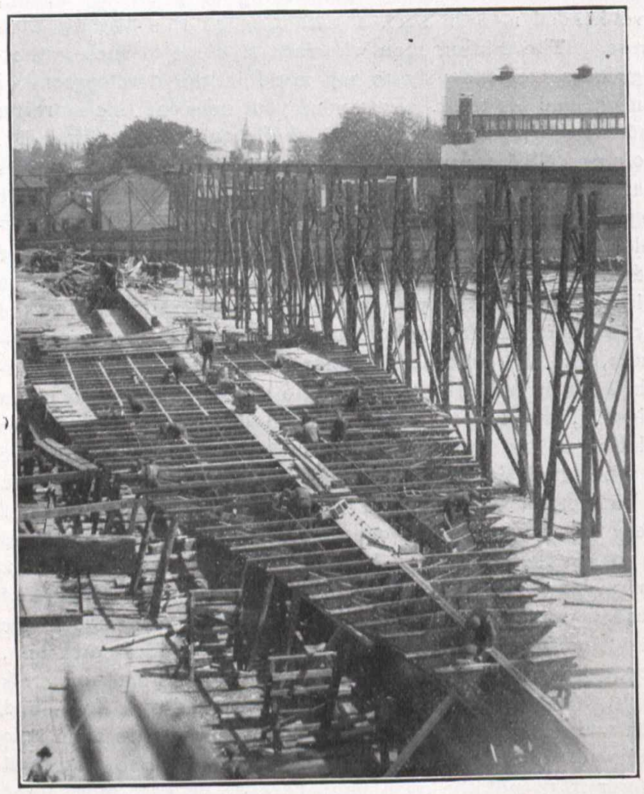
* Paper read before the American Mining Congress.

The production of phosphate rock in the United Kingdom decreased from a maximum of 258,150 tons in 1876 to 32 tons in 1907. In 1905 and 1906 no production was made. Imports in 1907 were 505,671 tons.

THE NEW STEAMER "HAMONIC."

When the steamer "Hamonic" of the Northern Navigation Company joins the fleet on the 15th of June, 1909, the great lakes will float one of the finest ships in all the world. The "Hamonic" is now being completed at Collingwood, by the Collingwood Shipbuilding Company.

Not so very long ago, a ship like this one would have been the pride and admiration of any Atlantic service. At the present time no ship on any waters can show more perfect construction, more comfort and luxury. When completed she will be the very highest type of vessels of her class, not only as to construction, carrying capacity and speed, but her passenger accommodation will be of a superior order with great beauty in design and ornamentation, while presenting an effect both rich and pleasing, the designer's dominating idea being that a beautifully harmonious scheme is more restful that an extravagantly elaborate plan of decoration.



Progress June 3rd.

The Ship's Dimensions.

The "Hamonic" is a big and capable ship. Her dimensions are:

Length over all	365 feet.
Length between perpendiculars	341 "
Extreme breadth	50 "
Moulded depth	27 "
Gross tonnage	5,000 tons

A Canadian Product.

The whole ship, from keel to trucks, is strictly the work of Canadian engineers, designers, and builders. While the Canadian yards have turned out many fine vessels, this one will be the first to combine in one hull the latest, best and most valuable features of modern naval architecture and engineering, ever delivered by Canadian builders from Canadian works.

The Hull.

The "Hamonic" was designed and is being constructed with strict regard to the rules of the Bureau Veretas and the Great Lakes Register, and under the inspection of the last-named corporation. Her rating therefore will be the highest possible in the lake service.

The hull is modeled with remarkably fine lines forward and a clean run aft, having in view a speed commensurate with the power of her engines.

It is being built on the channel system, with extra heavy frames and steel plates, tested at the mills, strong enough to pass the most rigid requirements in chemical, ductile and tensile qualities. The bottom is double, and fitted with fourteen compartments that will hold fifteen hundred tons of water ballast. The hull itself is divided by water-tight bulkheads into nine compartments, so that she will be unsinkable. To prevent rolling, she is fitted with bilge-keelsons. She will be always a safe ship, and steady in the roughest water.

Steel bulkheads running up to the spar deck completely separate the freight spaces from the part of the ship occupied by the passengers and crew.

The Machinery.

The engines are quadruple expansion, having a total of 7,006 indicated horse-power, fitted with the Yarrow Slick Tweedy counterbalancing system to prevent vibration. Steam is to be furnished by six single-ended Scotch boilers of 250 pounds pressure to the square inch, with Howden forced draft. Bunker capacity will be provided for 500 tons of coal.

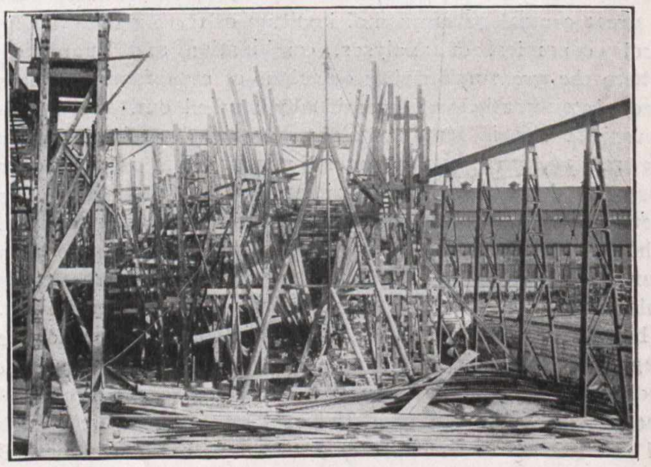
The propelling machinery and boilers are placed very far aft, but the funnel will stand well amidship, between the two masts, so that the view in profile is well proportioned and pleasing. This disposition of the power plant is made with reference first to the comfort of passengers, and next to the best arrangement of freight space. The other machinery is placed forward of the engines and in various parts of the ship, as best will serve their purposes.

She will be supplied with steam steering gear, capstans and windlasses operating patent bow and kedge anchors; a Nicholson Log will also be provided.

As electricity will enter largely into the decoration of the ship she will be brilliantly illuminated. Current will be furnished by Sturtevant generators installed by duplicate.

There is a complete artificial ice and refrigerating plant and a wireless telegraph installation.

The fire apparatus and life-saving equipment is ample, complete and up to the very strictest regulations and requirements of the Canadian and U.S. Governments, in everything about the ship, but in these two features most particularly, all that experience can suggest or forethought provide, will be done to assure the safety as well as the comfort of passengers.



Progress July 4.

Superintendence During Construction.

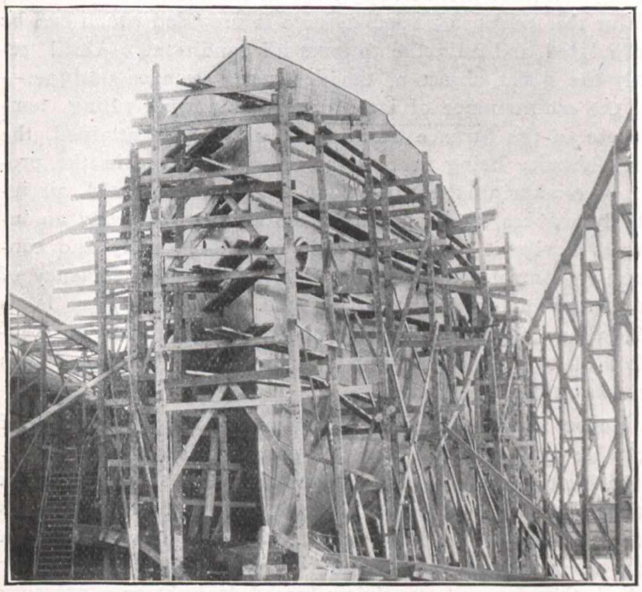
The construction is being carried on under the constant and painstaking supervision of the Northern Navigation Company's officers, as well as the inspection of the Great Lakes Register. Supplementing these, the services of Mr. Hugh Calderwood have been secured as Supervising Naval Architect, and in addition Mr. Frank Kirby, of Detroit and

New York, an eminent authority on marine construction has been retained as consulting architect and engineer.

The interior of the cabins and all the decorations are designed by and will be executed under the personal direction of Mr. Louis O. Kiel, of Detroit, an acknowledged authority and expert in such matters.

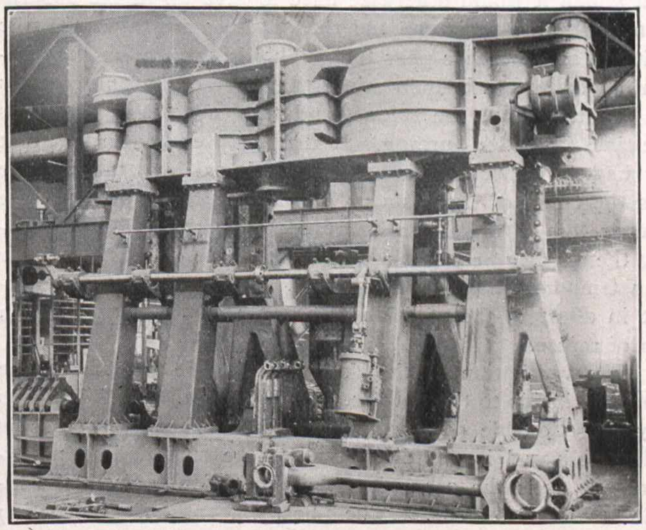
Cargo Capacity.

Seven gangways are provided on each side, five for freight, one for first class passengers and one for second



Progress October 3, Showing Staging.

class passengers and supplies. The five gangways leading to the freight space on the main deck are so arranged that each gangway serves two hatches, which open into the ship's five cargo holds. The very latest design of hoisting machinery for the handling of package freight will be installed, and it is expected the steamer will be one of the fastest "handl ng" ships in the package freight business. Her cargo capacity is about 3,000 tons of package freight, for 100,000 bushels of wheat, below the main deck. She will



Engines of the "Hamonic."

be fittted with elevator hatches to enable her to receive grain if desirable.

Passenger Accommodation.

The "Hamonic" will have accommodation for 400 first class passengers, 75 second class passengers, and 110 of crew and officers, and every attention has been paid to the comfort of passengers and crew.

Next to the Romans, the ancient Peruvians were perhaps the most efficient civil engineers. Their roads were marvellous, and the highway from Quito into the Chilean dominion was one of the most remarkable roads the world has ever known.

THE DESIGN AND WORKING OF A MODERN DESTRUCTOR.*

By William F. Loveday, Borough Surveyor, Stoke Newington.

In submitting a paper on this subject there is no need to give the history of the rise of modern destructors; so much has already been written that to rewrite it would be an insult to the intelligence of the municipal engineer. Suffice it to say, having analysed the refuse and ascertained the quantity of incombustible, vegetable, and other matter, that, given a known quantity, the results to be obtained can be calculated with almost mathematical exactness. The general trend of development and progress in destructor practice, more particularly during the past two years, has been on the following lines:—(1) The amelioration of the conditions for the workman in the destructor house; (2) the introduction of details in construction which ensure fairly high temperatures and a normal ruling condition in the furnace proper. More efficient means have been introduced for the ventilation of the destructor house, and this is a step which is undoubtedly in the right direction. It is well known that, in any plant that is not strictly up-to-date, a visit to a destructor plant is synonymous with dust, and the experience could never be looked forward to with anything but feelings of dismay and prospective discomfort. In up-to-date plants ventilating ducts are provided, and the house is so constructed as to permit of the air being renewed from four to five times per hour. The vitiated air is withdrawn through these ducts and led to the fan inlet, from whence it is propelled to furnace ashpits. In this direction, also, means have been introduced for facilitating the clinkering of the fires. This is by common consent the most laborious operation in the whole cycle in destructor working, and anything that can render easier the clinkering of the fires would be hailed by the firemen, at any rate, with the utmost satisfaction. Taper castings have been introduced which form a line of cleavage between and in the grates, and much facilitate the breaking up of the fires before withdrawal.

Although there are several different firms who specialize in destructors, yet there are practically only two groups or types—namely, the "single cell," and "continuous grate." These may be again subdivided or classified by the method adopted in feeding the refuse into the furnace—namely: (1) top feed—in which the refuse is fed in through the top directly on to the fire or on to a drying or desiccating hearth, and then pulled forward on to the fire-bars; (2) back feed—in which the refuse is fed in through an opening at the back and clinkered from the front; (3) front feed—in which the refuse is fed in through the front and clinkered from the same opening. With regard to the top feed, although possibly there is considerably less handling, yet there are grave objections so far as obtaining good results from the combustion and evaporization point of view. Should a load arrive which is either very wet or contains an unusual quantity of tins, earthenware, bottles, or other incombustible matter, it must of necessity go into a particular cell, with the consequent effect of reducing very considerably the temperature in that cell. Again, the refuse has to be pulled forward on to the bars, and it is difficult to get an even thickness and uniform density over the grate when handling long and heavy firing tools over a hot fire, with the result that the forced draught will take the thin parts, to the detriment of the thicker portion which most requires its aid for a complete and perfect combustion. The front or back feed enables the stoker to apply the refuse more evenly and with more discretion, and although the method of charging with the shovel by hand has been described as putting it on by the spoonful, yet to obtain the highest efficiency the makers of mechanical stokers have been employing this method of small quantities at a time with the best results.

In the single-cell type of destructor the cell is an isolated furnace, having an opening through which the refuse is deliver-

*Read before the Association of Municipal and County Engineers.

ed on to the grate bars and an opening at either the back or front for the outlet of the products of combustion. These latter pass into a main flue which is common to a number of cells built in parallel. The cell being isolated, the process of combustion must go on unaided by any adjoining fire, and the temperature obtained depends entirely on the quality of the refuse with which it is charged. There is a type of furnace which consists of two cells having a boiler between, so that the gases evolved in cell pass immediately under the boiler, and are, consequently, cooled before complete combustion has taken place. It has the further disadvantage that, at the time of clinkering, the admission of cold air must adversely affect the boiler, having regard to the fact that the boiler is in such close proximity to the cell. The continuous grate is, as its name implies, a number of grates in line, each having a separate ashpit, but with the space above the firebars communicating; that is to say, the gas is passed the whole length of the series of grates into a combustion chamber and from thence to the boiler. A charge put on any one grate must naturally receive a large amount of assistance from the other fires, and the time taken in the initial ignition and combustion must, therefore, be considerably less than in the single-cell type. The great fluctuation of temperature in the single cell affects the firebrick lining very seriously, due to expansion and contraction. This is taking place between each operation of clinkering, about every two hours. This fluctuation is reduced to a minimum in the continuous grate, for the reason that there are always other fires in the furnace at the time of clinkering any one fire. There can be no doubt, however, that the continuous-grate type of furnace construction is being looked upon with much greater favor, and a few words might be said with regard to the leading features which characterize the best known systems of this type.

It may be laid down that the following are absolutely essential features in the design of any furnace that can reasonably fulfil the primary objects for which its exists—viz., the complete destruction by fire of obnoxious matter without nuisance, and general provision for the utilization of the heat generated in the process: (1) a continuous furnace chamber with the grate laid off in sections, each section independently controlled and so operated that it is a complement of the others; (2) provision for heating and regulating the air supply for the necessary forced draught; (3) a combustion or dust-settling chamber; (4) steam generator. The rate of burning in a continuous grate is higher than in an isolated cell. This rate of burning is materially increased if the arch over the grate is undulating, which causes the gases in one fire to be deflected on to the next, and again from that on to a third. The gases distilled from the green or newly charged refuse must be more thoroughly cremated when brought into contact with other fires, than can be the case when going direct from an isolated cell to the boiler. It is obvious, therefore, that combustion being more perfect, a higher as well as a more regular temperature is attained, and, therefore, a higher rate of burning. As the result of careful observation the author has found that the ratio of burning on each grate on a three-grate unit is as 3, 4, and 5. On the grate furthest from the combustion chamber the rate of burning was 55.21 lbs. per square foot of grate area per hour; on the middle grate 74.6 lbs., and on the grate next the combustion chamber 89.6 lbs., which gives an average of 73 lbs. per square foot of grate area per hour over the whole area.

In the cycle of operations which takes place after the delivery of the refuse into the storage bunker there are three distinct stages, in each of which the features embodied in the furnace design play an important part. These stages are: (1) the charging stage; (2) the burning stage; (3) the clinkering stage. With regard to (1) a storage hopper or bunker is provided. This is placed in a position convenient of access for the firemen, and just opposite the charging door to the furnaces. It is usual to provide for approximately half a day's supply of refuse in the bunker, but, of course, the hours of collection in general determine the amount of storage that should be provided for. The refuse is shovelled direct from the hopper and spread over the furnace grate in one operation by the fireman. At stage 2 the utility of the continuous furnace chamber and sectional grates is at once put into effect, as also No. 2 of the essential features in the furnace design—viz., the heated air supply. Whenever the material is charged it is ignited by the flame from the adjoining fires, and the temperature of the furnace chamber is further increased by the forced draught air supply, which is heated by means of the air heater or regenerator. Control and regulation of the air supply are of the utmost importance, and for this purpose a special valve is provided which can be manipulated and adjusted to meet all conditions. Until recently the great object of the destructor furnace designer—viz., the maintenance of a uniform and normal ruling temperature in the furnace chamber—could not be attained, the chief difficulty being reached at the third stage in the process of clinkering the fires when an inrush of cold air inevitably reduces the temperature of the chamber. By an ingenious device it is now possible to automatically and continuously control the conditions determining the efficiency of combustion in the destructor furnace. This apparatus is an entirely new feature in destructor practice, and has been installed on the plant just put to work in New York, and has been an unqualified success.

House refuse ordinarily contains a high percentage of vegetable matter, which consists of upwards of 70 per cent. of moisture. Under these circumstances a steam jet as a means of supplying forced draught does not strike one as being as desirable as it would be, adding air saturated with steam to an already heavily charged moist fuel. The better method, therefore, of supplying forced draught or a pressure of air in the ashpit would be by fan. It is eminently desirable, however, that the air should be heated. This can be obtained from the waste gases after leaving the boiler by means of an air heater through which the gases pass down a series of tubes, whilst on the outside of the tubes the air is driven from the fan into the ashpit. There is thus a good exchange going on, the waste gases are made to give up a large amount of their heat to heating the air for forced draught. The heated air on entering the furnace absorbs whatever moisture there may be in the fuel, thereby saving the fuel to that extent which it would otherwise have to give up in the absorption of its own moisture and thus adding increased calorific value to an otherwise poor fuel. This is therefore a very important feature to bear in mind, that heated air rapidly takes up moisture from the refuse, and thus materially decreases the time taken for burning. It also is a well-known fact that air heated previously to being discharged into the furnace has the effect of increasing the temperature about twice the temperature of the air so delivered. The advantage of heating the air may be expressed in terms of coal. Thus with air at a temperature of 300 degrees F. is approximately equivalent in effect to the addition of about 1 cwt. of coal to each ton of refuse.

The ventilation of the destructor house should not be from the inside to the outside, but vice versa. By this means any objectionable odor which may arise when the refuse is being delivered is not distributed to the surrounding neighborhood, as is the case when the ventilation is from the inside to the outside. The best means of ventilation is by means of an air-duct constructed in the roof, communicating with the shaft supplying the air for forced draught for the furnaces. The air is drawn from every part of the house simultaneously, heated and passed through the furnaces, and as the only means of ingress for the fresh air should be at the openings at the ground level, this method ensures that the inside of the building is as fresh as it is possible to be. Incidentally, the fan thus serves a double purpose, as it extracts the air from the destructor house and affords a good system of ventilation, and also the purpose for which it was originally intended—namely, the supply of forced draught.

Generally speaking, the following are features which should be absolutely insisted upon in any destructor installation: (1) cleanly operation, absolute freedom from nuisance to the neighborhood, and maximum comfort for workmen; (2) minimum capital cost, consideration being given to the value of the steam and clinker, and general efficiency; (3) low maintenance charges combined with low labor cost; (4) the necessity for heating the air supply has been more than ever demonstrated in recent years, and this can be most economically effected by placing the heater in the path of the waste gases just at the boiler outlet; (5) maximum evaporation; (6) regular steaming; (7) clinker of marketable quality.

The plant at Stoke Newington was erected by Messrs. Heenan and Froude, Limited, of Manchester, and consists of two units of three grates each; each grate has an area of 25 square feet, and there is a separate ashpit to each grate. At the end of each unit is a large combustion chamber at right angles to the furnace, at right angles to this chamber and parallel with the furnaces are placed two Babcock and Wilcox water-tube boilers, each with a heating surface of 1,741 square feet. At the end of the boilers are the air heaters, and the gases after leaving these pass direct into the main flue. Each unit is provided with a separate fan and engine, which are used as before described for ventilating the building and supplying the forced draught. There is also a Worthington pump and an ejector for filling the boilers. The plant is in duplicate, and each unit is worked every alternate week. The floor of the destructor house is 10 feet 6 inches below the tipping floor, from which the refuse is shot into hoppers immediately in front of the furnaces. The furnaces are of the front-feed type—that is, they are fed and clinkered from the same opening. The average quantity of refuse received at the destructor in the summer is 30 tons per day, and in the winter 45 tons per day. This is dealt with by 2 shifts of 2 men each; the number of hours worked by each shift is 8 in the summer and ten in the winter. During the two years the plant has been in operation there has not been a sufficient use for the steam generated, and the author is, therefore, unable to give a complete year's working of the results which could be obtained. At present, beyond the small amount of steam required for the fan and the pump, there is a crusher engine of 15 horse-power, a disinfecting station, a small electric generating station with a dynamo of 77 kw. capacity, which is worked nightly at a load of 170 amperes and 515 volts, and 22 public slipper baths. The boilers are set to blow off at 160 lbs., and with the by-pass damper partly open steam is constantly blowing off. During the winter six months, between the hours of 10 a.m. and 2 a.m., 2¼ lbs. of water are evaporated per pound of refuse, and in the summer about 1½ lbs. per pound of refuse. In the summer work ceases at midnight. The clinker is used for a large variety of purposes. During the last nine months the author has used some 1,000 tons, which has resulted in a saving of £330 for ballast and sand. The clinker has been used for concrete in foundations of walls, retaining walls, floors, roofs, concrete foundations for paved roads (both wood and granite), and also paving yards and footpaths. The divisions between the slipper baths were made of reinforced clinker concrete, 1½ inches thick, at a cost of 3s. 5¼d. per sq. yard. The cost for burning the refuse equals 7.3d. per ton. In addition there is the cost of cleaning the flues amounting to 0.5d. per ton. A fitter is employed about the premises, a proportion of whose wages should be charged to the destructor. A boy on each shift is engaged for the purpose of picking out the tins from the refuse, which he pulls forward for the stokers, but this is no charge on the destructor, as the amount received for the tins equals their wages. The cost of disposing of the clinker in the first year amounted to £196, but during the second year there will be no charge for this, as the sales and use to which the clinker has been put will probably result in a profit.

Consulting and electrical engineers are now beginning to awake to the possibilities of the destructor. A few years ago these gentlemen would have nothing to do with them, but in those cases where the destructor has been run as an adjunct to electric and other installations the results have exceeded their expectations.

The following are three tests made at different seasons of the year, as under:—

Official Test of the Refuse Destructor for the North Metropolitan Electric Power Supply Company, St. Albans Electricity Generating Station.

Date of test	Jan. 20, 1909.
Duration of test	8.125 hours.
Weight of refuse burnt on test, 11 tons 13 cwt. 2 qr. 14 lbs. =	26,166 lbs.
Equivalent rate of burning for 18 hours, 25 tons 15 cwt. =	57,690 lbs.
Number of cells in use 3, area per cell 14.3 sq. ft. =	43 sq. ft.
Type of boiler	Water-tube.
Heating surface of boiler	1,966 sq. ft.
Total water evaporated (actual)	55,100 lbs.
Average temperature of feed water	63 deg. F.
Average temperature of steam leaving superheater	575 deg. F.
Average boiler pressure (gauge)	159 lbs. per sq. in.
Actual evaporation per pound of refuse—i.e., with feed at 63 deg. F.	2.1 lbs.
Equivalent evaporation per pound of refuse from and at 212 deg. F.	2.75 lbs.
Average temperature in combustion chamber	2,084 deg. F.
Maximum temperature in combustion chamber	2,318 deg. F.
Minimum temperature in combustion chamber	1,904 deg. F.
Average temperature of gases leaving heater	388 deg. F.
Average temperature of air entering fans	63 deg. F.
Average temperature of air entering ash-pits	268 deg. F.
Total weight of clinker, 2 tons, 17 cwt. =	6,384 lbs.
Percentage to total refuse burnt on test	24.4 per cent.
Total number of B.O.T. units generated (actual)	1,180
Equivalent number of B.O.T. units on basis, 30 lbs. steam per kilowatt-hour	1,836
Units used by fan motor	46.66
Percentage to total generated	3.95 per cent.
Units used by pump motor	15.06
Percentage of total generated	1.275 per cent.
B.O.T. units generated per ton of refuse (actual)	103.8
Equivalent units generated per ton basis, 30 lbs. steam per kilowatt-hour	159
Units per ton of refuse available for power supply after providing for forced draught and feed pump	99.0
Equivalent units per ton of refuse available for power supply on basis, 30 lbs. of steam per kilowatt-hour	153
Average percentage of CO_2 in flue gases (by Orsat)	12.2
Ditto (by auto continuous recorder)	12.35
Two men charged and clinkered the furnace during the test at 5½d. per hour each, therefore the cost of charging and clinkering per ton =	7¾d.

There was no nuisance created by the operation of the works, the chimney being practically smokeless throughout the test.

I hereby certify that the foregoing particulars are correct, and were obtained under my supervision.

(Signed) E. T. Ruthven Murray,
Engineer-in-Chief, North Metropolitan
Electric Power Supply Company.

Official Test of the Refuse Destructor at Corporation Electricity Generating Station, Cheltenham.

Date of test	June 24, 1908.
Total time of test (actual time of burning 16½ hours)	17½ hours.
Number of cells under test	4 (1 unit).
Total refuse burnt, 37 tons 7 cwt. =	83,784 lbs.
Rate of burning per hour	4,780 lbs.
Equivalent refuse burnt in 18 hours	38 t. 10 cwt.
Rate of burning per hour per square foot of grate area	47.8
Total clinker, 11 tons 19 cwt. 2 qr. =	26,824 lbs.
Percentage of clinker to total refuse	25 per cent.
Total water evaporation (actual)	103,890 lbs.
Water evaporated per hour (actual)	5,930 lbs.

Average temperature of feed water	81 deg. F.
Average pressure of steam	154.4 lbs.
Water evaporated per pound of refuse (actual)	1.24 lb.
Equivalent water evaporated per pound of refuse from and at 212 deg. F.	1.557 lb.
Average temperature of steam	521 deg. F.
Average superheat of steam	153 deg. F.
Average temperature in combustion chamber	1,840 deg. F.
Average percentage of CO_2 (four samples, each extending over 1½ hours)	12.9
Average temperature of air in destructor building	83 deg. F.
Total units generated (in 9½ hours only)	1,564.4
Average kilowatts	164.5
Average units per ton of refuse	77.1
Pounds of steam per unit hour	38.3 lbs.
Equivalent total kilowatts at 30 lbs. steam per unit	2,002 units.
Equivalent units per ton of refuse	98.1 units.

Conditions of Test.—Two shifts of nine hours each—i.e., about 16½ hours actual burning and one hour occupied in clinkering fires left overnight and cleaning out ashpits.

I hereby certify that this test was carried out under my supervision.

(Signed) J. S. Pickering, A.M. Inst. C.E.,
borough surveyor.

Average Results of Official Test on Refuse Destructor at Wood Green.

Duration of test	Aug. 17 to Sept. 12, 1908.	
Total hours worked under forced draught	162 h. 5 m.	
Amount of refuse burnt	530 t. 1 cwt.	
Average temperature in combustion chamber	1,736 deg. F.	
Average gas analysis	CO_2	12.89%
	O	5.77%
	CO	0.01
	N	81.30
Burning capacity for 24 hours of one unit of three cells based on above average rate	78.48 tons.	

CHEAPNESS VS. EXCELLENCE OF REINFORCED CONCRETE CONSTRUCTION.

M. C. Tuttle, Aberthaw Construction Company, Boston.

A well designed, well and honestly built concrete building is one of the best, both from the fire risk and maintenance standpoint, that an owner can buy. The recent advertising and writing regarding concrete has unfortunately emphasized the cheapness of this material for fireproof construction instead of its excellence and its limitations. The general belief in the cheapness of this construction and the fact that much of the designing has been handled by contracting firms whose only interest was to produce the work at as low a cost to themselves or to the owner as possible, has led to much very light construction. Light, both as to its carrying capacity and (in many cases) exceedingly light if considered under the action of fire, where beams, girders, and columns may lose an inch or so of their surface. In the case of such a light design there is no strength of steel and no cross section of concrete to spare in order to carry the theoretical load with the theoretical factor of safety, the most that can be said after the building is subject to fire is that the structure itself is non-combustible, and that it will be exceedingly difficult to repair the floors and columns so as to make them capable of carrying the figured loads with the figured factor of safety. It is probable that only the tremendous strength of well-built concrete,—a strength probably far in excess of the theoretical,—would make it possible for such light buildings to be put back into their original work. This means that in a conservative concrete design, there should be concrete enough used so that not only the steel but the concrete immediately about it shall be thoroughly protected from the action of ordinary fires. The extra cost of such protection is slight in the total cost of a building. The extra size of columns seldom would make a practical objection. In case such a building was burned, the replacing of the injured concrete by plaster would be simple and the strength of the structure would be all unimpaired. In the case of the light design, the strength of the structure could well be impaired so greatly that the safety of the building would be in question; and should the question of the removal of the whole structure arise, the owner of a reinforced concrete building would be facing a serious expense and one that designers of concrete buildings do not care to consider.

In contract to a well-designed and constructed building, a badly built structure or one improperly designed is probably one of the most unsatisfactory structures an owner can put on his premises.

FUEL ENGINEERING.

Conservation of our natural resources must proceed along two lines, first the more efficient use of those we now employ, and second the utilization of others hitherto neglected. Interest most naturally centres in those resources upon which we depend for our heat, our light, and our power. Water power development will at least slow down the pace at which our fuel supply is being exhausted, but fuel will continue to be burned. The efficiency with which that process is conducted and with which the resultant is utilized will likewise determine the rate of exhaustion of such material resources. Hence the somewhat sudden recognition of "fuel engineering" as a distinct branch of applied science.

Largely through force of circumstances the engineer rather than the chemist has been looked to as the expert in consideration of the efficiency of fuel. But the broad field of fuel engineering must include mine inspection, expert knowledge of methods of preparation, inspection, sampling and testing of coal, power-house practice, smoke abatement, the design of power plants, gas producer practice, and acquaintance with the manufacture of illuminating gas. In a word the knowledge required is a combination of that independently possessed by the mechanical engineer, the chemical engineer, and the mining engineer. As it is practically impossible that a single individual should possess such a diversity of knowledge, it is evident that the best results will be obtained by the co-operative work of a number of experts, each trained and experienced in his particular branch of the work. But such opportunity for co-operation is only warranted in a large and fully equipped organization.

PATENTS.

Below will be found a list of patents recently granted to Canadian inventors in Canada and United States, which is furnished by Messrs. Fetherstonhaugh & Company, head office, Royal Bank Building, Toronto, Ontario.

Canadian Patents.—J. O. Spang, Haileybury, Ont., automatic swivel lamps for automobiles; W. W. Cowan, Stratford, Ont., snow plows; G. A. Gauthier, Toronto, Ont., metal planers; C. C. Cameron, Ottawa, Ont., tire heaters; J. E. Kavanagh, Winnipeg, Man., annunciators for cars; N. D. Munn, Dresden, Ont., blacksmith's forge; B. Vanderslice, Montreal, Que., attachments for faucets.

United States Patents.—C. L. Chisholm, Marysville, N. B., telephone transmitter; J. M. Coleman, Lambert, Que., brake head; T. E. De Lury, Ottawa, Ont., means for developing photographic plates; C. E. Hand, Dundas, Ont., compasses or dividers; J. R. Kerr, Brantford, Ont., Gate opening and closing device; P. H. McEwen, Windsor, Ont., locking mechanism for emergency exit doors; J. McNamara, Montreal, Que., line casting machine; J. Morrison, Montreal, Que., water closet seat; G. R. Prowse, Montreal, Que., apparatus for generating and superheating steam; J. Reesor and C. W. Steel, Toronto, hot water heater; F. L. H. Sims, Toronto, Ont., agitator for carbide gas generators.

CORRESPONDENCE

[This department is a meeting-place for ideas. If you have any suggestions as to new methods or successful methods, let us hear from you. You may not be accustomed to write for publication, but do not hesitate. It is ideas we want. Your suggestion will help another. Ed.]

THE BULLETIN SANITAIRE.

Sir,—In giving currency once more to what is an absolutely unjustified and unfounded attack upon Christian Scientists in regard to their practice in notifying the authorities of the presence of contagious diseases, the writer feels that you have but been led to be an unwitting participant an attack upon a respectable body of your fellow-citizens, who, I make bold to say, are as jealous of, and as successful in, observing the laws of the land in which they live, as any other class of people that can be named. With your permission therefore, I shall address my remarks, as briefly as possible, to the article by Dr. Hutchinson in The Bulletin Sanitaire, from which these strictures have emanated.

Leaving out the cheap abuse, which has not even the merit of being apt or original, which convinces no thoughtful person, and which is usually the sign of a weak case, the doctor is reported to have said: "Another objection to notification comes from certain peculiar people calling themselves Christian Scientists." Now the writer of that sentence either knew nothing about the matter, or he was misinformed. If he knew nothing about it, it was emphatically his duty to have informed himself before attempting to inform the public. If he was misinformed, it will be in order to enlighten him. Sophocles said, "The truth is always the strongest argument," and the bulk of the people who are looking for the truth are not forever going to be deceived by misleading and distorted statements about Christian Science, or by frenzied and vituperative appeals calculated only to inflame the passions of bigots.

The fact of the matter is—and this can be readily verified by all who desire to know the facts—that Mrs. Eddy, the founder and discoverer of Christian Science, has expressly enjoined all her followers to abide strictly by the laws of the land in which they live, to report to the proper authorities all cases of contagious disease, and for the time being not to treat contagious diseases, "until Christian Science shall be better understood." If there are Christian Scientists who depart from this specific counsel, they must be very few in number, because, when it suits their purpose, our critics do not hesitate to term us "fanatics" in our rigid adherence to Mrs. Eddy's counsel; and moreover, there are always a few kind guides, philosophers and friends who are sufficiently interested in our progress to keep the public informed upon all infractions of the law by Christian Scientists, but despite their ingenuity and enterprise, extremely little is unearthed.

The statement is also made in the same article, that "These people are a menace to the community," but opinions may differ as to who or what is "a menace to the community," and an investigation of this charge will do no harm. If the charge is true, the investigation will not hurt it. Some people might think that a system (?) of medicine which has been a failure for four thousand years upon the testimony of many of its own most eminent practitioners, which is admittedly unable to cope with everyday diseases after forty centuries of experimenting, but which is nevertheless licensed to continue these experiments at the expense of a credulous public, is somewhat of "a menace to the community." A considerable number of people do now think that a system which number its annual failures by the thousands, and the victims of which are populating the cemeteries at an appalling rate, is a good deal of "a menace to the community," and when more people begin to do their own thinking on these matters, there is going to be an upheaval. In the mantime a few statistics may not be out of place.

"According to statistical comparison in two States one in the extreme north and the other in the extreme south, seventy per cent. of those who applied for Christian Science treatment during a period of one year had already failed to recover or to receive permanent benefits through medical treatment. Of these, ninety per cent. recovered or received permanent benefits under Christian Science treatment."—(The Relation of Government to the Practice of Christian Science, by Alfred Farlow.)

"'There are not less than thirty thousand persons in New York State who rely wholly on Christian Science treatment for sickness. Since January 1, 1907, there have been less than ten deaths in the entire State under Christian Science treatment. The average death rate for the year among the Christian Science population, even including those who were not Christian Scientists and who turned to it only after the doctors had given them up, was only 1.04 per thousand, as against the average death rate of more than eight for the entire State.'

"These figures are certainly astounding when analyzed by practical men who can take in their import and understand what they mean to mankind."—(Reprint from New York Sun—in Toronto Sunday World, November 3, 1907.)

Perhaps these figures will indicate to thoughtful people where the menace comes in.

Thanking you, Mr. Editor, for the opportunity of presenting these few facts. I am, yours very sincerely,

J. M. Jackson.

40 Homewood Avenue, Toronto, Ont.

THE FUTURE CROSS-TIE.

Sir,—Much criticism is given the Pennsylvania Railroad as regards their systematic raising of timber for cross-ties. Some writers call this "monumental folly," because they say wooden ties are sure to be replaced by reinforced concrete, and backing up the statement by declaring that the Italian Government has recently ordered as many as 300,000 of these reinforced concrete ties, for use in its railroads; and still further state that if one-tenth the money spent by the Pennsylvania Railroad in buying lands and planting trees for tie timber had been spent in experimenting with reinforced concrete ties the "tie question" would have been solved.

On the other hand another writer claims that we have yet to learn of any railroad system in this country who would prefer the concrete tie to the wooden one, saying further that the concrete tie will be adopted only when the price of wooden ties become prohibitive, if that unfortunate time arrives.

In both cases the Canadian railroads will probably hold to the old wooden tie for some years to come. For she does not need to cultivate the timber, and the opening of new undeveloped country will keep the price in check.

E. L. Miles.

Bala, Ont., April 1909.

ENGINEERING SOCIETIES.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. Percy Barnes, Edmonton; Secretary, H. M. Widdington, Strathcona, Alberta.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS (TORONTO BRANCH).—W. H. Eisenbeis, Secretary, 1207 Traders Bank Building.

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CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, Geo. A. Mountain; Secretary, Prof. C. H. McLeod. Meetings will be held at Society Rooms each Thursday until May 1st, 1909.

QUEBEC BRANCH OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.—Chairman, L. A. Vallee; Secretary, Hugh O'Donnell, P.O. Box 115, Quebec. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.—96 King Street West, Toronto. Chairman, J. G. G. Kerry; Secretary, E. A. James, 62 Church Street, Toronto.

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

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

INTERNAL COMBUSTION ENGINEERS' ASSOCIATION.—Homer R. Linn, President; Walter A. Sittig, Secretary, 61 Ward Street, Chicago, Ill.

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

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. H. Winfield; Secrttary, S. Fenn, Bedford Row, Halifax, N.S.

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

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

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

WESTERN SOCIETY OF ENGINEERS.—1735 Monadnock Block, Chicago, Ill. Andrew Allen, President; J. H. Warder, Secretary.

COMING MEETINGS.

American Society of Civil Engineers.—Annual convention, Mount, Washington Hotel, Bretton Woods, N.H., July 6 to 9. Secretary, Chas. W. Hunt, 220 West 57th Street, New York.

American Foundrymen's Association.—May 18-20. Annual meeting at Cincinnati, Ohio. Secretary, Richard Moldenke, Watchung, N.J.

American Railway Association.—May 19. Annual meeting at New York City. Secretary, W. F. Allen, 24 Park Place, New York City.

American Waterworks Association.—June 8-12. Annual convention at Milwaukee, Wis. Secretary, John M. Diven, 14 George Street, Charleston, S. C.

American Railway Master Mechanics' Association.—June 16-18. Annual convention at Atlantic City, N.J. Secretary, Jos. W. Taylor, 390 Old Colony Building, Chicago, Ill.

American Railway Bridge and Building Association.—October 19-21. Nineteenth annual convention at Jacksonville, Florida. Secretary, S. F. Patterson, Boston & Maine Railway, Concord, N.H.

International Railway General Foremen's Association.—June 1 to 5, 1909, at Chicago. E. C. Cook, Royal Insurance, Chicago, Ill.

Master Car Builders' Association.—June 21 to 23, 1909, at Atlantic City, N.J. J. W. Taylor, Old Colony Building, Chicago, Ill.

National Electric Light Association.—June 1 to 4. Thirty-second convention, Atlantic City, N.J. Secretary, John F. Gilchrist, 29 West 39th Street, New York.

National Fire Protection Association.—May 25 to 27. Annual meeting at New York City. Secretary, W. H. Merrill, 382 Ohio Street, Chicago, Ill.

ENGINEER'S LIBRARY

BOOK REVIEWS.

Books reviewed in these columns may be secured from the Book Department, Canadian Engineer, 62 Church Street, Toronto.

Directory of Portland Cement Manufacturers, 200 pages, price $1. In a review of this directory, which appeared in an issue of April 9th, on page 500, we stated in error that is was published by "The Cement Age." The publisher's are "The Cement Era," of 842 Monadnock Block, Chicago, Ill.

Manual of Canadian Banking, by H. M. P. Eckardt. Published by the Monetary Times, Toronto, Ont. Size, 6 x 9. Pages, 210. Price, $2.50. In his preface, the author points ou. that most bank customers—depositors, borrowers, purchasers of drafts, payees of cheques—have been confronted sometimes with rules and regulations not exactly understood, and perhaps causing irritation or displeasure. The book explains just why such rules are put into force. It traces the history of a bank from organization to success—or failure and outlines the duties of the officials.

Water Power Engineering.—By Daniel W. Mead, M.A., S. C.E., Professor of Hydraulics and Sanitary Engineering, University of Wisconsin. Published by McGraw Publishing Company, New York, 787 p.p., 413 illustrations, 89 tables. Price, ... net.

A treatise on the theory, investigation and development of water power, containing a large amount of valuable information and data on water-power engineering. In the first three chapters the early history of the development of water-powers and the fundamental principles underlying the study of hydraulics are outlined, with graphical solution of Kutter's, Bazin's, and Chezy's formulae, and the flow of water in pipes. Chapters IV. and V. present a detailed study of stream flow, discussing the reliability of comparative Hydrographs, the effect of head on power resulting from the fluctuations of stream flow with graphical investigations of the relations of power head and stream flow. The important subject of rainfall and its relation to stream flow with full illustrations and records, and the influence of the physical conditions on the run off, are fully treated under Chapters VI., VII., VIII., and IX., along with the suggestions outlined by the author for the study of stream flow by means of actual or comparative hydrographs, as illustrated, offers a more exact method of studying the flow and determining the extent of a proposed development than usually followed. Chapters XII., and XIII., deal briefly with the development of the turbine in the United States and Europe, manufacturers, turbine details, and data, with a study of the relative merits of the different types of turbine gates in general use. Under Chapter XIV. the author discusses the hydraulics of the turbine, omitting much of the heavier mathematics and vector solutions, and substituting a clear description of the laws of flow through turbines along the lines of both theory and practice, sufficient for the proper comprehension of the principles which govern their selection and installation. Chapter XV. deals with turbine testing, discussing its value, giving Smeaton's experiments, with a historical sketch of testing, along with data and curves of actual tests. Chapter XVI. contains a detailed study of turbine analysis and selection, illustrating the author's method of determining the operating characteristics of a turbine to operate under varying conditions from a study of the tests of turbines of the same series or class for set conditions, illustrating same by curves and data from actual tests. Chapter XVII. discusses in detail load curves, with load factor, and their influence on the design of the plant. The subject of turbine governing which for electrical reasons is an important one, is fully discussed in detail, with a chapter on the types of governors in general use. The remaining section of the book deals with the selection of machines, the design of plant, and the different types of turbine setting, with illustrations of the most recent hydro-electric practice along with the principles of the construction of dams. The author has also dealt with the cost of development and the different factors that enter into the sale of power, and ends with an outline of the extent and scope of the investigation necessary for a report on a water-power project. The appendix contains a detailed mathematical discussion on, water hammer, speed regulation, stand pipe theory, with tabulated turbine tests and other miscellaneous tables. The book covers a study of the entire field of a water-power project with numerous illustrations, and the treatments with illustrations, are in many cases, original. It is a valuable addition to the engineering literature on the subject, and could be read with profit by all engineers interested, a noticeable feature is that at the end of each chapter is appended a very complete index of literature relating to the subjects discussed.

—F. A. G.

Modern Baths and Bath Houses.—By William Paul Gerhard, C.E., New York; John Wiley & Sons, London, England: Chapman & Hall, Ltd. Cloth; 5¾ x 9¼ inches; pp 311; 130 illustrations in the text. $3, net.

The increasing interest in the subject of municipal public baths, and the great need of adding to the relatively small number of such institutions in our cities, combine to make opportune a good book on the subject. The volume is by no means confined to municipal baths, nor for that matter to water baths, but is a comprehensive treatment of water baths for private dwellings, municipalities, schools, factories, military barracks, prisons, hospitals, clubhouses, etc. The classes of baths named are, of course, indoor establishments. In addition there is a chapter on river and sea baths. Besides water baths, the author treats in considerable detail of air and sun baths, and medical and electric-light baths.

The author being strongly in favor of rain baths, especially for municipal and institutional use, and having taken an important part in introducing that type of baths to this country, naturally devotes considerable space to the subject. Details of the mixing and spraying apparatus for rain baths are given, and the volume also contains some other drawings of bath fixtures. The illustrations include, in addition, a goodly number of plans of municipal and other bathing establishments and a still larger number of half-tone views of all sorts of baths and bath houses.

The bibliography on baths and bathing will be useful to those who wish to pursue the subject further. An appendix contains a number of interesting extracts from the writings of various persons on bathing, as practised in Russia, Norway, Finland and Japan. The appendix also contains a few pages on baths for dogs.

Mention should be made, before concluding, of the fact that the book contains specifications for a municipal bath house (16 pp.).

Railroad Signal Dictionary.—An illustrated vocabulary of terms which designate American railroad signals, their parts, attachments and details of construction, with descriptions of methods of operation and some illustrations of British signals and practice. First edition; compiled for the Railway Signal Association by Braman B. Adams and Rodney Hitt, associate editors of the Railroad Gazette. Railroad Age Gazette, 83 Fulton Street, New York and Old Colony Building, Chicago. The Railway Gazette, Queen Anne's Chambers, Westminster, London, S.W., England. Full leather, 500 pages, 8½ × 12; price $6.

In Canada the art of railroad signalling is still in its infancy. With the continual influx of population, the rapid development that is taking place on every hand, the enormous expansion of trade and the constantly increasing activity in railroad construction and improvement, it must grow. The introduction of modern methods for the safe operation of trains following one another closely and moving with celerity will soon be a recognized necessity, and the most up-to-date signalling apparatus will naturally receive first consideration. Over three thousand elaborate illustrations, accompanied by terse descriptions of the functions of the instruments and mechanism illustrated, thirty or forty pages containing a complete dictionary of American railroad signalling, as well as a host of valuable information of interest to the signal engineer, the electrical engineer and the railway engineer generally, constitute a most handsome and timely volume. The illustrations, which comprise the second portion, are divided into five sections, namely: Signal indications, Block signals, Highway crossing signals, Interlocking and accessories. There is also a complete index to the engravings, which form the most important feature. And while a description and illustrations of the signalling devices used in Great Britain might have lent added interest, the first edition of "The Railroad Signal Dictionary" represents the most comprehensive work on the subject. It reflects great credit upon the authors, who are to be congratulated upon the apparent success of their initial attempt to deal with American railroad signals and signalling apparatus. —W. M.

The Elizabethtown Bridge.—By H. G. Tyrrell, Civil Engineer, 1847 Asbury Avenue, Evanstown, Ill. Size 6 × 9. Pages 24. Illustrated. Price 50 cents.

This is a pamphlet describing the new steel bridge over the Miami River at Elizabethtown, Ohio. The bridge is remarkable in being the longest Pratt truss bridge span in existence, with a clear length of 586 feet. The bridge was designed by Mr. Tyrrell, built under his direction in the year 1904. Stress sheets are given, showing the assumed loadings maximum stresses, and sizes of the various members. Plates are also given comparing the various other designs submitted and considered, and the general subject of long span bridges considered. Tables are given containing quantities and estimated costs for fourteen other different designs, and another table giving particulars of other long span bridges, in lengths above 400 feet. The Elizabethtown bridge has a span 36 feet longer than the next longest span, which is the railroad bridge across the Ohio River at Cincinnati. Extracts are given from the specifications under which the bridge was built.

Proceedings of the American Mining Congress. James F. Callbreath, jr., secretary, Denver, Col. Pages 270. Size 6 × 9. The published volume containing the proceedings of the eleventh annual session of the American Mining Congress, held at Pittsburg, Pa., last December, has just been received, and contains many articles of interest to the mining fraternity. Among the addresses delivered was one by Edward H. Harriman, America's Railroad King.

Mr. Harriman gave some interesting facts concerning the tonnage of freight hauled by railroads, showing that the crude products of the mines furnished 63 per cent. of the total freight tonnage handled by the railroads of this country during the year ending June 30, 1906, while the manufactured products of the mines furnished an additional 11 per cent.; so that the mineral products furnished for that year 64 per cent. of the total amount of freight carried by the railroads.

During the same year the products of the forests furnished 11 per cent. of the total; agricultural products 8 per cent., and manufactures other than from mine products 4 per cent.; which comparison brings out very clearly the overwhelming magnitude of the mining industry.

Mr. Harriman stated that the miner and the railroad builder were the two great advance agencies which made possible the immense industrial development which has occurred between the Alleghanies and the Pacific coast during the last sixty years.

President Taft expressed his desire to assist in every possible way in the development of mining, stating that the mining industry had grown to such proportions that it was deserving of all the assistance which the government could bestow upon it.

Senator Charles Dick, of Ohio, was another one of the speakers, who fully appreciated the importance and magnitude of our country's mining interests, and in an able address pointed out the necessity that existed for the creation of a Bureau of Mines by the government. Mr. Dick has been the champion of this bill in the Senate for several years.

One of the themes widely discussed was Conservation in mining both as regards material resources, and that more important factor, human life. The speakers being, Carroll D. Wright, ex-Commissioner of Labor; John Mitchell, ex-President of the United Mine Workers; Thomas L. Lewis, President United Mine Workers; Judge George Gray, of Delaware; James R. Carfield, ex-Secretary of the Interior; Congressman W. F. Englebright, of California, etc.

PUBLICATIONS RECEIVED.

Complete reviews of the following will appear in our "Books Reviewed" columns.

Twenty-Second Annual Report of the State Board of Health of Ohio, for year ended December 31st, 1907, size 6½×9½, 375 pp. C. O. Probst, M.D., secretary.

The Railroad Signal Dictionary, by Braman B. Adams and Rodney Hitt, associate editors of the Railroad Gazette, 500 pp., 9×12. New York: The Railroad Age Gazette, 83 Fulton Street; Chicago, and London, Eng., The Railway Gazette, Queen Anne's Chambers, Westminster, S.W.

Report of Proceedings of the American Mining Congress, eleventh annual session, Pittsburg, Penn., December 2-5, 1908, 270 pp., 6×9. James F. Callbreath, jr., secretary, Denver, Col.

Annual Report on Highway Improvement, Ontario, 1909, 92 pp., 6×9. A. W. Campbell, Deputy Minister Public Works, Toronto.

Thirty-Ninth Annual Report of tne Entomological Society of Ontario, 1908, 152 pp., 6×9. Hon. James S. Duff, Minister of Agriculture, Toronto, Ont.

Gas Producers and Gas Firing, and the advantages of gas firing over the direct use of coal, by Ernest Schmatolla, Metallurgical and Chemical Engineer, 317 High Holborn. London, W.C., Eng., 19 pp., 6×9; reprinted from the Mining Journal.

The Line Fences Act, by James Morrison Glenn, K.C., LL.B., Osgoode Hall, Toronto; 20 pp., 6×9; price 25 cents. St. Thomas, Ont.; The Municipal World, Limited.

Sewage Purification and Disposal, by J. J. Cosgrave, 6×9, 222 pp.; price $1.50. Pittsburg: Standard Sanitary Manufacturing Company.

Sanitation and Sanitary Engineering, by William Paul Gerhard, C.E., second revised and enlarged edition of Sanitary Engineering; 174 pp., 6×9; price $1.50. New York: William Paul Gerhard, C.E., 33 Union Square.

The Collection and Disposal of Municipal Waste, by William F. Morse, consulting engineer; 6×9, 462 pp. New York: The Municipal Journal and Engineer, 231-241 West 39th Street.

High Tension Underground Electric Cables, by Henry Floy, M.A., M.E., consulting engineer; 135 pp., 6×9; price $2. Electrical Publishing Company, 165 Broadway, New York, N.Y.

Elementary Dynamics, by Ervin S. Ferry, Professor of Physics in Perdue University; 182 pp., 6×9; $1.25 net. Toronto: The Macmillan Company of Canada.

Specifications for Steel Highway Bridges, 1909, 32 pages, including index, size 6×9; pub. doc. P. St. J. Wilson, State Highway Commissioner, Richmond, Va.

Chemical and Biological Survey of the Waters of Illinois; 88 pp., 6×9; pub. doc. Edward Bartew, Director, State Water Survey, University of Illinois, Urbana, Ill.

Seventeenth Annual Report of the Temiskaming and Northern Ontario Railway Commission; 260 pp., 6×9; pub. doc. Toronto: Hon. J. O. Reaume, Minister of Public Works, Parliament Buildings.

Steel Products.—From the Toronto representative, Mr. Nicholson, Traders Bank Building, we wave received an artistic booklet, distributed by the Lackawanna Steel Company, of New York and Buffalo, manufacturers of open hearth and Bessemer steel products. A full-page illustration of the company's works, which are located on a tract of land comprising 1,500 acres on Lake Erie, at Buffalo, N.Y., appears on the first page, while a short history and description of the plant, which includes over a thousand coke ovens, twelve blast furnaces, Bessemer and open hearth steel works and eight rolling mills, as well as foundries and other shops, employing 12,000 men, is given in another portion of the booklet. The company, whose head offices are at 2 Rector Street, New York City, have offices in Canada at 317 Craig Street West, Montreal, and Traders Bank Building, Toronto.

BOOK REVIEWS.

Vectors and Vector Diagrams applied to the Alternating Current Circuits. By William Cramp and Chas. F. Smith. Published by Longmans, Green & Company, New York; 252 pages, 114 illustrations; price, $2.50.

The book deals with the uses of vectors in the representation of alternating current phenomena, the first three chapters discussing vector representation and the methods of notation, illustrating the addition, subtraction, and multiplication of vectors, and the whole chapter 8 is devoted to an explanation of the product of vectors. This section clearly explains the use of vector diagrams in the representation of alternating current problems. Under chapters 4 to 7, the more important equations of the subjects, self and mutual induction, the transformer, the induction motor, and the alternating current commutating motors are discussed, the treatment being largely algebraic, vector diagrams not being used as much as might be expected from the heading of the book. The remainder of the book deals with and explains the various uses of locus diagrams with numerous illustrations, which represent the algebraic equations discussed. The book is clearly written and will prove of value to the student as a text book, and to those interested in the solution of alternating current problems.

—F. A. G.

General Lectures on Electrical Engineering. By Charles Proteus Steinmetz, A.M., Ph.D. Published by Robson and Adee, Schnectady, N.Y. Cloth-gilt top, 275 pages, 6 x 9, and 48 illustrations. Price, $2 net.

The book contains a series of lectures delivered by Professor Chas. P. Steinmetz, under the auspices of Union University, in the winter of 1907-8, to a class of younger engineers, mainly college graduates. The lectures are general in their nature, and give a broad review of the entire field of electrical power generation, transmission, distribution, control and utilization, owing to the nature of the subject, and limitation as to space, the treatment is essentially descriptive and not mathematical. The first lecture contains a discussion of general features, as the application, frequency with comparisons of the use of alternating and direct current. The next three lectures deal with distribution, discussing direct and alternating current distribution systems, and the relation of load factor and the cost of power. The fifth lecture contains a discussion of long distance transmission, dealing with voltage, frequency, live losses, transformers, resonance, and the effects of the higher harmonics on the system. The 5th and 6th lectures deal with harmonics of generating wave and high frequency oscillations. The 8th lecture deals with generation, discussing prime movers, operated by steam, water, or gas. The following three lectures discuss operation, with methods of control and protection. The remaining lectures deal with the utilization of electrical energy, giving three lectures on railroading, discussing the general features of train and motor characteristics. Electrochemistry, incandescent lamps, and arc lighting are also briefly discussed. The appendix (1) contains a paper read by the author, on Light and Illumination, and appendix two, a paper on Lightning and Lightning Protection. The book is written in a clear and intelligible manner devoid of the higher mathematics that usually characterise Dr. Steinmetz's works.

—F. A. G.

CATALOGUES.

Souvenir.—The International Portland Cement Company, Ltd., of Ottawa, Ont., are distributing a handsome souvenir book on the history, development and future of Portland cement. It is intended as an educator for men willing to know the truth concerning Portland cement, its production and best methods of building. The volume is well printed, and beautiful illustrations of all kinds of structures are given, including bridges, office buildings, churches, mills, and factories.

Steel Work.—In a handsome volume of 150 pages, the Hamilton Bridge Works Company, Ltd., of Hamilton, Ont., give a hundred illustrations of all kinds of bridges and structural steel work they have erected in every province from the Atlantic to the Pacific, together with notes in reference to the structures and a host of information of interest to engineers, architects, contractors and municipal officials.

Gas Engines.—Mussens Limited, of Montreal, are distributing pamphlets devoted to Hornsby-Stockport Gas Engines, which are giving satisfaction to many Canadian firms who have installed them.

Storage Battery.—The Gould Battery in isolated lighting plants is described in a booklet forwarded by the Gould Storage Battery Co., 341-347 Fifth Avenue, New York City. Numerous illustrations and some interesting figures are also given to assist in the selection of batteries best designed to meet requirements, and engineers interested in the economical operation of light, heat and power plants should send for a copy.

Air Brake Valve.—From the Westinghouse Air Brake Company, of Pittsburg, Pa., comes an interesting booklet, entitled Pamphlet No. 5030, which deals at some length with their type "K" Triple valve. A number of illustrations are also included.

Economizers in the power plants of textile mills are well described and illustrated in Bulletin 161 of the B. F. Sturtevant Company, of Hyde Park, Mass., designers and builders of heating, ventilating, drying and mechanical draft apparatus; fans, blowers, and exhausters; steam engines, turbines and electric motors, fuel economizers, etc.

Art Steel Ceilings.—A most comprehensive volume, prepared by the Pedlar People, of Oshawa, Ont., is just off the press. It contains illustrations of the many designs of art steel ceiling, mouldings, coves, etc., manufactured at this, the largest plant in the British Empire for the exclusive production of steel metal building material.

Coal Dealers' Supplies.—Illustrations and descriptions of coal dealers' supplies of many kinds comprise a pamphlet received from the C. W. Hunt Company, 45 Broadway, New York City.

Culverts.—We are in receipt of a handsome booklet devoted exclusively to a description and illustrations of ingot iron culverts, manufactured by the Ontario Metal Culvert Company, Ltd., Guelph, Ont. This booklet should be filed for reference by engineers and municipal officials.

Contractors' Supplies.—Mechanical equipment and supplies of all kinds, including locomotives, hand cars, rail jacks, steam shovels, dredges, cranes, pumps and ornamental ironwork are listed in a handsome catalogue entitled "Our Product," just issued by the Canada Foundry Company, Ltd., Toronto.

Construction Machinery.—From the Browning Manufacturing Company of Mansfield and Cleveland, Ohio, comes a series of bulletins descriptive of excavators, steam shovels, buckets, railway ditchers, lifting magnets and locomotive cranes, with illustrations, of interest to engineering contractors.

Gauges.—The Gronkvist Drill Chuck Company, of New Jersey, send a catalogue devoted to "Johansson" combination standard gauges.

A damming up of a flooded stream one inch will increase the discharge through an opening over ten per cent.

CONSTRUCTION NEWS SECTION

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

TENDERS.

Nova Scotia.

NORTH SYDNEY.—Tenders are requested until May 20th, for the construction of a stone church for St. Joseph's parish, North Sydney; and for a steam heating system. Harris & Horton, architects. Rev. W. F. Kiely, P. P., North Sydney.

New Brunswick.

MONCTON.—City Engineer, J. Edington, will receive tenders for the construction of the Bridge Street sewer.

Quebec.

VICTORIAVILLE.—Tenders for alterations and additions to Post Office, will be received until May 14th. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

Ontario.

LINDSAY.—Tenders will be received until May 17th for plumbing, steam heating, plastering, masonry brick-work and concrete, galvanized iron work, carpentry and painting and glazing. C. Callaghan, secretary.

FORT WILLIAM.—Tenders will be received until June 4th, for the construction of wharves at the mouth of the Mission River, at Fort William. Plans, etc., may be seen at the offices of H. J. Lamb, Resident Engineer, London, Ont.; J. G. Sing, Esq., Resident Engineer, Confederation Life Building, Toronto; W. P. Merrick, Esq., Resident Engineer, Fort William, Ont.; A. R. Decary, Esq., Resident Engineer, Post-office, Quebec; J. L. Michaud, Esq., Resident Engineer, Merchants Bank Building, St. James Street, Montreal; and at the Department of Public Works, Ottawa.

OTTAWA.—Tenders will be received by the Ottawa Public School Board, Trafalgar Building, until Friday, 21st May, for coal and wood. William Rea, secy.-treas.

OTTAWA.—Tenders will be received up to 31st May, 1909, for work required in connection with the abutments and approaches of the new bridge below the waste weir at Kingston Mills Lock Station on Rideau Canal. L. K. Jones, Secretary, Department of Railways and Canals.

PETERBORO.—Tenders will be received until May 17th, for interior fittings, Armoury, Peterborough. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

PETERBORO.—Tenders will be received until June 14th, for pumping equipment. W. Henderson, Superintendent Waterworks; S. R. Armstrong, Secretary, Water Commissioners. (Advertised in The Canadian Engineer.)

ST. THOMAS.—Tenders will be received until May 21st for building a sewage disposal plant. James A. Bell, City Engineer. (Advertised in The Canadian Engineer.)

TORONTO.—Tenders will be received until Friday, May 14th, for the erection of a new school building on Avenue Road. W. C. Wilkinson, Secretary-Treasurer, City Hall.

TORONTO.—Tenders will be received until the 20th inst., for the erection of a fireproof hospital building. E. J. Lennox, architect.

TORONTO.—The time for receiving tenders for several local improvement works previously advertised to close at noon on Tuesday, May 11th, has been extended to noon on Tuesday, May 18th. John J. Ward, Vice-Chairman Board of Control.

TORONTO.—Tenders will be received up to Tuesday, May 18th, for the supply of lumber, for the period commencing June 1st, 1909, and ending May 31st, 1910. Specifications may be obtained at the offices of the Property Department, City Hall, Toronto. John J. Ward, Vice-Chairman Board of Control.

TORONTO.—Tenders will be received until May 18th, 1909, for the supply of material and the construction of a water filtration plant. Further particulars appear in our advertising pages. Joseph Oliver (Mayor), Chairman, Board of Control.

TORONTO.—Tenders for reinforced concrete work, steel and iron work, tiling and other work required in the erection of a floor to the new engine-room at the High Level Pumping Station will be received by 18th May, 1909. John J. Ward, Vice-Chairman Board of Control.

TORONTO.—Tenders will be received up to June 1st, 1909, for the reconstruction of the bridges on Dundas Street, over the tracks of the Grand Trunk and Canadian Pacific Railways. John J. Ward, Vice-Chairman, Board of Control. (Advertised in The Canadian Engineer).

TORONTO.—Tenders will be received up to 20th May, for the supply of coal and wood required at Government House, Parliament Buildings, Osgoode Hall, Normal and Model Schools, Toronto, and for the Normal Schools at Ottawa, London, Peterborough, Hamilton, Stratford and North Bay, the Institution for the Deaf and Dumb, Belleville, and Institution for the Blind, Brantford, for the twelve months ending 30th June, 1910. H. F. McNaughten, Secretary Public Works, Ontario.

TOWNSHIP OF McNAB.—Tenders will be received up to Tuesday, May 18th, for the construction of a concrete arch bridge and abutments with filling and fencing, addressed to Mr. John McGregor, clerk of the Township of McNab. Plans and specifications have been prepared by Messrs. Macallum & McAllister, engineers, 612 Continental Life Building, where the same may be examined.

WELLAND.—Tenders will be received until May 18th, for wiring a building. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

WATERFORD.—Tenders will be received until May 8th for building of bridge abutments near Waterford. James Ross, clerk.

Manitoba.

BRANDON.—Tender will be received until Monday the 17th May for 7,500 lineal feet of 16-inch cast iron water pipe, in 12 feet lengths, 144 lbs. to the foot, and about 5 tons of special castings for the same. Pipe and specials to be tested to 30 lbs. to the square inch. The city will also receive about 500 cords of field stone, not larger than eight inch diameter, delivered at the city stone crusher. Price $5 per cord. R. E. Speakman, city engineer.

DELORAINE.—Tenders will be received up to June 1st, for the construction of 4,000 yards of cement sidewalks and crossings in the town of Deloraine. D. L. Livingstone, Secretary-Treasurer.

VIRDEN.—Tenders wanted for the supply of poles for telephone extension. A. P. Power, Secretary-Treasurer.

WINNIPEG.—Tenders for supply of the following quantity of lead pipe:—20,000 lbs. of 1-inch, 30,000 lbs. of ¾-inch, will be received up to May 17th. M. Peterson, Secretary, Board of Control.

Alberta.

LETHBRIDGE.—Tenders will be received until May 17th, for the construction of 20,000 square yards of cement sidewalks. C. M. Arnold, City Engineer.

LETHBRIDGE.—Tenders received up to June 5th for all plant, material, labor in the erection of a courthouse. Plans, etc., may be seen at engineer's office of the Department of Public Works, Edmonton, Calgary, or inspector of building, Lethbridge. John Stocks, Deputy Minister of Public Works, Edmonton.

Saskatchewan.

ESTEVAN.—Tenders will be received until Wednesday, May 19th, for constructing a waterworks system and a main sewer, comprising 7,300 feet of water mains, 2,400 feet of tile sewer, also steel water tower, gasoline engines and power pump. Willis Chipman, C.E., 103 Bay Street, Toronto, Ont.

MOOSE JAW.—Tenders will be received until May 31, for sewer, water main, manholes, etc. J. Darlington Whitmore, city engineer. (Advertised in The Canadian Engineer).

MOOSE JAW.—Tenders will be received until May 31st for the sinking of a test well for gas, oil or water. John D. Simpson, city clerk. (Advertised in The Canadian Engineer.)

YORKTON.—Tenders will be received until Monday, the 24th May, for the construction of sewers as follows:—2,000 feet of 12-inch, and 15,000 feet of 8-inch, with all necessary appurtenances. F. T. McArthur, Town Engineer, R. H. Lock, secretary-treasurer.

British Columbia.

KAMLOOPS.—Sealed proposals will be received up to Friday, May 28th, 1909, for steam and electrical machinery. Specifications may be obtained from H. K. Dutcher, civil engineer, Flack Block, Vancouver, B.C. J. J. Carment, City Clerk.

VANCOUVER.—Until May 20th, tenders will be received for a motor generator set and switchboard panel. William McQueen, city clerk.

VANCOUVER.—Tenders will be received up to Wednesday, June 2nd, 1909, for the supply of waterpipe for the City of Vancouver. Specification may be obtained from the waterworks office, City Hall. Wm. McQueen, city clerk.

VANCOUVER.—Tenders will be received up till May 20th, 1909, for six miles No. 10 B. & S. gage M. H. D. copper wire, W. P. insulation; 1,650 feet of six-pair No. 14 B. & S. gage stranded copper, oil insulation, lead covered; 1,100 feet, 6 pairs, with steel armouring; 4,550 feet, four-pair No. 14 B. & S. Wm. McQueen, City Clerk.

CONTRACTS AWARDED.

Nova Scotia.

DARTMOUTH.—The tender of Reid and Archibald for repairing the ferry wharf was accepted. Two tenders were received, and the prices were:—

	Reid & Archibald.	Mosher & Son.
Furnish and drive piles,	$4.50 each	$5 each.
Furnish and work lining timber,	$25 per M.	$25 per M.
Furnish and work caps,	$19.75 per M.	$20 per M.
Furnish and work joists,	$19 per M.	
Furnish and work 3-inch plank,	$18 per M.	$18 per M.

New Brunswick

MONCTON.—The following tenders have been recommended for acceptance:—Packard Electric Company, electric power, $134; Sumner Company for lead pipe, $255; the corrected tender of Sumner Company for brass goods, $175; the Canadian General Electric Company for electric supplies, $154.25; John McGinnis, cleaning and removing rubbish from the catch-basins, 27c. each.

Quebec.

HULL.—The contract of Messrs. Carriere and Wilson for the extension of the water-works to cost about $7,000, was confirmed at a recent meeting of the city council.

MONTREAL.—The contract for building the Montreal Technical School, was given to Peter Lyall & Sons, whose tender was $387,000. Eight firms tendered, the prices ranging from $479,319 down to the figure asked by Messrs. Lyall.

Ontario.

GUELPH.—At a meeting of the Puslinch Council, the tender of Charles Mattani for the construction of concrete abutments for the Sorby bridge at $795 was accepted, and the Stratford Bridge Company was awarded the contract for the steel superstructure at $1,307.

BRANTFORD.—The contract for the improvements to the police station was awarded to W. J. Adams, whose price, the lowest submitted, was $1,100.

BERLIN.—The following tenders were received by the Water Commission for black and galvanized pipes:—

Liphardt Bros.—

	Black.	Galvanized.
½-inch	$2.70	$3.73
¾-inch	3.40	4.55
1-inch	4.80	6.40
1¼-inch	6.60	8.90
1½-inch	7.90	10.70
2-inch	10.50	14.10

	M. Weichel & Son. Black.	Galvanized.	Conrad Bros. Black.	Galvanized.
½-inch	$2.95	$3.90	$2.89	$3.82
¾-inch	3.70	4.75	3.47	4.74
1-inch	4.90	6.75	4.99	6.80
1¼-inch	6.90	9.00	6.80	9.28
1½-inch	8.00	11.00	8.17	11.14
2-inch	10.50	14.50	10.89	17.05

The tender of Liphardt Bros. was accepted.

OTTAWA.—Tenders for the construction of the new grand stand, fire station and sub-police station at the exhibition grounds have been opened, but the bids were in excess of the architect's estimates of $85,000. No decision was arrived at. The tenders were in bulk, and were as follows:—E. G. Laverdure, $109,205; Doran and Devlin, $99,300; Ottawa Construction Company, $120,000; Courtney and Brown, $103,579; General Construction Company, $74,000.

PETROLEA.—At a meeting of the council the tender of the Oil Well Supply Company, for sewer grates for manholes was accepted, the price to be $2.45 per hundred pounds.

TORONTO.—The Temiskaming & Northern Ontario Railway Commission has awarded a contract for 2,000 tons of eighty-pound rails to the Algoma Steel Company, Sault Ste. Marie. The rails will be used for new sidings and double tracking along the line of the first division.

TORONTO.—Messrs. Breen & Burford, of St. Catharines, were awarded the contract for excavation work on the new wing which is being added to the Parliament Buildings. Their tender was the lowest.

TORONTO.—Contracts have been awarded by the Hydro-Electric Power Commissioner to the Dominion Wire Manufacturing Company of Montreal, for copper wire, and to the Ohio Brass Company, of Mansfield, Ohio, for the suspended insulars, their tender being the lowest. The electrical equipment of the protective system in the stations will be supplied by the Westinghouse Company.

TORONTO.—Contracts for the cable and conduits in connection with the city's electric power distribution plant were awarded last Saturday. The lowest tender in each case was the successful one. The British Insulated & Helsby Cables, Limited, of Prescott, England, was given the contract for copper cable at prices ranging from twenty cents per foot up to $1.34 per foot, according to the different sizes and voltages of the cable. Between 75,000 and 100,000 feet of cable will be used. The contract for the conduits was awarded to the American Sewer Pipe Company, of Akron, Ohio, at 4 7-10 cents per foot for single ducts made of vitrified clay. The minimum amount to be used is 300,000 feet.

Manitoba.

WINNIPEG.—Messrs. Haney, Quinlan & Robertson, who have the contract for the Winnipeg shops of the Transcontinental Railway, have sub-contracts as follows: Iron work, the Manitoba Bridge & Iron Works. Plumbing, direct and indirect heating, Cotter Bros. Mill work, the Rat Portage Lumber Company. Painting and glazing, the Taylor Paint and Decorating Company.

Saskatchewan.

PRINCE ALBERT.—Tenders for relaying the pipe line to Goschen were received as follows: McVean & Craig, $3,237; Welsh & Campbell, $4,900; George Pickering, $4,348; Boulton & Co., $4,000; George J. Fanell, 60c. a foot. McVean & Craig's tender was accepted.

British Columbia.

VICTORIA.—The Provincial Government awarded the contract for the public wharf at Prince Rupert, to the Westholme Lumber Company, for a sum approaching $70,000. The wharf will be 600 feet long and 80 feet wide. The piles will be of steel reinforced with concrete.

VICTORIA.—Following are the tenders for the addition to the electric light station in which the pumps for the salt water, high pressure system will be placed. Martin & Thomas, $4,666; Luney Bros., $3,849; Albert Turner, $5,284; Parker Bros., $4,295; Dinsdale & Malcolm, $4,668. The contract was awarded to Luney Bros.

VANCOUVER.—In connection with the 5 miles of concrete walks to be constructed, the following tenders were received by the board of works: D. G. McKenzie, 15c. for six-foot walks and 16c. for eight-foot walks; Lawrence & Hull, 13½c.; H. F. Jahn & Company, 14 3-10c.; Clinton Construction Company, 13½c; Concrete Engineering & Construction Company, 14 45-100c.; Scott & Ledingham, 12c. The price paid two years ago was 15c. per square foot. For grading streets only one tender was considered—that of Angus Morrison, whose prices, per lineal foot, ranged from 20c. to 99c., according to the streets on which the work was to be done.

RAILWAYS—STEAM AND ELECTRIC.

Ontario.

PORT ARTHUR.—The Canadian Northern Railway have a staff of engineers busy surveying near Nepigon.

PORT ARTHUR.—J. D. McArthur & Company will send a steel-laying gang of 150 men to Superior Junction to commence laying steel on the G.T.P. between that point and Winnipeg.

TORONTO.—Application is being made to the Railway Commissioners for the amalgamation of the Alberta Midland Railway with the Canadian Northern Railway. This line will be built between Calgary and Edmonton, and between Calgary, Lethbridge and Macleod and will be approximately five hundred miles long.

Manitoba.

BRANDON.—Tenders will shortly be called for the erection of a depot at Brandon for the C.N.R. As soon as the contract is awarded, the work will commence probably in three or four weeks.

WINNIPEG.—General Superintendent Price, of the Canadian Pacific, states that contracts have been let for work on six branch lines in the western division, involving the construction of about 270 miles of new track. The lines include that running east from Hardisty, one east from Stettler, one north from Cheadle to Alix, one from Kipt to High River, all in Alberta, one west from Weyburn, Sask.

Alberta.

EDMONTON.—Within two weeks the C.N.R. branch from Vegreville to Calgary will probably be started. It is expected that the names of successful tenderers will be announced from Winnipeg in a few days. This is the first branch line, guaranteed by the local government, to be started this spring. The company must finish 125 miles this year.

British Columbia.

KAMLOOPS.—The C.N.R. has two survey parties in the field north of Kamloops, locating a route through the Yellowhead Pass. The grading outfit will arrive in September. The G.T.P. and the C.P.R. also have parties in the neighbourhood of the North Thompson River.

VANCOUVER.—The tunnel designed by the Canadian Pacific Railway Company to obviate the 4 per cent. grade on the "Big Hill" between Field and Laggan, is virtually completed. The workmen from both ends of the bore have met in the centre. The tunnel is five thousand feet long, and cuts down the grade to a little over 2 per cent. It cost $1,500,000.

VANCOUVER.—Work is going steadily on in connection with the construction of the Howe Sound, Pemberton & Northern Railway, which will be seven miles in length and will cost $275,000. Messrs. Cleveland & Dutcher, civil engineers, of Vancouver, had charge of the location and secured a grade of less than 1 per cent.

LIGHT, HEAT, AND POWER.

Manitoba.

SWAN RIVER.—The question of building a dam on the Swan River for the purpose of supplying power and light is being discussed. An engineer has been engaged to make examinations and take levels, and will report to the Town Council on the feasibility and cost of producing power.

British Columbia.

KAMLOOPS.—W. R. Carnac Morris, C.E., of Vernon, visited this city recently in the interests of the Couteau Power Company, a concern incorporated for the purpose of generating electric power from Shuswap Falls with the object of supplying light and power and of operating electric railway lines. The amount of power obtainable at Shuswap Falls is estimated at over 8,000 horse-power.

VANCOUVER.—Options on water powers situated within fifty miles of Vancouver will be received by the city solicitor. The city is anxious to acquire a supplementary water supply for power purposes.

SEWERAGE AND WATERWORKS.

Manitoba.

BRANDON.—The Council have decided to construct a trunk sewer to cost $47,000 and a duplicate 16-inch main to cost $30,000. Tenders for the material are now being advertised.

FINANCING OF PUBLIC WORKS.

Quebec.

WESTMOUNT.—The City Council will consider a by-law to authorize a loan for the following purposes: Macadamizing and paving of roads, construction of drains and main sewers, granolithic sidewalks and brick crossings.

Saskatchewan.

MOOSE JAW.—At the last council meeting a by-law was introduced to raise $40,000 for the construction of a reservoir at Snowdy Springs, and the improving of the means of bringing the water to the city.

PRINCE ALBERT.—On May 29th the citizens will vote on by-laws as follows: Macadamizing streets, $26,400; extension of waterworks, $14,000; lighting plant, $10,000; sewers, $9,600; streets and sidewalks, $13,000.

Alberta.

CLARESHOLM.—The by-law to raise $74,000 to install a water and light system will be submitted to the ratepayers shortly. If the by-law carries, Claresholm will install a gravity water system.

LETHBRIDGE.—The ratepayers passed by-laws totaling $200,000, of which $153,000 is for a power plant. The rest is for local improvements.

British Columbia.

FERNIE.—By-laws for a new power plant ($50,000) and a new pipe for water supply ($100,000) have been passed.

KAMLOOPS.—On May 3rd a meeting was held to discuss money by-laws to provide for extensions to the electric light plant, a new city hall, sewer extensions and a new hospital.

VANCOUVER.—On May 15th, a $30,000 waterworks by-law will be voted on in the municipality of Oak Bay.

TELEPHONY.

New Brunswick.

ST. JOHN.—The N.B. Telephone Company have commenced operations in the way of underground construction, which consist of laying a conduit. One section will consist of eight ducts another seven and another six ducts. The ducts will be placed in two layers, four on the bottom, the whole being solidly encased in concrete. The estimated cost is $18,000. The plans include the laying of an underground system that will cost a quarter of a million dollars.

Ontario

BRANTFORD.—The Machine Telephone Company have poles along the Burford Road for about five miles outside the city. In three weeks they intend to have the phones ready for use.

TORONTO.—The latest issues of Government Gazettes contain notices of the incorporation of the following telephone companies: Tilbury Telephone Company, W. C. Crawford, Tilbury, Ont.; Drummondville Telephone Company, N. Garceau, Drummondville, Que.; Boggy Creek Rural Telephone Company, Lumsden, Sask.; North Carievale Rural Telephone Company, Carievale, Sask.

MISCELLANEOUS

Ontario.

KINGSTON.—The Board of Works have decided to build six macadam roads.

British Columbia.

VANCOUVER.—At a recent meeting of the Board of Works, City Engineer Clement reported that the cost of a bridge over the Ninth Avenue east ravine at Glen Drive would be $7,100, of which the B.C. Electric Railway Company was to pay $3,800. It was recommended that the work proceed.

CURRENT NEWS.

Quebec.

MONTREAL.—The Roads Committee have sent in requisitions for $2,500,000 for public work, to be completed this summer. Included in this amount are pavements, $1,000,000; sidewalks, $500,000; sewers, $133,000; pumping plant, $55,000.

MONTREAL.—Messrs. Crossley Bros., the well-known gas engine builders of Manchester, England, announce that in addition to supplying producer gas plants for utilizing bituminous coal, lignites, coke, sawdust, shavings, charcoal, etc., they have now designed a gas plant for utilizing the smoke box char which is usually taken from the smoke box of locomotives; similar material being also taken from the residue from blacksmith's hearths, and the like. This plant has not been designed simply to support a theory, but has been put to practical use, and the plant is now offered as a commercial proposition in a number of standard sizes.

Ontario.

BELLEVILLE.—The construction of a number of sewers is contemplated. The money will be raised by an issue of debentures.

OTTAWA.—Sir Robert Perks, Bart., M.P., is in Ottawa with a proposal for the construction of the Georgian Bay Canal.

PETROLEA.—At a meeting of the Town Council on May 3rd, Mr. James A. Bell, civil engineer, of St. Thomas, submitted an estimate showing that the probable cost of the new waterways bridge would be $4,000. A by-law covering this will shortly be voted on.

Alberta.

EDMONTON.—An agreement has been reached between the solicitors of the C.P.R. and the city in reference to the high level bridge to cost a million dollars. The plans will be completed in the course of a few weeks.

Saskatchewan.

INDIAN HEAD.—Work has been commenced on the new C.P.R. depot. The council are preparing a by-law for $25,000 debentures to replace a number of wooden bridges with concrete.

SASKATOON.—Mr. A. W. Cassidy, who was awarded the contract for building the new $50,000 school, discovered, after signing an agreement to build, and commencing excavation operations that he had made a mistake of $10,000 in his estimate. His amended tender is $53,569, which is still the lowest. The work is at a standstill awaiting a meeting of the school board.

PERSONAL.

MR. WM. M. TREADGOLD, B.A., has been appointed city engineer, Brampton, Ont.

MR. E. E. COLLEY, formerly of the C.P.R. engineering staff, has been appointed city engineer of Nelson, B.C.

MR. A. F. MACALLUM, the new city engineer of Hamilton, Ont., assumed charge on Monday morning, the 10th.

MR. A. R. SPREUGER has been transferred from Cap Rouge, Que., to the Transcontinental Railway staff at Cochrane, Ont.

MR. W. S. SKINNER has been appointed by the City of Moose Jaw, Sask., consulting engineer in connection with the installation of the light and power system.

WATSON, JACK & COMPANY, formerly in the Bell Telephone Building, Montreal, have removed to Room 709 Power Building, 83 Craig Street West, Montreal, Que.

MESSRS. SCHEAK & PRINGLE, with offices at 28 Wellington Street West, have been appointed Toronto representatives of Mr. Gunther Wagner of London, Hanover and Vienna, manufacturer of drawing inks, artists oil, etc.

MR. B. ELSHOFF, for twelve years assistant superintendent of the Allis-Chalmers-Bullock Company, of Cincinnati, and for the past two years superintendent of the electrical department of the Allis-Chalmers Company, of Milwaukee, has recently severed his connection with the last named company. Mr. Elshoff may eventually accept a position with an eastern firm, but for the present will remain in Milwaukee.

MR. CARE S. DOW, S.B., has jointed the staff of Walter B. Snow, publicity engineer, Boston, Mass. Mr. Dow was formerly of the Engineering Department, Harvard University and late publicity manager, B. F. Sturtevant Company, and formerly in charge of instruction and text book departments, American School of Correspondence. He brings to the organization a diversified experience which will add materially to the value of the service rendered in all lines of technical publicity.

MR. DWIGHT T. RANDALL, M.E., member of the American Society of Mechanical Engineers, late engineer in charge of fuel tests, Technologic Branch, United States Geological Survey, has associated himself with the Arthur D. Little Laboratory of Engineering Chemistry of Boston, in charge of the Department of Fuel Engineering. Mr. Randall, who is a graduate of the University of Illinois, was formerly connected with R. W. Hunt & Company, and Westinghouse, Church, Kerr & Company, and later in charge of the Steam Engineering Laboratory of the University of Illinois, and of steam and boiler tests at the St. Louis Exposition.

TEMISKAMING AND NORTHERN ONTARIO RAILWAY LOCOMOTIVES.

A week ago it was announced that the T. & N. O. Railway Commission had placed an order with the Canadian Locomotive Company, Kingston, Ont., for six locomotives. We give herewith the principal dimensions of these engines:

Engine.

Gauge	4 feet 8½ inches
Type of engine	10-wheel passenger
Fuel used	Bituminous coal
Weight in working order, drivers	114,000 lbs.

Weight in working order, total	145,500 lbs.
Wheel base of engine, rigid	13 feet 6 inches
Wheel base of engine, total	23 feet 8 inches
Wheel base of engine and tender	52 feet 6 inches
Length over all, engine and tender	61 feet 10 inches
Width over all, engine and tender	10 feet
Height over all, engine and tender	14 feet 9½ inches
Heating surface, fire box	139 square feet
Heating surface, tubes	1,693 square feet
Heating surface, total	1,832 square feet
Diameter of driving wheels	63 inches
Material of driving wheels, centres	cast steel
Diameter and length of driving journals	8½ × 10 inches
Diameter of cylinders	19 inches
Stroke of cylinders	24 inches
Type of boiler	Extended wagon top
Working pressure of boiler	200 lbs.
Number of tubes	245
Diameter of tubes	2 inches
Length of tubes	13 feet 2¼ inches
Injectors	No. 8 locomotive type
Safety valves	Locomotive plain type
Brakes	Westinghouse
Kind of packing	R. R. Co. metallic

Tender

Weight of tender, loaded	120,000 lbs.
Capacity of tank in imperial gallons	5,000
Style of tank	Hopper type
Coal capacity	Ten tons
Style of truck	4-wheel arch bar type
Diameter of wheel	33 inches
Kind of wheel	Cast steel centres steel tires
Diameter and length of journal	5 × 9 inches
Brake beam	Simplex steel beams

RAILROAD ORDERS.

(Continued from Page 641.)

6891—April 23—Amending Order No. 6617, dated March 22nd, 1909, by striking out the word "eastern" in the fourth line, the word "east" in the seventh line, and the word "north-easterly" in the tenth line of paragraph 1 of the said Order and substituting therefor, respectively, the words "western," "west," and "north-westerly."

6892—April 26—Temporarily approving agreements of four Telephone Companies entered into with the Bell Telephone Company in November 1908, and March 1909.

6893—April 26—Releasing to the G.T.R. Company piece of land forming part of Cadastral Lot No. 247, in the Parish of St. Antoine de Longueuil, County of Chambly, Province of Quebec, for the more convenient accommodation of the public and for the traffic of its railway.

6894—April 23—Directing the C.N.R. to provide and construct railway crossings between Sections 35 and 2, Township 41 and 42, Range 13, West of the 3rd Mer. and on Section 22, in District 21-J-3, in the Province of Saskatchewan.

6895 and 6896—April 26—Granting leave to the Andover & Perth Electric Light Commissioners, to erect, place, and maintain electric light, power, and heat wires across the track of the C.P.R. at its station house, Perth, N.B., and Andover, N.B.

6897—April 26—Authorizing the C.P.R. to construct, maintain and operate branch line at Sulphide, Ont., to and into the premises of the Nicholas Chemical Company of Canada.

6898—April 26—Granting leave to the Municipal Corporation of the Township of McKim, Ont., to construct a crossing over the right-of-way of the C.P.R. in the said township.

6899—April 26—Granting leave to the Monk Rural Telephone Company to erect, place and maintain wires across the tracks of the G.T.R. at Church Street, County of Carleton, Ont.

6900—April 26—Granting leave to the Bell Telephone Company to erect, place, and maintain its wires across the tracks of the C.N.R. at mileage 13.45 west of Hawkesbury, Ont.

MARKET CONDITIONS.

Toronto, May 13th, 1909.

A quiet confidence seems to have settled upon the metals trade in the States, in place of alternate feverish doubting and hoping that has been going on for months. The steel trade is much improved; the demand both for pig-iron and finished steel is heavy, the production larger, and it looks as if the stagnation and depression which so long prevailed have departed. The out-put of copper has been very large, but increased consumption helps to offset it and price remains steady. Tin is well maintained, lead quiet, spelter weak. Old Country advices as to iron and steel are more favorable, shipbuilders and other large users being better employed. Founders here are more busy.

Bricks are in good demand; in Toronto the activity is great and the price very firm, house-building being brisk. Cement still appears to be in the dumps, and with the overwhelming supply now in the market it is impossible that the price can advance beyond that long quoted for car lots. Intermittent glimpses of spring sunshine, succeeded by snow and frost, do not encourage business of any kind as much as might be expected, not building, certainly. Lumber dealers find the demand irregular, and for builders' hardware the demand is slack.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

Antimony.—The market fairly active; price continues at 9½c.

Axes.—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

Boiler Plates.—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.75; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

Building Paper.—Plain, 30c. per roll; tarred, 40c. per roll. An increased demand is reported.

Bricks.—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10, for common. Don Valley pressed brick move also freely. Red and buff pressed are worth, delivered, $18; at works, $17.

Cement.—The supply is far beyond the demand, and every maker seems to have his storage capacity occupied to the full. There is no reason, therefore, to look for any immediate change in the present quotation of $1.70 per barrel, including bags, or $1.30 without bags, car lots; for smaller quantities $1.40 to $1.50 per barrel in load lots delivered in town and bags extra. In paper packages, price would be, including paper bags, $1.40 to $1.50.

Coal Tar.—In much greater request at former price, $3.50 per barrel.

Copper Ingot.—Firm and active, both abroad and here. Local price continues at 13½c. to 14c.

Detonator Caps.—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $1.

Dynamite, per pound, 21 to 25c., as to quantity.

Roofing Felt.—A very decided increase in business this month, prices not yet advanced; we quote $1.80 per 100 lbs.

Fire Bricks.—English and Scotch, $30 to $35; American, $27.50 to $35 per 1,000. The demand has become quite active, and stocks are low.

Fuses.—Electric Blasting.—Double strength, per 200, 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5. Bennett's double tape fuse, $6 per 1,000 feet.

Galvanized Sheets.—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.05; 12-14-gauge, $3.15; 16, 18, 20, $3.35; 22-24, $3.50; 26, $3.75; 28, $4.20; 29, $4.50; 10¾, $4.50 per 100 lbs. Fleur de Lis—28-gauge, $4.30; 26-gauge, $4.05; 22-24-gauge, $3.50. Queen's Head—28-gauge, $4.50; 26-gauge, $4.25. Sheets continue in active request.

Iron Chain.—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40.

Bar Iron.—$1.95 to $2, base, from stock to wholesale dealer. Market well supplied.

Iron Pipe.—Black, ¼-inch, $2.03; ⅜-inch, $2.26; ½-inch, $2.63; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.81; 3-inch, $20.76; 3½-inch, $26.13; 4-inch, $29.70; 4½-inch, $38; 5-inch, $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50. Prices firmly maintained.

Lead.—Prices steady outside. This market holds firm at $3.80 to $3.90, with an active movement.

Lime.—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b., car. More is moving, in medium to small lots.

Lumber.—The greater ease in the money market having permitted or encouraged more building of warehouses or factories, the result is felt by the lumber trade in a marked demand for Southern pine of large dimensions. This wood, which has been scarce in this market, is beginning to come in freely, and some beautiful clear stuff, as large as 10 by 20 inches, is in stock. For hemlock there is a fair demand, with a scarcity of the longer lengths. It is noticeable that 32-inch lath are rising in price, as we foreshadowed a week or two ago, sales of several cars have been made lately at $1.50. Prices are rather stiff, all along the line. Dressing pine quotes $32 to $35 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22; shingles, British Columbia, $3.20; lath, No. 1, $4.25; No. 2, $3.75; for white pine, 48-inch; for 32-inch, $1.50.

Nails.—Wire, $2.25 base; cut, $2.70; spikes, $3. Moving freely.

Pitch.—The demand continues slow. perhaps because buildings are not far enough advanced yet. Price so far unchanged at 70c. per 100 lbs.

Pig Iron.—There is more activity and prices are maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21; in Canadian pig, Hamilton quotes $19.50 to $20.

Plaster of Paris.—Calcined, wholesale, $2; retail, $2.15. Trade normal.

Putty.—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.05.

Ready Roofing.—In very active request at prices per catalogue. It is impracticable to quote figures, so great is the variety of this kind of goods, but prices are firmly held.

Roofing Slate.—Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But No. 1 Pennsylvania slate 10 x 16 may be quoted at $7.25 per square of 100 square feet, f.o.b., cars, Toronto.

Rope—Sisal, 9½c. per lb.; pure Manila, 12½c., Base.

Sewer Pipe.—

	4-in.	6-in.	9-in.	10-in.	12-in.	24-in.
Straight pipe per foot	$0.20	$0.30	$0.65	$0.75	$1.00	$3.25
Single junction, 1 or 2 ft. long	.90	1.35	2.70	3.40	4.50	14.65
Double junctions	1.50	2.50	5.00	....	8.50	.....
Increasers and reducers	....	1.50	2.50	....	4.00	.....
P. traps	2.00	3.50	7.50	....	15.00	.....
H. H. traps	2.50	4.00	8.00	....	15.00	.....

In steady demand; price 73 per cent. off list at factory for car-load lots; 65 per cent. off list retail. Small lots subject to advance.

Steel Beams and Channels.—Quiet. We quote:—$2.50 to $2.75, according to size and quantity; if cut, $2.75 to $3; angles, 1¼ by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

Steel Rails.—80-lb., $35 to $38 per ton. The following are prices per gross ton, for 500 tons or over: Montreal, 12-lb. $45, 16-lb. $44, 25 and 30-lb. $43.

Sheet Steel.—Market steady, at the former prices; 10-gauge, $2.50; 12-gauge, $2.55; American Bessemer, 14-gauge, $2.35; 17, 18, and 20-gauge, $2.45; 22 and 24-gauge, $2.50; 26-gauge, $2.65; 28-gauge, $2.85. Quite a quantity of light sheets moving.

Tank Plate.—3-16. $2.40 100 lbs.

Tool Steel.—Jowett's special pink label, 10½c. Cyclops, 16c. "H.R.D." high speed tool steel 65c.

Tin.—Market firm and demand good. The price continues at 31c. to 31½c.

Wheelbarrows.—Navvy, steel wheel, Jewel pattern, knocked down, $21.60 per dozen; set up, $22.60. Pan Canadian, navvy, steel tray, steel wheel, per dozen, $3.30 each; Pan American, steel tray, steel wheel, $4.25 each.

Zinc Spelter.—Business active, market firm at $5.25 to $5.50, outside market improved.

* * * *

Montreal, May 12th, 1909.

In the United States the general tendency continues upwards. There has been a fair increase in volume of business in pig-iron recently, and it is reported that several furnace interests have withdrawn from the market until higher prices prevail. Isolated sales are taking place at old prices, but the market, generally, is 25c. per ton higher for delivery during the remainder of the first half, and 50c. per ton higher for delivery during the second half. Southern furnaces which have heretofore been keen competitors, have advanced their prices to a basis of northern and eastern grades. In steel products, apart from the reduction in iron, the tendency is in an upward direction, from 5c. to 10c. per 100 lbs. more being asked during the past week or two. There is a marked indisposition on the part of producers to contract for a long period at prevailing figures. Generally speaking, the market, while not being conspicuous for strength, is showing quite a little improvement, this applying especially to tonnage changing hands. The volume is fully 50 per cent. greater than last year, and almost if not quite as great as in the heaviest year in the history of the country. The make is about 85 per cent. of a record. It would now seem as though the tariff adjustment could not be made by the first of June, the date mentioned some time since, but it is still felt that in a month from that time the matter will have been finally disposed of.

Trade in England and the Continent continues about the same, whatever changes are taking place being in the right direction. Pig-iron prices, both Scotch and English, are gradually stiffening, and it is also reported that the German makers and holders are looking for higher prices. In finished material, the tendency is in the same direction, and it is reported that some large makers are declining to make contracts for future delivery. All makers are apparently looking for better prices and are not anxious to book more than just sufficient to keep their works operating at to-day's figures. Cables just received quote an advance of an additional shilling per ton on high grades of Scotch pig-iron.

In the local market, a good business is passing. A considerable tonnage of pig-iron is being disposed of to consumers who are evidently anxious for prompt delivery. In sympathy with United States and European markets, Canadian makers are asking, and to some extent securing, higher prices for pig-iron. Imported brands will, of course, take the higher prices now prevailing, and Canadian makers are therefore enabled to secure higher prices on their product also.

Very few changes have taken place in the following list of prices, the tone of the market, however, being again on the firm side, generally speaking, and demand being fairly active:—

Antimony.—The market is dull at 8½ to 8¾c.

Bar Iron and Steel.—Prices are steady and trade is better. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ⅜-base; tire steel, $1.90 for 1 x ⅜-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; smooth finish, $2.70; imported, $2.20.

Boiler Tubes.—The market is steady, quotations being as follows:—1½ and 2-inch tubes, 8½c.; 2½-inch, 10c.; 3-inch, 11½c.; 3 1-2-inch, 14¾c.; 4-inch, 19c.

Cement.—Canadian cement is now so cheap that it holds the market. Quotations are for car lots, f.o.b., Montreal. Canadian cement is readily available at $1.35 to $1.50 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½c. extra, or 10c. per bbl. weight.

Building Paper.—Tar paper, 7, 10, or 16 ounces, $1.60 per 100 pounds; felt paper, $2.40 per 100 pounds; tar sheathing, No. 1, 35c. per roll of 400 square feet; No. 2, 35c.; dry sheathing, No. 1, 45c. per roll of 400 square feet, No. 2, 28c. (See Roofing; also Tar and Pitch).

Chain.—The market is steady as follows:—¼-inch, $5.30; 5-16-inch, $4.05; ⅜-inch, $3.65; 7-16-inch, $3.45; ½-inch, $3.20; 9-16-inch, $3.15; ⅝-inch, $3.05; ¾-inch, $3; ⅞-inch, $2.95; 1 inch, $2.95.

Copper.—Prices are firm at the recent decline to 13¾ to 14c.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 18c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1. Electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3.50; 6-ft. wires, $4; 8-ft. wires, $4.50; 10-ft. wires, $5. Double strength fuses, $1 extra, per 100 fuses. Fuses, time, double-tape, $6 per 1,000 feet.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Comet, $4.25; Gorbal's Best, $4.25; Apollo, 10¾ oz., $4.35. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge. American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe.—(See Pipe, Wrought and Galvanized).

Iron.—The outlook is steady. The following prices are for carload quantities and over, on cars, Montreal, delivery from dock being 35c. less; Canadian pig, $18.50 per ton, Montreal; No. 1 Summerlee, $18.75 to $19; selected Summerlee, $18.25 to $18.50; soft Summerlee, $17.75 to $18; Clarence, $17 to $17.25 per ton.

Laths.—See Lumber, etc.

Lead.—Prices are about steady, at $3.60 to $3.70.

Lead Wool.—$10.50 per hundred, $200 per ton, f.o.b., factory.

Lumber, Etc.—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight rate of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $22 to $25. Spruce, 1-in. by 4-in. and up, $16 to $18 per 1,000 ft.; mill culls, $14 to $16. Hemlock, log run, culls out, $14 to $16. Railway Ties; Standard Railway ties, hemlock or cedar, 35 to 45c. each, on a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft.., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carrying $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, $2.50; XXX, $3.

Nails.—Demand for nails is poor, but prices are steady at $2.30 per keg for cut, and $2.25 for wire, base prices.

Pipe.—Cast Iron.—The market continues steady at $33 for 8-inch pipe and larger; $34 for 6-inch pipe; $34 for 5 inch, and $34 for 4-inch at the foundry. Pipe, specials, $3.10 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.—The market is steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized. The discount on the following is 69 per cent. off for black and 50 per cent. off for galvanized; ½-inch, $8.50; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-nch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

Rails.—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $30.50 to $31 is given for 60-lb. and 70-lb.; 80-lb. and heavier, being $30; rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

Railway Ties.—See lumber, etc.

Roofing.—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. (See Building Paper; also Tar and Pitch).

Rope.—Prices are steady, at 9c. per lb. for sisal, and 11c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¼-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $6; ⅝, $7.25; ¾, $8.50; ⅞, $10; 1-in., $12 per 100 feet.

Spikes.—Railway spikes are in dull demand and prices are steady at $2.30 per 100 pounds, base of 5½ x 9-16. Ship spikes are also dull and steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

Steel Shafting.—Prices are steady at the list, less 25 per cent. Demand is on the dull side.

Steel Plates.—The market is steady. Quotations are: $2.15 for 3-16; $2.25 for ⅛, and $2.15 for ¼ andthicker; 12-gauge being $2.30; 14-gauge, $2.15; and 16-gauge, $2.10.

Telegraph Poles.—See lumber, etc.

Tar and Pitch.—Coal tar, $3.75 per barrel of 40 gallons, weighing about 500 pounds; roofing pitch, No. 1, 90c. per 100 pounds; and No. 2, 50c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; pine pitch, $4 per barrel of 180 to 200 pound. (See building paper; also roofing).

Tin.—Prices are unchanged, at 32 to 32½c.

Zinc.—The tone is steady, at 5½ to 5¾c.

* * * *

Winnipeg, May 11th, 1909.

With a decided improvement in the weather, activity has now become general in all building and contracting lines. Although the cold weather of the past fortnight interfered with progress to some extent, the favorable turn in climatic conditions has led to an increased rush in Winnipeg for permits, and the building department has experienced one of the busiest weeks since the season of 1907. With continued fine weather it is expected that the May total will break all previous records, and altogether the prospects for 1909 point to its eclipsing all former years.

As an indication of the situation it may be mentioned that during the the first three months of 1908 the building permits issued in the city of Winnipeg amounted to $141,000. During the same three months of 1909 the permits issued amounted to $1,059,900. The building total for April shows 252 permits issued, covering 279 buildings to be erected at a cost of $1,066,000, as against 191 permits for 221 buildings to cost $642,000 for April, 1908. This makes a total to date for 1909 of 526 permits issued, amounting to $2,136,000, as compared with 307 permits and $783,000 for corresponding period of 1908.

The Manitoba Bridge & Iron Works, Limited, has obtained the contract from the general contractors, Haney, Quinlin & Robertson, for the whole of the structural steel in the new Transcontinental Railway shops at St. Boniface, amounting to nearly 5,000 tons. This is said to be the largest contract for structural material that has been given in Canada this year, the contract price being in the neighborhood of $350,000. The new bridge shop of the company is being rushed to completion, and fabrication of this material will commence about 1st June.

The city has accepted tenders for the different asphalting works to be carried out this year on several of the main thoroughfares. The total cost of these improvements will amount to $134,000.

Active operations have been commenced on the large building which is to be the home of the Winnipeg Horse Show in Orborne Place. All material is on the ground, and five of the sixteen great arched trusses, each weighing ten tons, which will carry the roof of the building, are ready for hoisting. Although the work has been unavoidably delayed, the contractors, G. H. Archibald & Company, will have the contract completed in time for the opening of the Horse Show on June 26th.

With so much work on hand and in contemplation, the outlook in all departments of the trade is particularly bright and encouraging, and as a consequence a brisk demand for building requisites has set in. Prices for

(Continued on Page 45.)

NEW INCORPORATIONS.

Altona, Ont.—Central Telephone Co., $40,000; J. Underhill, W. J. Monkhouse, Pickering Township; N. Baker, Uxbridge.

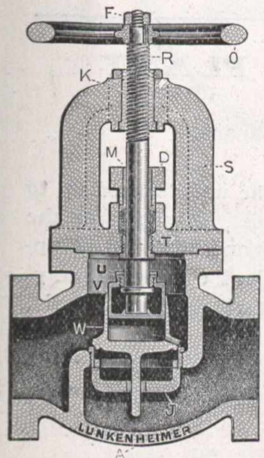
Elk Lake, Ont.—McRae, Downey Prospecting Company, $100,000; L. Downey, J. McAlpine, Elk Lake; D. McRae, Cobalt.

AMONG THE MANUFACTURERS

A department for the benefit of all readers to contain news from the manufacturer and inventor to the profession.

LUNKENHEIMER NON-RETURN BOILER STOP VALVES.

The necessity for a reliable Non-Return Stop Valve on each boiler when several are operated together, is now universally recognized, and in some countries their installation is required by law.



When several boilers are connected to a common header, it is evident that if a tube is blown out or a fitting ruptured, the steam from the battery of boilers will rush into the header and discharge through the boiler which is disabled. The difficulty of closing a stop valve in the event of such an accident is apparent. The Lunkenheimer Co., of Cincinnati, Ohio, have designed a Non-Return Boiler Stop Valve, which they claim entirely overcomes this danger. This valve is intended to be placed between the boiler and header.

A Lunkenheimer Non-Return Stop Valve on a boiler prevents steam being turned into it when it has been cut out for cleaning or repairs, for the reason that the valve cannot be opened by hand. It can, however, be closed by hand the same as any other stop valve.

The Lunkenheimer Company state that their Non-Return Valves are made only of the best materials, and that the areas are unusually large and free. The internal dashpot and piston prevents chattering of the disc. All wearing parts are made of bronze and the gland and stuffing-box are bronze bushed.

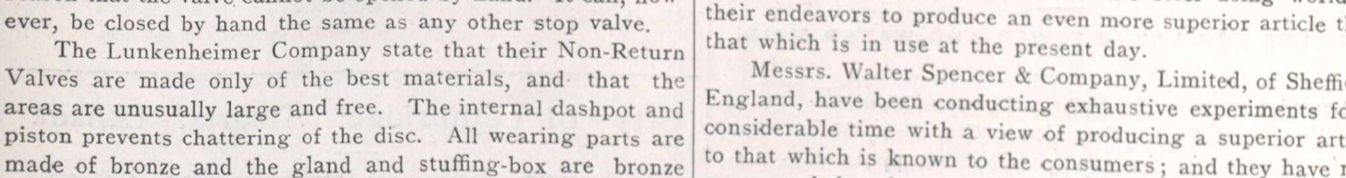
For superheated steam work these valves are made of "Puddled" Semi-steel with nickel trimmings and nickel-steel stems.

The above are made in sizes from 4 to 10 inches inclusive, and can be furnished with screw or flange ends.

The Lunkenheimer Company will gladly send upon request catalogues and discriptive matter or any desired information in regard to these Non-Return Boiler Stop Valves.

A NEW "POLYPHASE" SLIDE RULE.

A novel style of slide rule capable of perforating a wide variety of calculations, and on this account called the polyphase slide rule, will be of interest to all whose labours involve arithmetical or trigonometric computations. It is made in a similar form to the ordinary Mannheim slide rule, being a little wider in order to accommodate an extra scale upon the slides, and have been pronounced by all who have seen and used it to be an especially serviceable rule and one upon which a wide variety of calculations may be readily handled. In addition to the regular A.B.C.D. and trigonometrical scales of the ordinary slide rule, the polyphase has on the face of the slide an inverted C scale between the B and C scales, and on the edge of the rule in place of the millimeter scale is placed a scale of cubes.



This arrangement enables squares and square roots, cubes and cube roots and a wide variety of combinations such as the 4th, 5th, 7th and 11th powers and 6th roots to be taken with one setting of the slide, and the position of the inverted C scale on the slide enables many problems involving three factors to be performed at one setting also. The advantage of this arrangement lies not alone in the lessened time required to work an example, but also in the increased assurance of accuracy due to a fewer number of settings. In a circular which is furnished with this rule 70 different examples showing a wide variety of problems involving roots, powers and combinations illustrate the manifold uses to which the polyphase slide rule may be put. Nor are these difficult either, as the arrangement of the scales is so simple that their relations may be readily grasped and new combinations especially applicable to the particular work in hand easily worked out upon them.

This slide rule, which is shown in the accompanying illustration, has just been brought out and placed upon the market by Keuffel & Esser Company, New [illegible]

A NEW HIGH SPEED TOOL STEEL.

A great deal has been said and written recently regarding the new high speed steel that is now being placed on the market; and the manufacturers of tool steel have been of late commanding the attention of the steel using world in their endeavors to produce an even more superior article than that which is in use at the present day.

Messrs. Walter Spencer & Company, Limited, of Sheffield, England, have been conducting exhaustive experiments for a considerable time with a view of producing a superior article to that which is known to the consumers; and they have now announced that they are able to place on the market a "water hardening" high speed steel which gives infinitely better results than the air or oil hardening steels. This brings it into more universal use, as many small factories have not the conveniences for air hardening, whereas the smallest possible works can use the water hardening steel which is in every way superior, inasmuch as the new steel will keep its cutting edge very much longer and if necessary take a much heavier cut.

High speed drills have also been commanding the attention of Messrs. Walter Spencer & Company, and they are now manufacturing a high speed drill that is made from special registered section steel. These drills will last considerably longer, and do more rapid work than the ordinary high speed milled drills.

A case which has been in court in Minneapolis affecting the use of certain formulæ has reached a decision by the Supreme Court of the State. The ruling is to the following effect: Equity recognizes a secret in trade as property and will protect trade secrets by injunctions as against those who seek to disclose or use them by a violation of confidential relations or contracts, express or implied, arising from their relations to or dealings with the owner thereof. Any person, however, lawfully acquiring knowledge of such secrets, not patented, may use them if the manner of obtaining such knowledge and the use of them would not constitute a breach of confidence or good faith.

TENDERS CALLED FOR

CITY OF MOOSE JAW, SASKATCHEWAN

Tenders will be received by the City of Moose Jaw, addressed to the undersigned, on Monday, May 31st, at 8 o'clock p.m. for the sinking of a Test Well for Gas, Oil, or Water, the contractor to undertake to complete the Well before being entitled to any portion of his contract and to provide a schedule showing the allowance he will make on his full contract price if the city call him to stop work at less than the depth agreed upon; the Contractor to provide everything necessary except the well casing now in possession of the City, which he shall take over and allow for at a price to be named in his tender. Tenders are to be accompanied by a deposit of 5 per cent. on the contract price, said deposit to be returned to the Contractor as soon as the plant has been put in operation on the ground.

Alternative tenders are required for a well 2,500 feet and 3,000 feet respectively, the lowest or any tender not necessarily accepted.

JOHN D. SIMPSON, City Clerk.

Moose Jaw, April 27th, 1909.

CITY OF MOOSE JAW, SASKATCHEWAN

TENDERS FOR LAYNG SEWER AND WATER MAIN.

Sealed tenders addressed to Alderman Matthews, Chairman Water and Sewer Committee, City Hall, Moose Jaw, will be received in the Council Chamber up to 8.30 p.m. Monday, May 31st, 1909, for Labor and certain Materials in connection with laying approximately 15,000 feet of 8-inch tile Sewer and 6-inch C.I. Water Main, Manhole, etc. The lowest or any tender not necessarily accepted.

Plans and specifications can be seen in the office of the undersigned.

J. DARLINGTON WHITMORE,
City Engineer, City Hall.

TENDERS

Sealed tenders addressed to the undersigned, and marked "Tender for Sewage Disposal," will be received up to noon on **Tuesday, the 18th inst.,** for the building of a Sewage Disposal Plant for the City of St. Thomas. Plans and specifications can be seen and blank forms of tender obtained at the office of the undersigned. A marked cheque, payable to the Treasurer of the City of St. Thomas for $500.00, must accompany each tender as a guarantee of good faith.

JAS. A. BELL,
City Engineer.

St. Thomas, Ont.

WATER WORKS PLANT

Peterborough, Ontario, Canada.

Sealed tenders will be received by the undersigned up to Monday, the fourteenth day of June next, at noon, for the manufacture and installation in place of one, and two pumping units of three millions imperial gallons each per twenty-four hours, water works pumps, with turbine water wheels, etc., complete.

Specifications can be obtained at the office of W. Henderson, Superintendent, Water Commissioners, Peterborough, Ontario.

No tender necessarily accepted.

S. R. Armstrong,
Secretary, Water Commissioners,
Peterborough, Ontario, Canada.

6th May, 1909.

City of Lethbridge, Alberta, Canada

TENDERS FOR WATERWORKS PUMP

TENDERS will be received up to the 17th day of May, 1909, for a steam pumping equipment to deliver 2,000,000 gallons per 24 **hours.**

Specification, drawings, and form of Tender, may be obtained from Messrs. Smith, Kerry & Chace, Confederation Life Building, Toronto, on and after May 3rd.

Tenders are to be addressed to Messrs. Smith, Kerry & Chace, Toronto.

Each tender must be accompanied by a certified cheque, payable to the order of the Secretary-Treasurer, City of Lethbridge, for ten per cent. (10%) of the amount of the tender, which cheque will be returned unless the tenderer fails upon request to enter into a contract at the rate stated in the tender.

The lowest or any tender will not necessarily be accepted.

TENDERS CALLED FOR

CONDUIT

The city of Toronto will shortly call for tenders for the laying of about 300,000 duct feet of underground conduit. For specifications, apply to the Electrical Department, City Hall.

FOR SALE

Patent rights for Canada and necessary machinery for manufacture of the

CLARK AUTOMATIC NUT LOCK

acknowledged to be the only nut lock that locks and stays locked.

The above patent rights and machinery are hereby offered for sale by tender. The inventory value of machinery is $5,204.13.

Offers will be received by the undersigned agent for the owners until May 31st, 1909.

The highest or any tender not necessarily accepted.

For further information apply to

G. S. LAING,
Nanton Building, Winnipeg.

(Continued from Page 667.)

the present remain stationary, with the exception of beams and channels, which are slightly lower.

Appended are Winnipeg quotations:—

Anvils.—Per pound, 10 to 12½c.; Buckworth anvils, 80 lbs., and up, 10¼c.; anvil and vice combined, each, $5.50.

Bar Iron.—$2.50 to $2.60.

Beams and Channels.—$3 to $3.10 per 100 up to 15-inch.

Building Paper.—4½ to 7c. per pound. No. 1 tarred, 84c. per roll; plain, 60c.; No. 2 tarred, 62½c.; plain, 56c.

Bricks.—$11, $12, $13, per M, three grades.

Cement.—$2.25 to $2.50 per barrel, in cotton bags.

Chain.—Coil, proof, ¼-inch, $7; 5-16-inch, $5.50; ⅜-inch, $4.90; 7-16-inch, $4.75; ½-inch, $4.40; ⅝-inch, $4.20; ¾-inch, $4.05; logging chain, 5-16-inch, $6.50; ⅜-inch, $6; ¼-inch, $8.50; jack iron, single, per dozen yards 15c. to 75c.; double, 25c. to $1; trace-chains, per dozen, $5.25 to $6.

Dynamite.—$11 to $13 per case.

Hair.—Plaster's, 80 to 90 cents per bale.

Hinges.—Heavy T and strap, per 100 lbs., $6 to $7.50; light, do., 65 per cent.; screw hook and hinge, 6 to 10 inches, 5¼c. per lb.; 12 inches up, per lb., 4¼c.

Iron.—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5.

Lead Wool.—$10.50 per hundred, $200 per ton, f.o.b., Toronto.

Pipe.—Iron, black, per 100 feet. ¼-inch, $2.50; ⅜-inch, $2.80; ½-inch, $3.40; ¾-inch, $4.60; 1-inch, $6.60; 1¼-inch, $9; 1½-inch, $10.75; 2-inch, $14.40; galvanized, ½-inch, $4.25; ¾-inch, $5.75; 1-inch, $8.35; 1¼-inch, $11.35; 1½-inch, $13.60; 2-inch, $18.10. Lead, 6½c. per lb.

Picks.—Clay, $5 dozen; pick mattocks, $6 per dozen; clevishes, 7c. per lb.

Pitch.—Pine, $6.50 per barrel; in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Plaster.—Per barrel, $3.

Roofing Paper.—60 to 67½c. per roll.

Lumber.—No. 1 pine, spruce, tamarac, British Columbia fir and cedar—

Nails.—$4 to $4.25 per 100. Wire base, $2.85; cut base, $2.90.

Tool Steel.—8½ to 15c. per pound.

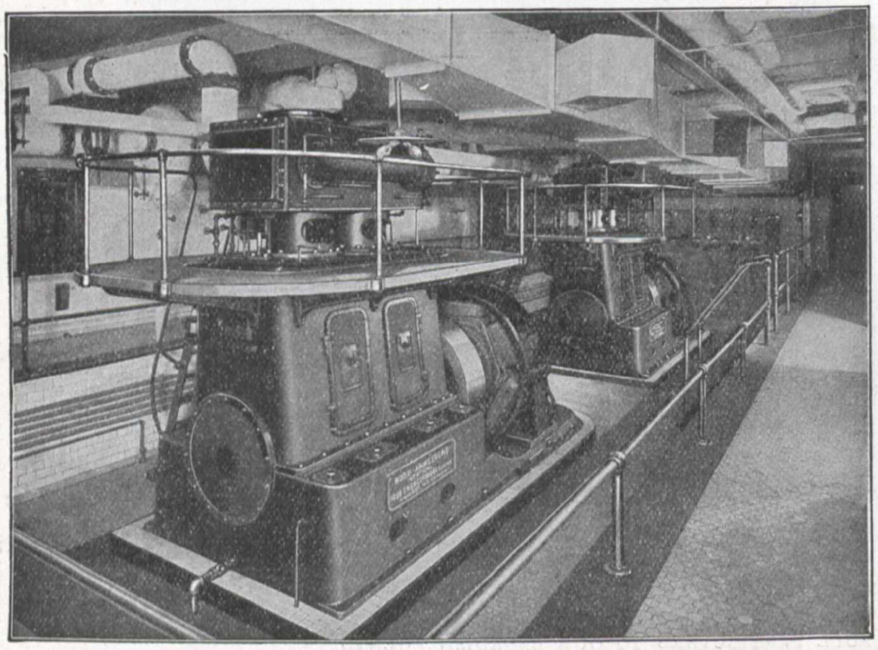
Timber.—Rough, 8 x 2 to 14 x 16 up to 32 feet, $34; 6 x 20, 8 x 20, up to 32 feet, $38; dressed, $37.50 to $48.25.

Boards.—Common pine, 8-inch to 12-inch wide, $38 to $45; siding, No. 2 white pine, 6-inch, $55; cull red or white pine or spruce, 6-inch, $24.50; No. 1 clear cedar, 6-inch, 8 to 16 ft., $60; Nos. 1 and 2 British Columbia spruce, 6-inch, $55; No. 3, $45.

High Speed Vertical Engines

OF THE ENGLISH ENCLOSED TYPE, WITH PRESSURE OILING SYSTEM INSTALLED BY US AT THE

TRADERS BANK, TORONTO

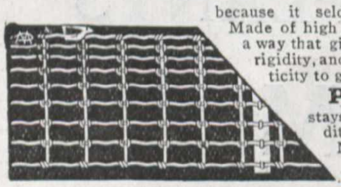


ROBB ENGINEERING CO., Limited

AMHERST, N. S.

DISTRICT OFFICES { Traders Bank Building, Toronto, WILLIAM McKAY, Manager
Bell Telephone Building, Montreal, WATSON JACK, Manager.
Union Bank Building, Winnipeg, J. F PORTER, Manager.

THE FENCE THAT SAVES EXPENSE



because it seldom needs repairs. Made of high grade material and in a way that gives maximum strength, rigidity, and at same time enough elasticity to give long wearing qualities.

PEERLESS

stays tight regardless of weather conditions. Resists stock successfully. Made of No. 9 wire throughout. Send postal for interesting Free Book. 3

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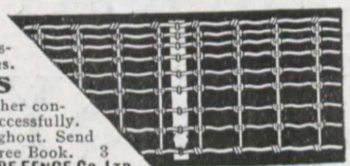

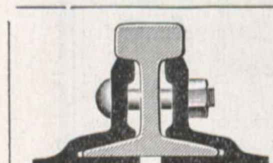

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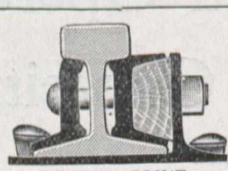

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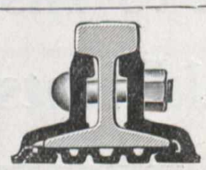

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(Continued from Page 7)

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Campbellford, Ont. — Northumberland Pulp Company, $100,000; I. S. Fairty, E. W. Wright, H. T. Hunter, Toronto.

Hamilton, Ont.—Oil and Gas Producers, $1,000,000; R. L. McIntyre, J. M. Sinclair, Toronto; O. G. Carscallen, Hamilton.

Owen Sound, Ont.—McDougal & Evans, $100,000; R. A. McDougal, J. McQuaker, A. A. Evans. T. I. Thomson, $40,000; T. I. Thomson, T. W. Thomson, L. Ferguson.

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An Engineering Trades Directory.

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Dominion Equipment & Supply Co., Winnipeg, Man.

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Toronto & Hamilton Electric Company, Hamilton, Ont.

(Continued on Page 50)

WHERE TO BUY.

(Continued from Page 48).

Conveyors
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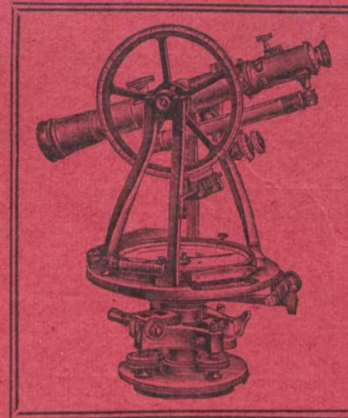

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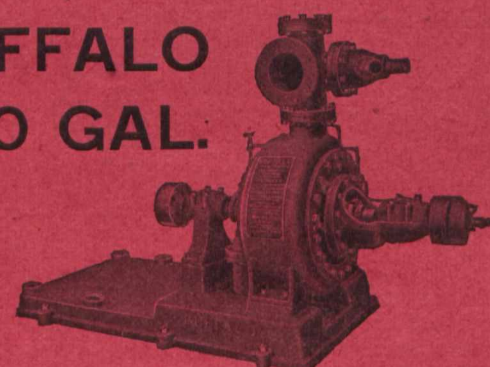

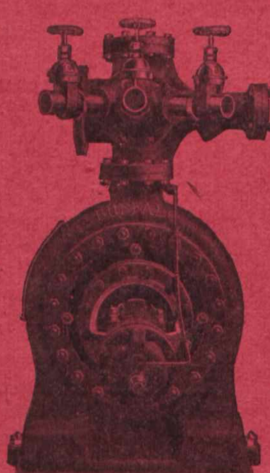

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