PAGES

MISSING

The Canadian Engineer

WEEKLY

ESTABLISHED 1893

Vol. 17. TORONTO, CANADA, NOVEMBER 26th, 1909. No. 21

The Canadian Engineer

ESTABLISHED 1893.

Issued Weekly in the interests of the

CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER, AND THE CONTRACTOR.

Editor—E. A. James, B.A. Sc.

Business Manager—James J. Salmond

Present Terms of Subscription, payable in advance:

Canada and Great Britain:		United States and other Countries:	
One Year	**$3.00**	**One Year**	**$3.50**
Six Months	**1.75**	**Six Months**	**2.00**
Three Months	**1.00**	**Three Months**	**1.25**

Copies Antedating This Issue by Two Months or More, 25 Cents.

ADVERTISEMENT RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto
Telephone, Main **7404** and **7405**, branch exchange connecting all departments

Montreal Office: B33, Board of Trade Building. T. C. Allum, Editorial Representative, Phone M 1001.

Winnipeg Office: Room 315, Nanton Building. Phone 8142. G. W. Goodall Business and Editorial Representative.

London Office: 225 Outer Temple, Strand, T. R. Clougher Business and Editorial Representative, Telephone 527 Central

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

NOTICE TO ADVERTISERS

Changes of advertisement copy should reach the Head Office by 10 a. m. Monday preceding the date of publication, except the first issue of the month for which changes of copy should be received at least two weeks prior to publication date.

Printed at the Office of The Monetary Times Printing Co., Limited, Toronto, Canada.

TORONTO, CANADA, NOVEMBER 26, 1909.

CONTENTS OF THIS ISSUE.

RAILWAY BUILDING IN WESTERN CANADA.

The year 1909 has established a record for railroad construction in Western Canada. Twenty-eight millions have been spent on construction work alone. Supplies and material involved an expenditure of a further 28 millions. And who can count the millions spent by the settler, the small merchant, and the builder, all because the railroad has created new markets, new towns, and new outlets.

The C.P.R. completed the second track from Winnipeg to Fort William, and incidentally doubled the capacity of the "spout." They shortened the mountain section by the Field spiral tunnels, and forged the last link in the third trunk line from Winnipeg to Edmonton. As if that was not enough, they built branch lines here and there, reaching out for the great Western trade.

The C.N.R. constructed a line into the Goose Lake country. They are pushing westward from Midale.

The G.T.P. opened the third transcontinental across the prairie to Edmonton and extended it to the Yellowhead, and already the construction of branches both to the north and to the south has been commenced.

Next year the railway race will be even more apparent and more strenuous. The C.N.R.-McBride agreement indicates the extensive plans of the C.N.R. in British Columbia. The line from the Yellowhead Pass to Kamloops, down the Fraser Canyon to Vancouver, will be expensive to build, but will open up a large, new district. The C.N.R. will also continue their Midale line towards, if not into, Lethbridge. Lethbridge is to-day the object point not only of the C.N.R., but also from the south, the Great Northern, who are pushing a line in that direction. The Weyburn line of the C.P.R. is also heading that way.

The G.T.P. will next year have very heavy work on their mountain section, and in addition they will construct their Wainwright-Calgary branch, which will give them access to Southern Alberta. Next year the West will be overrun with an army of engineers, contractors and navvies—and this fight will continue until the railroads are able to handle, without congestion, the output of the plains.

FLOW OF STREAMS.

Much money has been spent in Canada on hydro-electric plants—unfortunately, much of it misspent. It is the exception to find developed water powers that have not been over-developed, with the result that many companies and municipalities find they have available only a fraction of the power on which they calculated.

When a stream is under consideration as a source of water power the minimum, maximum and total flow of the stream for the several seasons of the year and the average of several years are among the first information required. Usually, too, this information, which is so valuable, is required very quickly. There is no time for a long series of gauging, and the engineer must estimate as best he can the minimum flow from whatever information is available.

So many factors enter into the question of stream flow—the drainage area, the character of the soil, rock and vegetation on that area, the contour, the elevation and the location—that the problem is too intricate for the private individual to fully solve.

After watching with considerable interest the support given by municipalities and Provinces to public ownership ventures, and noticing the effect such movements had upon the individual initiative, we venture the opinion that if more attention and more money had been given to experiment, if the Governments had conducted investigation as to stream flow, rate of evaporation, effects of ponding on stream-flow, percolation and other elements that enter into this problem, they would have done a greater service to the people.

So many of the questions require years of study and careful observation that the consulting engineer cannot undertake the work. His clients want a report now—not three years hence. It is true that in the Northern States of the American Union much good work has been done under somewhat similar conditions, and using their conclusions fair results may sometimes be secured. But conditions here are not altogether similar. The months of frost and snow are longer, the vegetation and summer temperature more varied, and the rate of evaporation and percolation very uncertain quantities.

This work is all the more necessary because of the many blue books and reports that have been issued, and are being issued, in which **estimates** (?) of Canadian water powers are given. The statistics are compiled to attract capital, to make known our great wealth of water power—and rightly so. But too frequently descriptive figures are taken for exact calculations, with unfortunate results.

Mr. R. S. Lea, M. Can. Soc. C.E., in Quebec, and Mr. W. H. Breithaupt, M. Can. Soc. C.E. in Ontario, have done good work in bringing the attention of governing bodies to these questions, and if Canadian water powers are to be developed—and not exploited—the Government should employ a permanent staff to investigate and report upon matters affecting stream flow. It is done in Alberta and Saskatchewan. Why not in the other Provinces?

EDITORIAL NOTES.

For several months we have been busy compiling a complete list of manufacturers of contractors' supplies and equipment for engineers. On page 6 of this issue appears an index to catalogues devoted to machinery and equipment of many kinds. If you require new machinery or new equipment, we can put you in direct communication with reputable manufacturers, if you will send us the index number. We want to be of service to you.

* * * *

The next few years will see the linking up of the Peace River and Athabasca districts to commerce and its markets. The men who have waited twelve years for the railroad, the railroad men themselves, and those who see into the future any distance at all will obtain the primary benefits.—The Monetary Times of Canada.

LOCOMOTIVE COUNTERBALANCING.*

By Mr. H. H. Vaughan,
Assistant to Vice-President, C.P.R., Montreal.

The counterbalancing of locomotive engines is one of the few problems in connection with that apparently simple yet exceedingly complex machine which are capable of an exact theoretical determination.

When the weights, locations, and movements of the various parts of an engine are known, it is possible to calculate accurately the forces which they cause at any speed of rotation, and apart from some practical considerations, such as the engine being constricted in its lateral movements by the wheels which support and guide it on the rails, and the fact that it is connected in a more or less imperfect way with a tender, the movements which result from the action of these forces can also be exactly ascertained; this subject has consequently been very thoroughly treated by a number of writers, and I shall therefore endeavor to discuss, as shortly as possible, the theoretical principles which underlie it.

The disturbing forces which necessitate the counterbalancing of any reciprocating engine are those required to start and stop the mass of the reciprocating parts at each

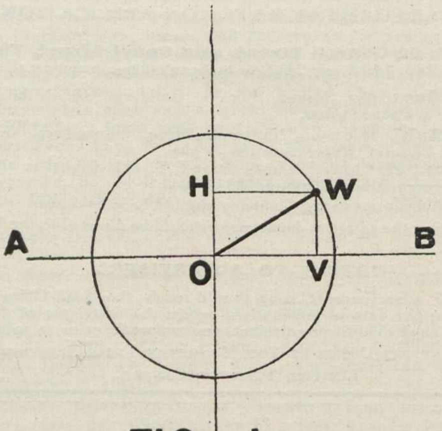


FIG. 1

end of the stroke; neglecting the disturbance caused by the obliquity of the connecting rod, which is unnecessary to consider in any existing type of locomotive, these forces are identical with that caused by a corresponding mass at the crank pin, with the exception that they have no vertical effect.

In Fig. 1 let the weight W be rotating round the centre O, at a velocity of V feet per second; then what is known as the centrifugal force, which is really the force that is required to make W. move in a curved line instead of in a straight line, as it would do if left to itself, acts along the line W O, and equals $\frac{W V^2}{32.2r}$ when r is the radius in feet.

This force W O can be resolved into two components W H and W V, the first acting entirely in a horizontal, and the other in a vertical direction; it will be seen that when W is on the vertical diameter W H is nothing, while W V equals W O, and when it is on the horizontal diameter W H equals W O while W V is nothing. Now, if the weight W moved backwards and forwards along the horizontal line A B in such a way that its position on that line was always vertically under or over the position of W when rotating uniformly

*Read before the Central Railway Club.

around the centre O, the force necessary to accelerate or retard it is always W H, or, in other words, equals the horizontal component of the centrifugal force due to an equal weight rotating in a circle.

This is what happens in the case of a weight such as a piston and crosshead actuated in a horizontal line by a connecting rod, as in Fig. 2; here the distance of the weight P from the centre of the stroke corresponds with the horizontal distance of the crank pin C from the centre O, and the force accelerating or retarding it is equal to C H when C O equals the centrifugal force which P would exert if moving on the path of C.

Since P in this case is moving entirely in a horizontal plane, it gives rise to no vertical forces whatever, and it is

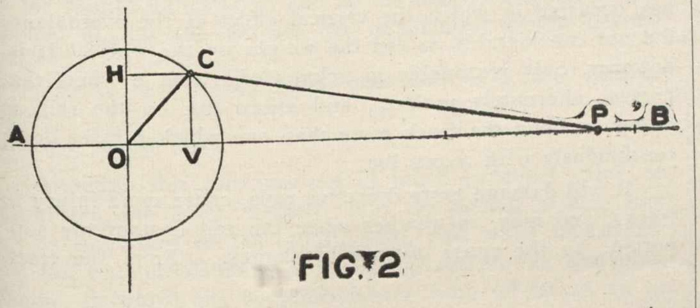


FIG. 2

this fact that introduces all the difficulties in connection with balancing an engine; before, however, discussing that question, the connecting rod must be referred to. It is evident that this has at one end a circular, and at the other a reciprocating movement, while between the ends, the motion of any part is of an intermediate nature; the result is the same as though part of its weight were concentrated at the crank pins and had a circular motion, while the remainder was concentrated at the crosshead and had a reciprocating motion.

In a paper read before the Northwest Railway Club, in 1893, I suggested that four-fifths of the weight of the back end should be taken at the crank pin, and the weight of the front end and one-fifth of the back end at the crosshead, figures that were obtained by calculations from two or three types of rod; this question was, however, treated in an exceedingly ingenious and scientific way in a paper read before the New York Railway Club, by Mr. R. A. Parke.

He developed an accurate method for obtaining the exact division of weights for any rod, and his results showed for modern types of rod that five-sixths of the weight of the back end of the rod should be considered as concentrated at the crank pin with reasonable accuracy. I would refer anyone interested in this subject to his paper, as it is a most interesting example of the application of a really difficult mathematical analysis, by which an absolutely simple method is deduced for obtaining correct results. I consider, however, for practical purposes, that five-sixths of the weight of the back end is sufficiently accurate, and that figure is used on the Canadian Pacific.

There is one more elementary statement to make, namely that a weight of W pounds at a radius 2r has the same effect as a weight of 2W pounds at a radius r; this follows immediately from the value of the centrifugal force $\frac{M V^2}{32.2r}$ for with the same number of revolutions V is proportional to r, so that for equal forces Mr must be a constant. For simplicity, therefore, all balance weights will be assumed to be placed at the same distance from the centre as the crank pin.

With these facts in mind, let Fig. 3 represent an ordinary engine, and let all the rotating weights be concentrated at the crank pin W, say 1,000 lbs.; let the reciprocating weights be concentrated at the crosshead at P, say 1,500 lbs. The rotating weight can be balanced by a weight of 1,000 pounds placed at C, diametrically opposite W on the other side of the centre; evidently, whatever be the position of the crank, the forces caused by the two weights are equal and opposite, and there is no resulting force to disturb the axle at O.

When, however, attempting to balance the 1,500 lbs. at P, by placing 1,500 lbs. at C, the condition is entirely different; the horizontal forces caused by the movement of P are exactly equal and opposite to those caused by the 1,500 lbs. at C, but as no vertical forces are caused by P's movement, the vertical forces caused by the movement of the 1,500 lbs. at C are left entirely unbalanced, and the effect is the same as though a weight of 1,500 lbs. at C were entirely unbalanced vertically.

Whatever weight then is introduced at C to balance the horizontal forces caused by P, causes vertical forces equal in amount to the extent by which those due to P are reduced; there is no possible combination by which this can be avoided, except by using crank pins that are not at right angles to each other.

For instance, if there were a crank pin at C and a connecting rod as shown by the dotted line C L, then if the weights at L and P were in substantially the same plane and equal, they would practically balance each other, as is the case with four-cylinder engines, which can be almost perfectly balanced without introducing any vertical forces, while three-cylinder engines can be balanced longtitudinally, but are, with respect to nosing, almost in the same class as two-cylinder engines. The latter are the engines now under consideration, and in their case the question of counterbalancing is a compromise.

If P is left unbalanced the engine is said to be badly balanced, if P is completely balanced the engine is said to be well balanced, but vertical forces are introduced which certainly may be injurious to track or bridges.

The extent of the force due to any unbalanced weight may be calculated at any speed, but is usually taken at 40

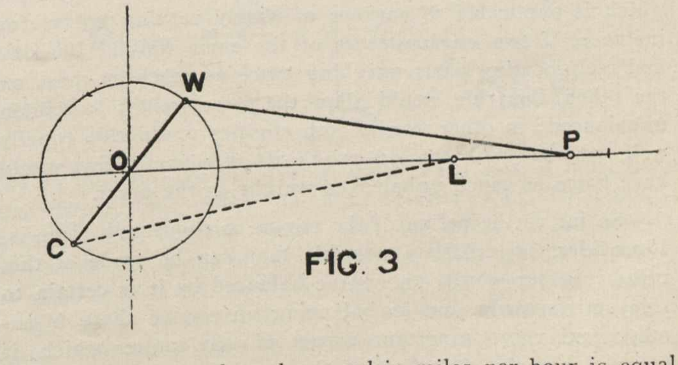


FIG. 3

times the weight when the speed in miles per hour is equal to the diameter of drivers in inches; it really varies with the stroke; and the exact figures are 38.5 for a 24″ stroke, 41.7 for a 26″, and 44.9 for a 28″; taking 40 for an approximate figure, 500 lbs. at C above that required to balance the rotating weights, or, as it is termed, "as overbalance," means a force of 20,000 lbs. acting upwards and downwards at each revolution, and while this seems a high figure, it is occasionally found.

The speed of 69 miles per hour is high for a 69″ wheel, but it represents a possible condition, and it must be remembered that while the factor of 40 is not reached until that speed for that size of wheel, that it increases with the square of the speed, so that it is not advisable to consider a lower speed.

Evidently, then, it is desirable to keep the overbalance as small as possible, and yet on the other hand the reciprocating parts must be partially balanced for the comfort of the men, and the various rules of counterbalancing have really indicated the nature of the compromise.

The rule most commonly used in America has been that recommended by the committee on the subject at the M.M. Convention in 1882, in which two-thirds of the reciprocating parts are balanced; this compromise has, on the whole, given very satisfactory results, and constituted a great advance on one of the methods given as an answer to the inquiry made by the committee, which was "to figure a little and then guess at it."

The two-thirds rule, however, is not necessarily satisfactory; it proves so in the majority of cases, because the relations between the weight on drivers, weight of engine, and reciprocating parts do not vary greatly in engines of ordinary types, but the first great advance was made when Mr. G. R. Henderson, in a report made to the Norfolk and Western Railway, in 1895, pointed out that the allowable weight of unbalanced reciprocating parts was a factor of the weight of the engine.

Assuming only, that the maximum speed is proportional to the diameter of the drivers, and that it is desired to construct engines that will be reasonably comfortable for the men at that speed; in other words, that will vibrate to the same amount, then evidently the disturbing forces, or the weights of the unbalanced parts, may vary in direct proportion to the weight of the engine.

Mr. Henderson showed that engines in which $\frac{1}{400}$ of the weight of the engine was unbalanced rode satisfactorily, and that $\frac{1}{360}$ can be left unbalanced without objectionable vibration; we have then in this rule a scientific method of determining the weight of reciprocating parts that may be left unbalanced, and yet allow the engine to ride reasonably well, which is applicable to engines of widely varying types; for instance, if two engines were of the same weight, but one had reciprocating parts weighing twice as much as those on the other, this rule would allow the same weight to remain unbalanced; in other words, both engines would ride equally well, whereas with the old two-thirds rule one engine would have twice as much unbalanced weight as the other.

So far as the action of the engine is concerned, there is, I consider, no criticism possible that can be made of this rule; in other words, an engine balanced by it is certain to ride satisfactorily, but in balancing an engine there is another and very important aspect of the matter which it ignores, namely, the effect of the overbalance on the track. This side of the question has often been referred to, and its effect discussed in a general way, but so far as I am aware, locomotive builders have never really established any rule limiting its amount, although they have recommended balanced compound engines or the utilization of the weight of the tender, which I shall refer to later. On the other hand, no maintenance of way engineer has, I believe, defined the limit of overbalance which he considers permissible, although he will cheerfully advocate none being used; neither is he able, except in extreme cases, to show any definite evidence of damage from this cause.

Taking, however, the maximum speed before referred to, an overbalance of 500 lbs. in a wheel carrying 20,000 lbs. causes the pressure between that wheel and the rail to vary from 40,000 lbs. when the overbalance is down to nothing when it is up, and any greater overbalance would tend to lift the wheel from the rail.

Testing plant experiments show that when the calculated effect of the overbalance exceds the weight on the wheel that it does actually leave the rail, and that there is a definite blow when it strikes it again.

I have analysed this action (see "American Engineer" for February, 1909), and have shown that this blow may, in extreme cases, be severe and sufficient to account for the damage that is occasionally met with; on the other hand, I do not believe that any case of repeated bending of rails has occurred in which the vertical effect of the overbalance did not considerably exceed the weight on the wheel. It is, however, only reasonable to acknowledge that a wheel that presses alternately nothing, and 40,000 lbs. on the rail, is going to effect the track more than one which presses down continuously with 20,000 lbs.

It will damage more defective rails, cause more injury to tracks, and may, in weather when the rail is unevenly supported, be the cause of rail breakages. From the track

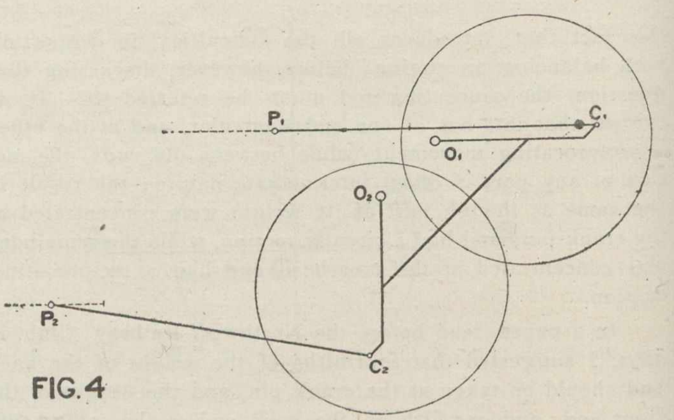


FIG. 4

point of view, therefore, the less the overbalance the better, and the problem of the locomotive engineer is to determine to what extent it can possibly be reduced. To discuss this I must refer more in detail to the action of the unbalanced weights on the engine

In Fig. 4 let P_1, P_2, be the right and left crossheads respectively, C_1, C_2, the crank pins, and O_1, O_2, the overbalances; as C_2 and O_2 are in the middle of the stroke they have no horizontal effect, and there is a longitudinal force equal to P_1—O_1 tending to drive the right side of the engine backward; as P_2 comes to the end of its backward stroke there is a similar force tending to draw the left side of the engine backward, and at that time the effect of P_1 and O_1 is nothing.

This action is repeated at the back of the stroke, so that the action of the unbalanced weight is to drive the engine backwards and forwards as a whole, and also to cause the ends of it to vibrate transversely; or, as it is usually called, "make it nose."

There are then two distinct actions of the unbalanced weight in an engine, which I will call the longitudinal and transverse movements; the latter you will agree, I believe, is not generally very noticeable, but on small 8-wheel engines it is objectionable when running at a high rate of speed.

Some years ago, when working on this subject, I noticed, as I dare say you have, that on the longer, heavier engines, the nosing from unbalanced weights was not noticeable, and in a paper before the Northwest Railway Club, in 1896, I advocated a rule in which the unbalanced weight was increased in proportion to the length of the engine as well as to its weight. This rule was defective, as it increased the longitudinal vibrations on a long engine as compared to a shorter one of equal weight, and as the longitudinal vibrations are those which render an engine rough riding, it could not, and no rule could increase the unbalanced weight beyond a certain amount without being objectionable.

It is true that engines balanced by it rode satisfactorily, but that was because it started with a short engine with $\frac{1}{400}$ of the weight unbalanced, and on the longest engines it was applied to, did not increase the unbalanced weight beyond $\frac{1}{360}$, which is an amount that does not, as a rule, lead to criticism by the men.

Although this rule was not of much practical value, it recognized one point, namely, that the nosing motion was not as important as the longitudinal, and when investigating the counterbalancing of some engines on the Canadian Pacific, in which the counterbalances were off-set so as to increase the longitudinal, and decrease the nosing movement, it occurred to me that by allowing an increase in the nosing movement, a decrease in the amount of overbalance could be obtained without increasing the longitudinal movements.

This can be done by means of off-set counterbalance weights, but as they have a serious objection, the same result can be obtained by means of supplementary counterbalance weights placed at right angles to the cranks. This arrangement is shown on Fig. 5, S_1, S_2, indicating the supplementary counterbalances and the arrows the direction of the forces.

Neglecting the difference in the distances, centre to centre, of the balance weights and the pistons, which it is not necessary to consider here, it will be seen that the forces at O_2 and S_1 both tend to drive the engine forwards as against that of P_2 driving it backwards; in place of a force $P_2—O_2$ driving it backward as in Fig. 4, the force is, therefore, reduced to $P_2—(O_2 + S_1)$ on the other hand, the force $P_2—O_2$ still tends to throw the front of the engine to the right, and it is assisted by S_1.

The net result therefore is, an engine that is balanced longitudinally as an engine would be with an overbalance $O_2 + S_1$, and balanced transversely as though its overbalance were $O_2—S_1$. To put this into figures, suppose the engine weighs 160,000 lbs., and the reciprocating parts weigh 1,300 lbs. a side; the permissible unbalanced weight at $\frac{1}{400}$ of the weight is 400 lbs., leaving 900 lbs. to be balanced, or 300 lbs. per wheel, if the engine has six drivers; if the weight per wheel is 20,000 lbs., this overbalance is 1.5 per cent. of the weight on the wheel, and the variation in pressure at the maximum speed is 12,000 lbs. or 60 per cent.

This would not be an unusual case, in fact it would be an ordinarily well-balanced engine. Now, if we place a supplementary balance weight of 100 lbs. on the opposite wheel, and reduce the overbalance to 200 lbs., this 200 lbs., and the 100 lbs. from the other wheel, make up the 300 lbs. to balance the engine longitudinally, but for transverse balance the 100 lbs. has to be deducted from the 200 lbs. overbalance, so that only 100 lbs. is balanced in each wheel, or 300 lbs. altogether.

Taking 300 from 1,300, leaves 1,000 lbs. unbalanced transversely, or $\frac{1}{160}$ of the weight, and we, therefore, have an engine that longitudinally has $\frac{1}{400}$ of its weight unbalanced, but transversely $\frac{1}{160}$ unbalanced. The overbalance has been reduced from 300 to 200, but the reduction in the effect on the track is not quite as great as this; the greatest effect of S_2 and O_2 is not when O_2 is vertical, but it equals $\sqrt[2]{(O^2_2 + S^2_2)}$ or, for the two weights in question 222 lbs., a reduction of 78 lbs., or 3,120 lbs. at the maximum speed.

I am not entirely prepared to say how far this system can be carried, but from the experiments so far, it would appear that an engine having $\frac{1}{400}$ of its weight unbalanced longitudinally, and entirely unbalanced transversely, is entirely satisfactory as far as its riding qualities are concerned. This would mean that the supplementary balance was equal to the overbalance, and in that case the effect on the track would be 71 per cent. of that of an ordinary overbalance giving the same longitudinal effect, and this reduction can be accomplished without detriment to the ordinary qualities of the engine, or without introducing any objectionable troubles.

It is true that the nosing must be prevented by the pressure on the hubs of the wheels, but against this, it must be remembered, that when balance weights are distributed amongst three or four wheels that the effect of the overbalance on the boxes of all except the main wheels is just the same as it is on the track, and that the steadying effect on the engine is obtained at the expense of wear in the boxes. The wheel base on an engine is so long, compared to the distance from the centre of the engine to the centre of the cylinder, that a very small pressure on the hub is able to overcome a nosing motion much better than a balance weight, and probably with less wear.

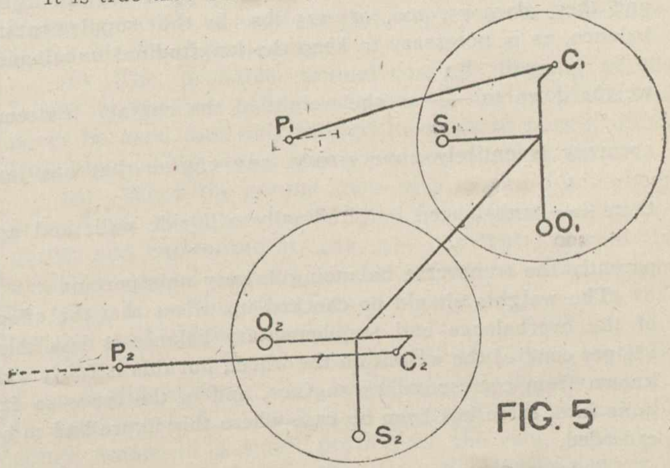


FIG. 5

We are not, however, leaving engines entirely unbalanced transversely except as an experiment, but are leaving from $\frac{1}{100}$ to $\frac{1}{150}$ of the weight unbalanced transversely, and $\frac{1}{400}$ unbalanced longitudinally with extremely satisfactory results; one passenger engine has been entirely balanced longitudinally and entirely unbalanced transversely. It is reported to be a "perfect riding engine," and its balance is exactly the same as a 3-cylinder engine having two outside cranks each at right angles to the inside crank, and otherwise unbalanced, so that it has been shown that an engine of this kind would be entirely satisfactory as far as the balancing is concerned.

We are, however, using the system of balancing to reduce the action of the overbalance on the rail, and have adopted a rule to balance the engine so that the overbalance in any one wheel shall not, if possible, exceed one per cent. of the weight on that wheel, and is limited to 1¼ per cent.

The latter figure causes a variation of 50 per cent. of the weight on the wheel at the maximum speed, and while I have, of course, no accurate information to show that this is the proper limit, it is so much better than on many existing engines, that I feel that it is a sound limit to work to, and we are certain that under no conditions can any hammer blow occur from wheels balanced in this way. So far, no engine has been met with in which it is not possible, by using supplementary balances, to obtain satisfactory results without increasing the overbalance above this amount.

There are also one or two practical advantages in the system of allowing a greater unbalanced weight transversely. It is possible to properly counterbalance consolidations, as the supplementary weights can be placed in the wheels at right angles to the crank, thus overcoming the difficulty experienced of not being able to get sufficient balance opposite the crank without an excessive overbalance in the leaders and trailers.

It makes the adjustment of the balance very easy It is only necessary to cast the main balances 75 or 100 lbs. light, and then place 75, 100, or 125 lbs. in the supplementary balance, as is necessary to keep the longitudinal unbalanced weight down to $\frac{1}{400}$ of the weight of the engine. Extreme accuracy is entirely unnecessary, any engine that has less than $\frac{1}{400}$ unbalanced longitudinally will ride well, and apparently the transverse balancing is very unimportant.

The weights should be checked up to see that the effect of the overbalance and supplementary balance is less than 1¼ per cent. of the weight on the wheel, but this is fairly well known from corresponding engines, and in the types so far gone into, there has been no case where this figure had to be exceeded.

These advantages are, of course, incidental. The chief interest is, I consider, the fact that an engine may be unbalanced transversely to a far greater extent than longitudinally without causing its riding qualities to be objectionable, consequently, the overbalance can be reduced, and its effect on the track maintained within reasonable limits.

I have referred to the utilization of the weight of the tender. This has been done on the Prussian State Railways by coupling the engine with tender so firmly that the weight of the tender assisted in absorbing the longitudinal vibrations. If this could be done the factor of $\frac{1}{400}$ could, of course, be applied to the total weight of the engine and tender, and I understand that engines have run with the reciprocating parts entirely unbalanced with satisfactory results.

We have always found here that when less than $\frac{1}{360}$ was unbalanced, trouble has developed in keeping up the connection between engine and tender, and lost motion has occurred very quickly. I feel that, with our heavy reciprocating parts and hard service, this method is hardly practicable, and it does not afford any hope of being able to avoid some system of balancing for two-cylinder engines.

Before closing, I wish to refer to offset counterbalances, as it is obvious that the combination of main and supplementary balances I have described is the same as an off-set balance weight; the trouble with the latter is that it cannot be weighed, and must be calculated.

Some very serious errors have been introduced by depending on weighing it, especially where it is off-set, to reduce the nosing movement; in Fig. 6 let C_1, C_2, be the crank pins, O_1, O_2, the counterbalances (not only the overbalances); when weights are placed on the crank pins at C_1, they do not show the weight of the overbalance at O_1, as is the case with an ordinary balance opposite the crank; suppose the crank pin radius be 12″ and the counterbalance O_2 is set 4″ off the centre line; evidently the weight at C_1 acting at 12″ is helped by that at O_2 acting at 4″, and the mistake has been made of thinking this weighed the counterbalance at O_1; it does not begin to.

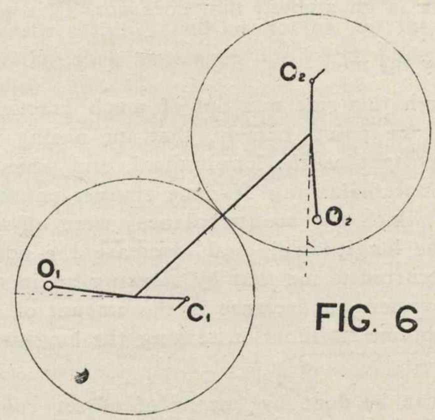


FIG. 6

O_1 in addition to balancing the weights at C_1, is balancing the entire weight of the crank pin and hub, and a numerical example will show what happens. Suppose O_1 is also 12″ from the centre, and that the weight of the crank pin and hub at C_1 is 500 lbs., and that the counterbalance desired is 400 lbs. Neglecting the fact that O_1 is not quite 12″ from the vertical line, it would require 900 lbs. at O_1 to give a counterbalance of 400 lbs. in addition to balancing the weight of the hub; this 900 lbs. would also act at O_2 at a distance of 4″ from the centre line, and consequently the weight required at C_1 to balance would be $\frac{900 \times 12 - 900 \times 4}{12}$ or 600 lbs., of which 500 lbs. is supplied by the crank pins and hub, leaving only 100 lbs. actually necessary to balance an overbalance of 400 lbs.

Evidently, this might easily be very misleading, and the difficulty is that, from the weight on the crank pin the actual overbalance cannot be calculated except by estimating the weight of the crank pin and hub, and knowing the exact off-set of the centre of gravity of the counterbalance.

For this reason the arrangement of counterbalance weights directly opposite the pin is far better, as they can accurately be weighed and the supplementary balances of known weight afterwards added.

I think that is all I have to say just at present, gentlemen, and I now declare this subject open for discussion. If any member has anything to put forward in this connection, I am sure we shall be very glad indeed to have his opinion, and if anyone has any questions to ask I will be glad to answer them.

THE

Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

TORONTO WATER SUPPLY AND WASTE.

Last week Mr. Allen Hazen, lecturing upon "Slow Sand Filtration" in Toronto, called attention to the large per capita amount of water used in Toronto. He stated that if the consumption was allowed to increase at its present rate the slow sand filters at present being installed would be found inadequate.

This statement is reasonable, as slow sand filtration will only allow of limited quantities of water being treated per acre of filter, and any increase over the amount at once shows itself in loss of efficiency.

The city of Toronto must either adopt some method of decreasing its per capita rate of supply, or make up its mind to at once borrow another large sum of money for increase of the filter plant area, otherwise slow sand filtration is going to prove a failure without even giving it a fair test.

Ten years ago Mr. Rust (City Engineer) reported as follows:—

Extract from City Engineer's Annual Report for the year 1899:—

"This year, taking the population to be 215,000, the consumption averages 99.7 gallons per head; of this, the metered water amounts to 12.5 gallons per head. Between three and four o'clock a.m., when there is practically no consumption, water is being pumped at the rate of 15,000,000 gallons per day, or 70 gallons per head of population. Careful measurements of the discharges of the sewers, which were taken recently for sewage disposal purposes, show that the minimum quantity carried off by all the sewers was at the rate of 15,214,000 gallons per day, showing a very close agreement with the rate at which water was being pumped between 3 a.m. and 4 a.m.

"It is evident that the greater part, if not all, of this 70 gallons per head was waste water, leaving 17.2 as the quantity used for domestic purposes. That this quantity is very close to that actually used the experience of the following cities indicates: At Fall River the quantity per head for domestic purposes is 11.2; at St. Lawrence, 16.3; at Woonsockett, 14.1; at Worcester, 14; while for London, Birmingham, Manchester and Sheffield the rate per capita is from 13 to 25 gallons. So that, allowing 10 gallons per head for incurable waste (this being the amount fixed upon by Mr. Freeman in his report to the New York Water Board) and adding to this amount 12.5 gallons metered water and 17.2 for domestic purposes, a total of 39.7 gallons per head would be a fair figure for all purposes, including incurable waste. In other words, 60 per cent. of the water pumped is absolutely wasted without benefit of any kind being derived from it. It would, therefore, appear reasonable on economical grounds alone to take some measures to reduce this waste."

This straightforward and alarming report, handed in by the present City Engineer ten years ago, has been followed by a further increase in the per capita consumption.

In 1899 the per capita consumption was 99.7 gallons.

In 1909 the per capita consumption is over 120 gallons.

In 1899 about 12,000,000 gallons per day of water were being pumped to waste.

In 1909 about 21,500,000 gallons per day of water are being pumped to waste.

We respectfully ask that the Board of Control at once obtain an estimate from the City Engineer of the cost as follows:—

(a) The annual cost of pumping 21,500,000 gallons per day without benefit of any kind being derived from it.

(b) The probable annual cost of treating 21,500,000 gallons per day of waste water, represented as sewage, at the Morley Avenue site.

(c) The probable annual cost of filtering at the Island 21,500,000 gallons per day of water which will never be used, but only filtered in order to pass it direct from the leaking water mains to the inleaking sewers.

(d) When the annual costs of a, b and c have been arrived at, then we would like these sums added together and capitalized at, say, 3½ per cent., so that the available capital amount can be arrived at which might be spent in putting the Toronto water supply on a reasonable and efficient basis."

We must not run away with the idea that the Council did nothing after receiving Mr. Rust's report. In 1900 we find a small sum appropriated to test the actual waste in a small portion of the city, extending from Dundas Street on the west to Manning Avenue on the east, and from College Street on the south to the city limits on the north, the number of houses being 2,090; the tubs, 3,008; lawn hydrants, 472; baths, 864; closets, 932. In this section of the city systematic repairs to mains and tap fittings were made. **Before the repairs were made the consumption of water amounted to 234,163 gallons per day. After the repairs were made the consumption amounted to 140,565 gallons per day.** The leaks on mains numbered 58, showing a loss of 26,122 gallons per day, and the leaks to service taps 308, with a loss of 59,304 gallons per day. This loss of 40 per cent. in a sparsely built up section of the city would, of course, have shown a much larger percentage of loss in other parts more thickly populated. Mr. Rust concludes in connection with this test as follows: "The time is not far distant, unless proper means are taken to prevent waste, when the ratepayers will be called upon to provide large sums for improvements to the system."

Now, here comes the point. Although the above facts have been officially made known to the corporation, the facts have been pigeon-holed and embalmed, only to be resurrected by a New York engineer when he finds that his filtration plant is not acceptable to the waste conditions which prevail.

Why, in the name of everything reasonable and municipal, were not the people told at once that the $750,000 voted for water filtration would be of no practical use unless their water supply was measured out to them by a meter? We have to wait until the city is pledged to a filtration scheme, until the work is half completed, until the engineer for the works happens to address a casual meeting of the Canadian Society of Civil Engineers, in order to obtain this important information, quoting the very words of the engineer: "Unless steps are taken by the corporation to lessen the tremendous waste of water, the filters at present being installed will prove inadequate for the purpose of purifying the water."

The above procedure absolutely excels in municipal muddle, and the retention of valuable and available information. However, out of evil good may evolve, and if the conditional predicted failure of the filtration plant will only make the Council wise to the enormous sum annually wasted in pumping 21,500,000 gallons of water per day for the mere fun of simply pumping it and filtering it in order to flush the sewerage system, then we may yet be able to say, "All's well!"

The suggestion to meter the water for domestic purposes in order to curtail the waste is radically bad from a hygienic point of view. The towns quoted by Mr. Rust in Great Britain where the per capita consumption is low are not metered. The British principle is totally against metering domestic supply. For legitimate purposes the people should feel that they have a free and unbounded right to water. Cleanliness should not be made the privilege of those who can afford to bath and wash, and dirtiness the penalty of those who may first have to consider the effect of a morning tub upon the meter index.

There is a huge difference between an unbounded supply of water for legitimate purposes and direct waste caused by faulty mains, bad workmanship, and total lack of proper inspection and supervision.

Where there are good, sound mains and thorough inspection and supervision, an unbounded legitimate supply of water is represented by about 30 gallons per head per day. Any figure above this amount is up to the corporation or those managing the system to explain and make good. The onus is not with the consumer, but with the method of supply.

The October outputs of the Nova Scotia Steel Company were as follows:—Steel, 7,148 tons; pig iron, 5,640 tons; coal, 77,130 tons.

* * * *

The statement of the Winnipeg Electric Railway for September shows gross earnings for the month, of $218,088, an increase of 24 per cent., while the net earnings increased 21 per cent. For the nine months of the year the gross totals $1,848,897, an increase of 20 per cent., the net gain being the same. Earnings are at the rate of 14 per cent. on the common stock.

SEWAGE DISPOSAL.

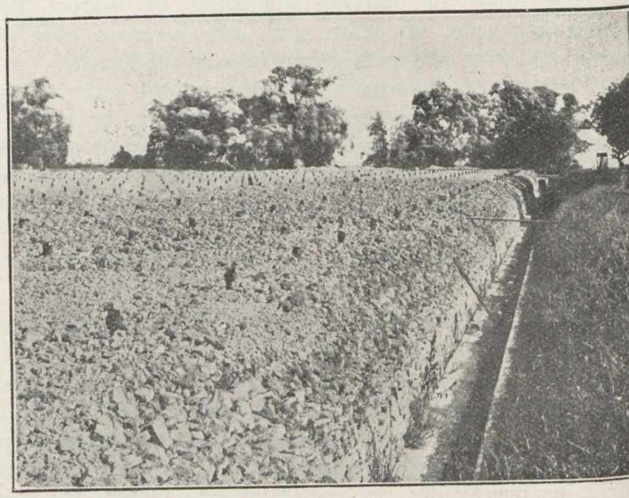
REMOVAL OF PUTRESCIBILITY.

Chapter VII.—Continued.

Distributing Appliances.

Revolving sprinklers and travelling distributors have been used more extensively in Great Britain than on this continent for distributing sewage over percolating biological filters.

Mr. Clark, chemist to the Massachusetts Board of Health, recently read a paper before the Boston Society of Engineers, following after a visit to Great Britain, his remarks upon revolving sprinklers, are here worth quoting. Mr. Clark states that when he started on his round of visits he was strongly inclined to believe that the use of nozzles (fixed sprays) was the common-sense method, but that he has become convinced that under English conditions revolving or travelling distributors are by far the best, as with these, other things being equal, filters produce better effluents per unit of filter surface, and every square inch of filter can be used. He points out that "by sprinkling nozzles operating under a constant head, as at Birmingham and Salford, as can be seen from observation of these areas, and as has been shown by experiments at Lawrence and elsewhere, only about 50 or 60 per cent. of the filter is really used." That is to say, if 2,000,000 gallons of sewage are applied daily to an acre bed by means of nozzles, a considerable area will operate at the rate of 5,000,000 or 6,000,000 gallons per acre daily, while a portion will only operate at a rate of 500,000 gallons or less. "There is little or no spreading of sewage as it passes through filters of clinker, coke, or broken stone. In other words, if the sewage was as perfectly distributed over the Birmingham filters, as over the Hanley, Heywood, and other filters, the area of these filters might perhaps be reduced 50 per cent., the cost of construction be not more than half as great, and the same purification result be achieved. Even in this country," Mr. Clarke goes on to say, "I believe, perfect distribution, even if the form of distributor necessitates covered

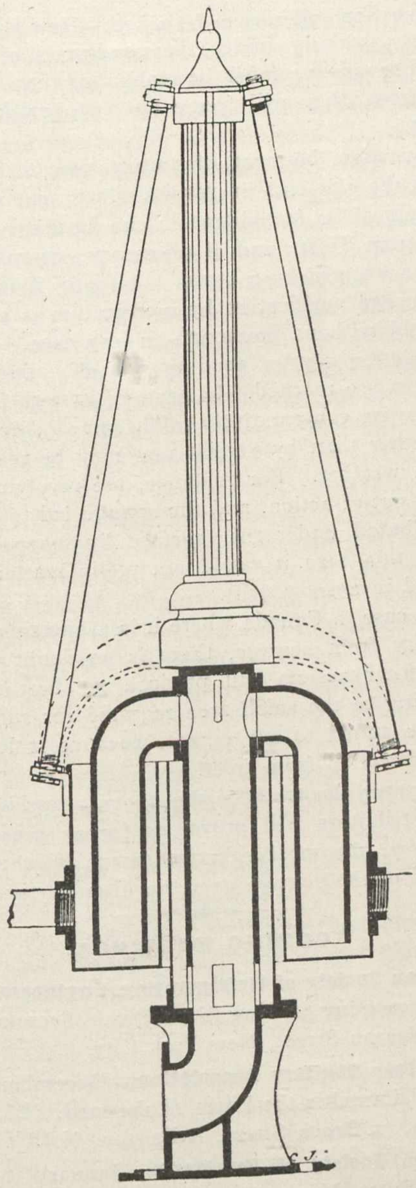


Fixed Sprays.—Hamilton Sewage Disposal Works.

*Prepared specially for the Review by Mr. T. Aird Murray, Consulting Engineer, Toronto.

filters for winter work, may in the end be the practical method of construction and operation."

In the case of revolving distributors, the filters are constructed circular in shape. The sewage is generally fed by means of a dosing tank which is supplied with the sewage liquor after the solids have been settled out. There are many forms of distributors on the market, all of which, however, agree in certain general principles. The dosing tank is located about 1 ft. 6 in. above the distributing arms, providing the necessary power for the revolving action. The sewage is generally led by a syphon fixed at the outlet of the



Circular Distributor.—(Messrs. Jennings, Limited, London, S.E.)

dosing tank, ensuring intermittency of discharge, and passes to a central drum or cylinder fixed in the centre of the bed. To this drum are fixed four horizontal radiating pipe arms, perforated, to allow the sewage issuing in the form of a spray. The force and head exerted by the sewage, causes the distributing arms to slowly revolve around the filter, the sewage being sprayed evenly over the whole surface. They are made from comparatively small sizes to about 100 feet in diameter; when anything over this diameter is required, electric or other motor power is generally used to promote the revolving action.

Owing to the fact that large size revolving distributors are clumsy and heavy, it is more usual to provide filter units of not more than 60 feet in diameter, this size worked with a 1 ft. 6 in. head from the dosing tank gives the best working results.

A filter 60 feet in diameter by 6 feet deep will provide a filter capacity of 628 cubic yards, or a surface area of 1-16th of an acre, and will treat per day 125,000 gallons of sewage at a rate of 200 gallons of sewage to each cubic yard of filtering material, or at a rate of 2,000,000 gallons of sewage per acre.

The dosing tank should be of a capacity equal to a discharge at each syphonage of not more than two gallons per super yard of filter area. In the above case with a 60-foot diameter sprinkler, we have 314 super yards of wetted area which represents 628 gallons for each intermittent discharge. With 125,000 gallons per day, this would allow of about 200 discharges per day, providing 7 minutes for each discharge. On the line of pipe supplying the sewage from the dosing tank to the filter it is usual to insert a regulating valve, so that the rate of supply to the distributor can be fixed for a given period of discharge. In the above case, if the valve be so fixed that the contents of the dosing tank are discharged in 3½ minutes, then 3½ minutes are allowed for rest between each discharge.

At first sight intermittency of supply to a percolating filter may not appear to be of great importance, as air at all times has free access to the body of the filter. In fact, it was the custom at first to work all percolating filters continuously, and they became known as continuous filters in contradistinction to contact beds. It was soon found, however, that greater efficiency attended the automatic dosing tank supply than the continuous supply.

In our issue of October 8th last, it will be noted that the main points to be observed in order to obtain the maximum efficiency in purification from percolating filters were enumerated, two of these points were as follows:—

(d) That the passage of the drops of sewage through the filter be sufficiently slow, to give ample time for the absorption film to extract from each drop of sewage, the organic impurities contained.

(e) That the liquid supplied to the filter never be under pressure, beyond the gravity inherent to each drop, so that there is no flushing of the filter.

The above intermittency of supply at a rate of discharge of 2 gallons per super yard of filter area, appears to provide conditions answering the demands of the above two paragraphs.

Each individual dose of sewage passes through the filter without being pressed forward by the succeeding dose. Revolving distributors supplying sewage to a filter intermittently will provide for twice the amount of sewage which can with equal results be passed through continuously.

Percolating filter beds worked continuously by revolving distributors will treat twice as much sewage per cubic yard of filter than can be treated by contact beds.

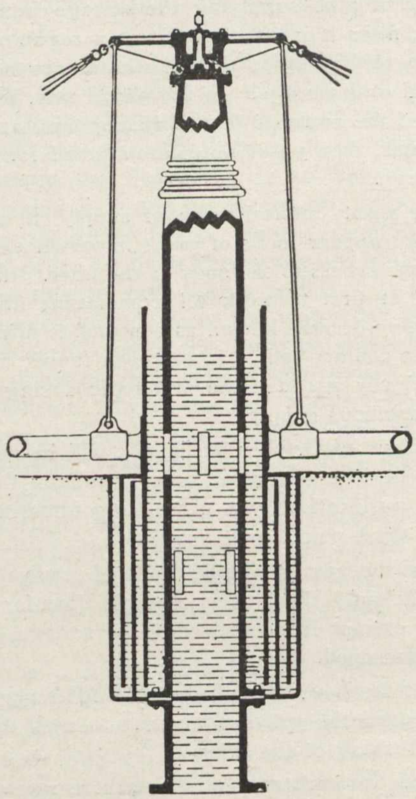
Percolating filter beds worked intermittently at doses not greater than equal to 2 gallons per super yard of filter will treat four times as much sewage per cubic yard of filter than can be treated by contact beds. The revolving perforated arms of the distributors are, as a rule, provided with terminal screw caps, to allow of cleaning. In some cases the distributing arms are open troughs provided with side perforations, in the latter case the power for revolving the apparatus is directed to a turbine placed in the central drum.

Travelling distributors have been designed to meet cases where rectangular filter beds are in use, or for cases where the units are so large that the head obtainable is not sufficient, or again when no head can be utilized and mechanical power must be resorted to. The principal of distribution is, however, much the same, viz., by means of moving perforated arms.

In the case of travelling revolving distributors, it is usual to provide a rail around the circumference in which the arm moves, resting on a wheel, motor driven.

In many cases, however, travelling distributors are worked automatically by the sewage head. The Candy-Caink distributor is a well-known type. These are in use at Worcester (England), and are 200 feet in diameter.

The "Fiddian" distributor is somewhat remarkable, and is of a different type to the usual form of perforated pipe arm. The sewage is conducted to buckets of an elongated water wheel, which not only revolves on its horizontal axis, but



The Cresset Distributor.—(Messrs. Adams Hydraulics, Limited, York, England.)

travels itself on the surface of the filter by means of wheels fixed on or connected to its axle. A head of at least 15 inches is required to operate the apparatus. In this case there are no joints to trouble with, and the sprinkler has no small holes to block up, and it is said to give uniform distribution irrespective of rate of flow.

Perhaps the best known power distributor is that invented by "Scott-Moncrief." It may be worked either by an oil or electric motor on rails as above described surrounding the filter. Good distribution is obtained, but the whole apparatus is cumbersome and weighty, and requires strong walls and foundations to the filter beds, necessitating costly work.

The "Adams Electrically-driven Distributor" is a more simple and less costly apparatus. No rail is required. The motive power is by means of fans electrically driven. A great point in favor of this power distributor lies in an arrangement by which the power is automatically cut off when the velocity of the distributor is sufficient.

For a simple and effective distributor worked without power, the writer from experience can speak well of the "Cresset" distributor, also manufactured by the Adams Company. In the latter case the joint between the standing and moving parts is made by means of an air lock, and there is no mechanical joint. The loss of head is very small. In fact the distributor will work effectually with 9 inches head from the dosing tank. The weight of the distributor is carried on ball bearings running in an oil bath, and the whole design is excellent.

The question will at once be asked,—How about revolving distributors working under the conditions of a Canadian winter? The answer must be emphatic, that if unprotected rrom the frost, they will freeze up with temperatures at or below zero.

The question, however, of protection is a small one compared with the efficiency in results which are to be obtained. A filter unit of 60 feet diameter can be easily and cheaply protected from frost, and if necessary, completely housed, and the air warmed by a stove. In fact, it is questionable whether sewage purification by nitrification is possible under extreme cold without protection in any case. It is known that nitrification results tend to fall off after certain low temperatures are reached. In parts of eastern Canada where the winters are comparatively mild, some other form of distribution other than by distributors may be resorted to during severe weather. For instance, the revolving distributor can be put out of action, and the sewage led to the filter bed and distributed under the surface by means of weeping pipes. In this case it would not really matter if the filter was covered in a snow drift.

In any case in Canada where it is a question of removing putrescibility from sewage, there is no doubt but that the biological filter system will produce the best results; and further owing to the small area required for such a plant, it is the more suited to our climate because it lends itself to effectual protection from frost.

If we grant the truth of the above proposition, then revolving distributors will prove, as far as present evidence goes to show, the most effective means of obtaining equal distribution of the sewage over the filter surface.

COMING MEETINGS.

American Society of Refrigerating Engineers.—December 6. Annual meeting in New York City. Secretary, Wm. H. Ross, 154 Nassau Street, New York City.

New Jersey Sanitary Association.—December 3-4. Annual meeting at Laurel-in-the-Pines, Lakewood, N.J. Secretary, J. A. Exton, 75 Beech Street, Arlington, N.J.

Montana Society of Engineers.—January 6-8. Annual meeting at Butte, Mont. Secretary, Clinton H. Moore, Butte.

American Institute of Chemical Engineers.—December 8-10. Annual meeting at Philadelphia, Pa. Secretary, J. C. Olsen, Polytechnic Institute, Brooklyn, N.Y.

American Association for the Advancement of Science.—December 27. Annual meeting at Boston, Mass. Secretary, L. O. Howard, Smithsonian Institution, Washington, D.C.

American Society of Agricultural Engineers.—December 28-29. Annual meeting at Ames, Iowa. Secretary, L. W. Chase, University of Nebraska, Lincoln, Neb.

Association of American Portland Cement Manufacturers.—December 14-15. Annual meeting at New York City. Secretary, Percy H. Wilson, Land Title Building, Philadelphia, Pa.

EUROPEAN ENGINEERING LABORATORIES.*

Robert W. Angus, B.A.Sc.
Professor of Mechanical Engineering.

During the past summer the writer had the pleasure of visiting Germany, Switzerland, England and Scotland, and made it a point to see the engineering laboratories in Brunswick, Hanover, Berlin, Dresden, Munich and Darmstadt in Germany; in Zurich in Switzerland, and in London, Birmingham, Newcastle, Edinburgh and Glasgow in Great Britain.

In Europe, more especially continental Europe, the engineering laboratory has been brought to a great state of perfection, so that probably the very best in the world are to be found there. To get even a superficial acquaintance with these one would need to spend a very considerable amount of time and energy, and I very much regret that my time was so limited that it was impossible to study the different institutions as I should have wished. It soon became evident that I must not only omit a number of the technical schools altogether, but also that the available time must be devoted to my own special work almost entirely, and it was necessary for me to confine my effort largely to the laboratories in hydraulics and mechanical engineering; i.e., heat engines and boilers and other special mechanical work. This article, therefore, deals almost exclusively with laboratories used in connection with the above special subjects.

With regard to the schools visited, it should be stated that an especial effort was made to visit the most notable in the different countries. It must not be inferred, however, that only the least important were omitted, because after it had been decided that it was essential to visit certain places, geographical location combined with other circumstances determined those that must be omitted, and some places of excellent reputation had, therefore, to be left out.

An account of these laboratories will now be given mainly in the order in which they were visited, and, as Germany was the starting point, the schools in that country will be described first.

German Technical High Schools.

The Germans are a very thorough and industrious people, who believe in doing well whatever they attempt to do. One is not, therefore, surprised to find that they have been very thorough in the matter of technical education, and that they have established engineering schools of the very highest order.

But the development of these schools is not due alone to the characteristics of the nation, but probably quite as much to the great change in the occupation of the people which has occurred in the last few years. In a report on the German Technical High Schools, made in 1903 by Dr. Rose to the British Government, it is pointed out that in 1871 the population of Germany was 38,000,000, of whom only about 15,000,000 were in the various industries, the remainder being engaged in agricultural pursuits. In 1900 the population had increased to 58,000,000, of whom about 38,000,000 were engaged in the industries, while the number in agricultural pursuits was slightly less than in 1871.

It will be self-evident that the nation which is to have a healthy industrial growth must at the same time properly prepare her people for their opportunities in this regard, and must train her men to develop the industries in the best possible way. The importance of engineering schools in this connection is well known, and Germany has not been slow to realize this, and has established within the last forty years no fewer than ten Technical High Schools for the teaching of engineering and allied sciences. These schools are located at Aachen (Aix) Brunswick, Berlin, Darmstadt, Dresden, Hanover, Karlsruhe, Munich, Stuttgart, and Dantzig, cities pretty well distributed over the empire, many of them also being located in important industrial districts. The number of these schools is being increased from time to time as occasion demands.

It is to be noted that the above list includes only the Technical High Schools and not the great number of universities and schools of various other kinds which are engaged in a somewhat similar line of work. The term "Technical High School" must not be misunderstood in this connection, as it designates an entirely different class of institution from that to which the name is applied in this country. In Germany the name is applied to the real engineering school, the students in these being of similar standing to regular university students and the courses of instruction being somewhat more advanced than engineering courses here.

The amount of money expended on the establishment of these various schools has been very great, and the annual contribution by the State for maintenance is also liberal. It is difficult to get definite information on these points, but so far as could be learned the expenditure for buildings and equipment at Berlin (Charlottenburg) would exceed $2,500,000, but, of course, this is far the largest institution of its kind in Germany. At Hanover the expenditure for similar purposes has been about $500,000, at Brunswick the steam and gas engine laboratory alone cost about $75,000, while all the buildings at Dresden and Darmstadt, both sets of buildings being new, have cost $1,300,000 and $1,500,000, respectively.

The cost of maintenance of these Technical High Schools is also high for various reasons, the most important of which are probably: (1) That the schools are very completely equipped and kept fairly well up-to-date; (2) that there are a great number of instructors, and (3) that the fees are comparatively low. The number of students per instructor (including professors, lecturers and assistants) in very few cases exceeds twelve and in many cases is as low as nine. According to the reports to which I have referred, the annual State support to the various Technical Schools varies from about $178,000 in Dresden, $98,000 in Stuttgart, $92,000 in Hanover, to about $50,000 in Darmstadt, and the total to five of these schools in one year exceeded $470,000. The balance of the money required to maintain these institutions is received from students' fees and other sources, the above figures giving only the support received from the State.

An opportunity offered itself to learn something relative to this matter about Dresden, where it was found that the annual grant for apparatus and supplies for the steam, gas and hydraulic laboratories alone was $3,000.

It may be interesting to state that for the year 1907-8 the Faculty of Applied Science of the University of Toronto cost the State about $66,000 (allowance being made for fees received), and the total invested in buildings and equipment in engineering would not exceed $700,000.

The German people have not been slow to take advantage of the facilities offered along the lines of engineering education, for the total number of students in the nine older schools would considerably exceed 16,000. In Berlin alone there were nearly 5,000 students in 1901-2, in Munich in

*Abridged from an address delivered before the Engineers' Club, Toronto, Ont.

1905-6 about 2,800, while the present attendance at Darmstadt is nearly 2,000, at Brunswick about 500 and at Hanover 1,500.

These statistics are of some interest in showing how technical education has taken hold in Germany, and as I went from place to place and saw many new buildings and new additions to old ones I was fully impressed with the fact that the people are alive to their opportunities in that line.

That the courses given in these institutions are varied and thorough is at once evident on glancing at any of the

The Main Building—Berlin Technical High School.

"Programmes" issued by them. I might give one illustration, that of the Munich Technical High School, as the calendar for 1906-7 is at hand. The courses there are: (1) Civil engineering, in which there are three divisions—(a) civil engineering; (b) agricultural civil engineering; (c) surveying; (2) architecture; (3) mechanical engineering, which is sub-divided into (a) mechanical engineering; (b) electrical engineering; (4) chemistry; (5) agriculture. All these courses extend over four years, with the exception of surveying and agriculture, both of which are three-year courses.

Space will not be taken to quote the list of subjects in each year, but these would indicate more advanced mathematics than is given in this country, and, indeed, an examination of the entrance requirements for fully-qualified students shows that the latter are much more advanced when they enter than the matriculants here. A fairly large proportion of these entering have a considerable knowledge of both analytical and descriptive geometry, and of the calculus, and are well advanced in the general subjects.

The absence of shops and shopwork is very noticeable in the German Technical High Schools, as these shops are very common both in Great Britain and America, scarcely any institution in the latter two countries in which mechanical engineering is taught being without them. As there is considerable discussion on this question of university shops continually being heard, careful attention was paid to this point, but I was unable to find a single school in Germany with these shops, the opinion apparently being that the proper place to learn shop practice is in the shops of manufacturers, and some experience in this class of work is practically always demanded before graduating, in many cases a year of work in a manufacturing plant being required.

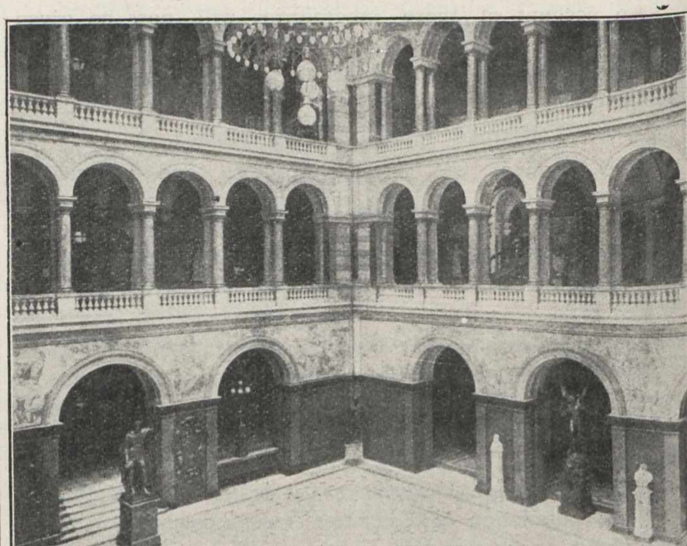
The money which would otherwise be invested in the shops is thus devoted to laboratory equipment.

Berlin.

In both Hanover and Brunswick the opinion was freely expressed that in order to see the best Technical School one must go to Berlin, and as this institution is well known to us in America my anxiety to get there increased daily, and it was with considerable expectancy that I reached this great German city.

Berlin has a population of about 3,000,000 people, and is probably the greatest commercial and manufacturing city in Continental Europe. The manufactures include large numbers of locomotives, engines, dynamos, etc., and here one finds enormous shops, such as those of the Allgemeine Electricitats Gesellschaft, with a working capital of $25,000,000 and 13,000 employees; the Berlin Maschinenbau Aktien Gesellschaft, a very large concern, having special residences erected for its men; Siemens and Halske; the Borsig works, employing 6,000 men and turning out 450 locomotives yearly in addition to many engines, pumps, etc., and many other very large shops. This city is also the capital of Prussia, is the residence of the Kaiser, and the seat of the Imperial Government.

Here, then, in this great city in the midst of so much business and progress one naturally expects to find a first-class engineering school, and one does not expect too much, for the Royal Prussian Technical High School is in many respects by far the greatest in Europe, and doubtless also in the whole world. Passing out through the delightful Tiergarten, one sees on crossing a small stream the massive "Hauptgebaude" or main building, a magnificent structure nearly 750 feet long and about 290 feet wide, with a floor area exceeding 330,000 square feet.



Interior Main Building—Berlin.

To appreciate fully the grandeur of this building one must visit it, for it is so customary to see engineering schools plain and with very little adornment that one seems to be in a strange atmosphere in this grand place. The building was erected in 1878-84, and is richly decorated with busts and sculptures of such noted men as Gauss, Eytelwein, Schinkel, Redtenbacher and many others, amongst whom it was a pleasure to see Watt and Stephenson. In front of the building are monuments to Alfred Krupp and Werner Siemens. Some illustrations are given of the general appearance of this building.

This Technical High School had its beginning in 1799 as a Royal Building Academy, which was combined in 1879 with a Trade Academy established in 1821. Since 1879 it has borne its present name. On the celebration of its one hundredth anniversary in October, 1899, the Kaiser granted the school the right to bestow the degree of Doctor of Engineering, a degree first conferred upon Prince Henry of Prussia (honoris causa).

There are about fifty-five fully qualified professors, besides many assistants, private lecturers, etc., making a total teaching staff of nearly two hundred. There are nearly 5,000 students in attendance, of which number about 80 per cent. are fully qualified. Nearly one-half of the students take the mechanical and electrical course, a fact not surprising in view of the great amount of manufacturing done in Germany.

The Berlin Technical High School, like other Prussian schools of the same class, is under the control of a Rector and Senate. The Rector is elected annually by the votes of the professors, but his election must be approved by the King of Prussia.

Returning now to the buildings, it will be seen from the plan of the grounds that almost every laboratory has a separate building of its own, the main building being used for the collection of models, lecture rooms, museums, professors' rooms, draughting and other rooms of like nature, some laboratories and the offices of the institution. There are thus ten buildings, viz.; 1, The main building, already mentioned; 2, a building for mechanical engineering; 3, a chemical building; 4, a building for experiments on heating and ventilation; 5, a building for testing materials and gas engines; 6, an electrical laboratory building; 7, a building for steam engines; 8, a boiler-house; 9, a chemical museum; 10, an hydraulic building. These buildings also contain the laboratories for belt-testing for gas and oil engine and automobile testing, and for the testing of the power required to drive machine tools.

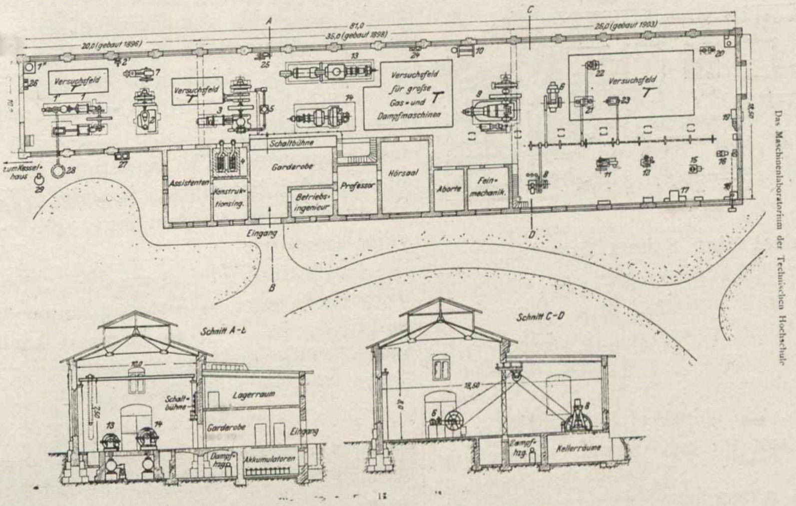
In such an institution it is evidently impossible in limited time to look carefully into all the laboratories, so that it was possible only to glance through many of them in order to leave proper time for the machine, gas engine, belt-testing and hydraulic laboratories, which will now be described in some detail.

(a) The Engine Laboratory.—The building containing this laboratory, which was erected in the years 1896, 1898 and 1903 (see figure)., is 365 feet long and of width varying from 33 feet to 60 feet, the clear height of the main portion being 26 feet. It is well lighted throughout by very large side windows, as well as by others in the roof, and the whole main part is served by a travelling crane of five tons' capacity. Some of the engines are used for light and power, but as there are so many of them in the building no difficulty seems to be experienced in getting any machine desired for experiment.

The laboratory contains a horizontal cross-compound engine of 60 horse-power, directly connected to a pump and all parts specially arranged for testing; a 220 horse-power quadruple marine engine, complete, with condenser; a 150 horse-power triple expansion engine for superheated steam; a 300 k.w. Brown-Boveri Parsons turbine; a 200 k.w. turbine by the Allgemeine Electricitats Gesellschaft, Berlin; a 40 horse-power Woolf locomotive type engine and boiler; several types of air compressors of good size; a 150 horse-power Deutz suction gas engine; a number of gas and gasoline engines, and a Borsig refrigerating machine. In connection with the machines described there are necessary condensers and pumps, gas meters and all conveniences for testing, and nearly every machine drives a dynamo, which is used to produce the load for experimental work. Friction brakes are not considered as reliable as electrical loads, so that the former are not used to any extent.

This laboratory also contains a number of dynamometers of various styles, apparatus for testing nozzles and orifices, and several fairly large testing floors. All pipes are placed under the floor, either in trenches or in the basement, which extends under part of the laboratory and provides room for some of the condensers and pumps.

This laboratory is well adapted to research work on account of the large size of the machines, and some very valuable work has been done, results of which are published in German periodicals



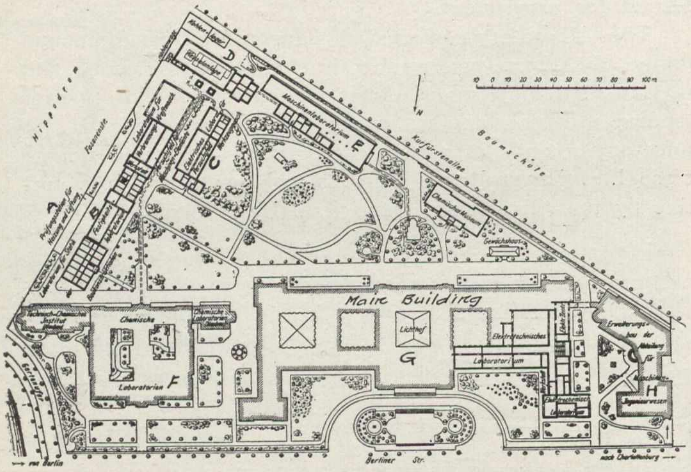
The Engine Laboratory.

1, 1' horizontal engine and pump; 2, quadruple expansion engine, 220 horse-power; 3, triple expansion engine, 150 horse-power; 4, superheater; 6, Wolf locomotive type engine; 7, air compressor; 9, suction gas engine, 150 horse-power, 13—300 k.w. Parsons turbine, 15—200 k.w. turbine. Other numbers refer to small machines. T are test and research floors. The dimensions are in metres.

It should be stated that the descriptions of the apparatus are not complete, and in such an article as this it is possible merely to mention the more important machines.

The laboratory is under the direction of the well-known Prof. Josse.

(b) The Gas Engine Laboratory.—This laboratory, which is in charge of Prof. Riedler, is designed especially for testing gas engines and automobiles, although, as previously stated, there are a number of gas engines in the engine laboratory just described. The space available for this work is over 170 feet long, and varies in width from over 40 feet to about 70 feet, the height being about 25 feet, and all the light being obtained from the sides. The whole of the building is served by a ten-ton travelling crane.



Plan of Berlin Technical High School Grounds.

Starting from the lower left-hand corner and going up the side of the triangle the first building, A, is the laboratory for heating and ventilation research; the next, B, is for strength of materials and gas engine and automobile testing; C, the electrical laboratory; D, the boiler-house; E, the engine laboratory; F, the chemical building; G, the main building; H, the building for mechanical engineering.

The laboratory contains a 200 horse-power suction gas engine, with dynamo, constructed by the Vereintige Maschinenfabrik, Augsburg. This engine, which is four-cycle and double-acting, has the latest type of valve gear, and is well adapted to testing. The gas for this engine is made by suction gas producers, of which there are two of 200 horse-power each, located in a separate building, the gas being led over to the laboratory in pipes.

In addition to the above there is a 40 horse-power Korting engine, a 25 horse-power Korting oil engine, a 20 horse-power Diesel engine, several other engines, special apparatus for doing research work on explosive mixtures, numerous gas meters, etc. The engines are all equipped with dynamos, which are used to produce the load.

A very interesting feature of this laboratory is the automobile testing plant, designed for testing the horse-power and tractive force of automobiles of all sizes and powers up to 200 horse-power. The power of the engine is determined by placing the automobile on a dynamometer driven by the back wheels of the latter, which dynamometer may be adjusted to suit any size of machine. Power is absorbed partly by means of dynamos and partly by Prony brakes, the former being very easily adjusted to give any load desired with great precision. The tractive force is also measured by a special device, which cannot be explained here for lack of space.

That this automobile testing plant is in great demand was evidenced by the fact that there were five or six machines waiting to be tested when the laboratory was visited.

There are also testing floors available for other purposes, space being left below these so that access to the lower side of the floor may be easily obtained.

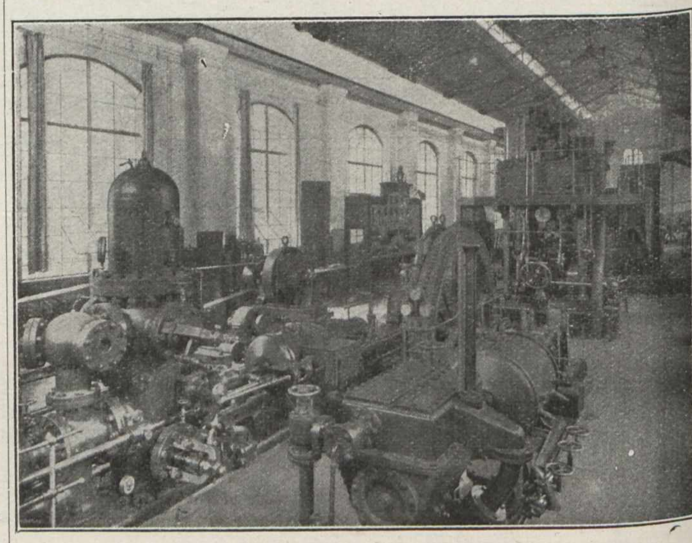
(c) Laboratory for Testing Belts and Machine Elements.—This laboratory is about 23 feet wide and 90 feet long, and contains various machines for testing the friction of journals, the holding power of friction clutches, and for similar work connected with the elements of machines. There is also a belt-testing machine capable of testing pulleys eight feet in diameter, driving a belt as wide as 16 inches. The machine is driven by two 100 horse-power motors, which may run at any speed from 200 to 600 r.p.m. Rope pulleys, six feet in diameter, with four grooves, may also be tested on this machine.

The power applied to the belts is measured at the motor, and the power delivered, as well as other data relative to the working of the belt, obtained by suitable means at the driven end.

On this machine, in addition to the work on leather belts and various kinds of ropes, very valuable experiments on the steel driving bands now in use in Germany have been made, and with a machine of this size reliable information may be obtained on full-sized specimens instead of on the small models which must be used in most schools.

(d) Laboratory for Heating and Ventilation.—I regret that I have been unable to get any material description of this laboratory. The apparatus is very elaborate and complete, and a description is soon to be published. This laboratory is about 500 feet long and 20 feet wide, so that it is quite extensive.

(e) Hydraulic Laboratory.—This laboratory, which is illustrated here, is situated some distance from the other buildings, in order to bring it beside a natural stream of water. The stream in question is the Landwehr Canal, which is used by barges in the city of Berlin, and which joins the River Spree about a mile distant.



The Engine Laboratory—Berlin.

Adjacent to the hydraulic laboratory for the Technical High School is the large channel installed by the Government for making tests on ships' models, etc.

In almost all cases hydraulic laboratories situated on natural streams are smaller than those not so situated, because in the latter case a very considerable amount of room is occupied by the large pumping machinery required for the supply of water for turbines of the reaction type, and also because experimental artificial channels must be provided in the buildings to take the place of the natural channel outside.

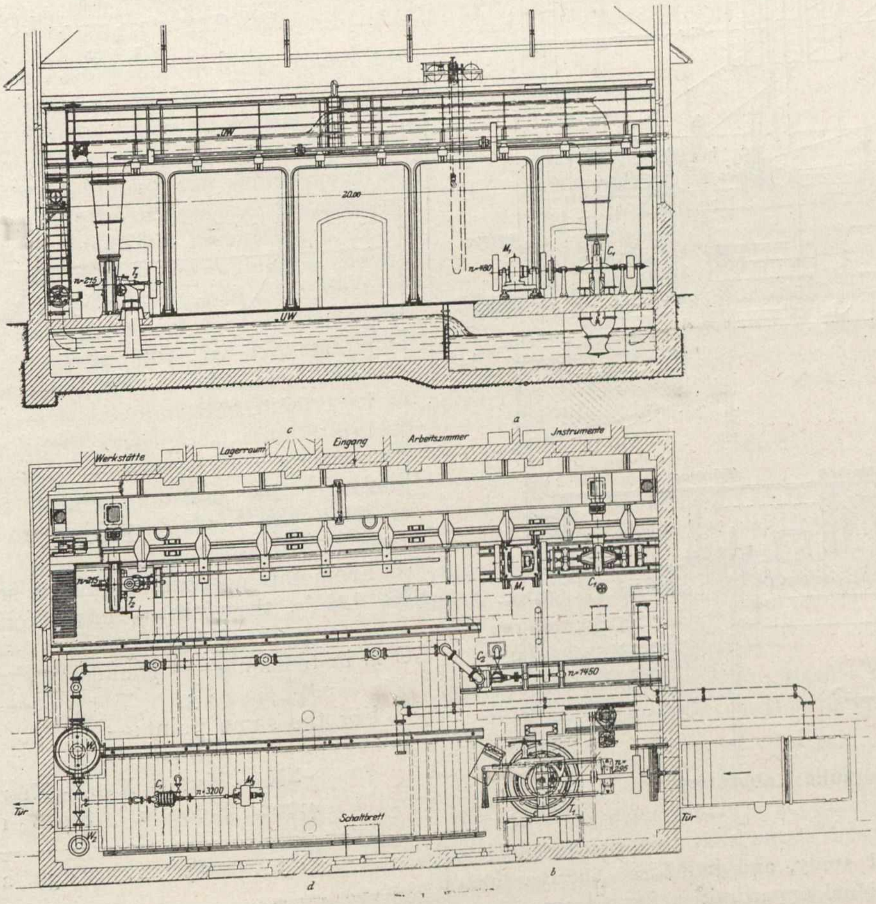
The power obtained from the stream of water is used laboratory of the Technical High School at Berlin, which occupies a building over 60 feet long and about 58 feet wide, but also includes a channel outside about 180 feet long. It is in charge of Prof. Ernst Reichel.

The power obtained from the strteam of water is used in driving a turbine with vertical axis made by J. M. Voith, of Heidenheim, for experimental purposes. The available fall is only about five feet, but there is a flow of about 85 cubic feet per second, so that the turbine is of fairly large power. It runs at a speed of 74 revolutions per minute, and is equipped with a good turbine governor and a brake for measuring the power, but the wheel may also be used for driving the pumps, etc., in the laboratory if desired. Numerous experiments are made on the wheel, and facilities are also provided for the testing of wheels of other makes. The discharge water is measured by a method fairly common in Germany, but apparently not used in this country so far as I am aware. On account of the low head available it was deemed inadvisable to use a weir, which would mean the loss of a part of the available head, in this case seriously reducing the latter.

The cross section of the tailrace is rectangular and of uniform section, and a screen of light material impervious to water is made, which is placed in the stream in a vertical position and normal to the direction of flow. This screen is supported on light, frictionless rollers, and as it nearly fills the channel the velocity of the screen gives the mean velocity in the cross-section if the screen is properly designed and supported.

This method of measuring water appears to be accurate, and is very convenient, although it cannot be used in any irregular channel nor in a channel of shallow section. In the latter case the screen can scarcely be made to show the average velocity in the stream, because it must in all cases be kept some distance above the bottom of the latter, and hence it is not properly affected by the bottom velocity, the screen thus moving at a faster rate than it should.

On account of the small natural head available a second turbine has been installed, to which the water is supplied by a centrifugal pump, and in connection with this there is a long steel channel about 3 feet wide, 6 feet high, and about 55 feet long, supported near the roof by means of steel columns.



Hydraulic Laboratory.

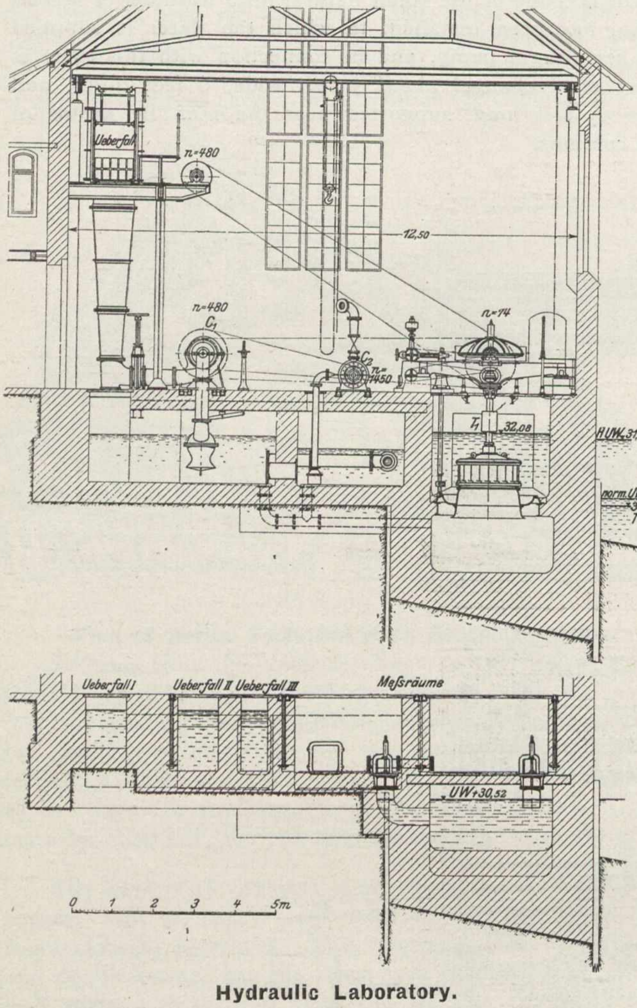
T_1 40 horse-power Voith turbine, C_1 Gehauer pump, M_1 electric motor, T_2 Voith turbine for 20-foot head, C_2 Weise and Monski pump, C_3 and M_3 Jaeger six-stage pump and motor. Measuring channels below the floor are shown. Dimensions are in meters.

Water is supplied to this channel by a centrifugal pump built by Gebauer, and having a capacity of nearly 9 cubic feet per second against about 24 feet head. The water flows down the channel, and after passing over a weir, where it is measured, is delivered to a Voith spiral turbine of the full capacity of the pump.

The laboratory further contains a Weise and Monski four-stage pump for 33 feet head and about 0.7 cubic feet per second; a six-stage Jaeger pump for 650 feet head; various motors for driving the pumps; three fairly large measuring canals under the floor; a large vessel for pressure work, and various other devices for measuring jets and determining the resistance of pipes, etc.

Every facility is offered here for reliable research work, and the laboratory is rather crowded. Commercial turbines are also tested here, and up to the present time fifteen have been tried; in such cases the working head, the speed and the discharge are all automatically recorded simultaneously on one instrument.

The apparatus for this laboratory cost about $23,000, exclusive of the channels, etc., made in concrete under the floor.



Hydraulic Laboratory.

This brief description shows that this great school is well worthy of careful study, and indicates that the laboratories present exceptional opportunities for research work. Good advantage has been taken of the facilities offered, and the institution well deserves the prominent position it now occupies amongst the leading Technical Schools of the world.

BONDING OF NEW AND OLD CONCRETE

The statement is advanced that bonding new and old concrete can be accomplished in the following manner: Clean the surface of the old concrete with clear water and a stiff broom. Apply a mixture of one part of hydrochloric acid and three parts of water with a brush, making several applications one after the other. Then scrub the surface with clean water and a stiff brush until all the acid is washed away and the surface is perfectly clean and free from loose particles. While it is still wet apply the fresh concrete, and keep the new concrete damp for at least a week, being careful not to allow it to become dry at any time.

PROBLEMS IN APPLIED STATICS.

T. R. Loudon, B.A.Sc.

This series of problems began in the issue for the week, October 22nd, 1909. It is assumed that the reader either has an elementary knowledge of the subject of Statics, or is in a position to read some text on such theory.

For the forces acting at the point BPLG (Statical Diagram, Fig. 75):—

$$\Sigma Y = Y_{BP} + Y_{PL} + Y_{LG} + Y_{GB} = 0.$$

$$0 - \frac{8,000}{\sqrt{3}} \cdot \frac{\sqrt{3}}{2} + LG \cdot \frac{\sqrt{3}}{2} + 0 = 0.$$

$$LG = \frac{8,000}{\sqrt{3}}.$$

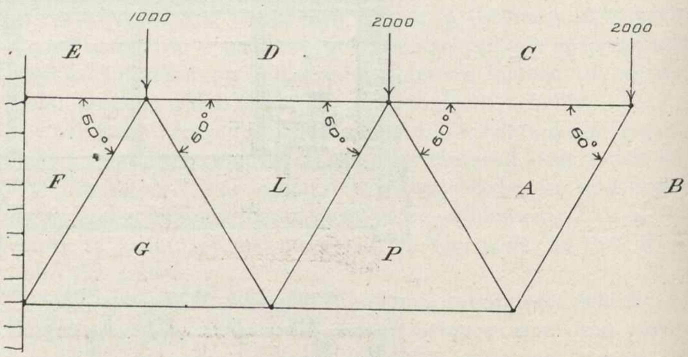


Fig. 67.

From this positive result it is seen that Y_{LG} is positive. LG is, therefore, a tensile force; i.e., the member

LG is in tension $\frac{8,000}{\sqrt{3}}$ pounds.

For the same point:—

$$\Sigma X = X_{BP} + X_{PL} + X_{LG} + X_{GB} = 0.$$

$$-\frac{4,000}{\sqrt{3}} - \frac{8,000}{\sqrt{3}} \cdot \frac{1}{2} - \frac{8,000}{\sqrt{3}} \cdot \frac{1}{2} + GB = 0.$$

$$GB = \frac{12,000}{\sqrt{3}}.$$

The X_{GB} is evidently positive. GB is seen to be a compressive force. The member GB is, therefore, in compression $\frac{12,000}{\sqrt{3}}$ pounds.

Considering the point GLDEF (Statical Diagram, Fig. 77):—

$$\Sigma Y = Y_{GL} + Y_{LD} + Y_{DE} + Y_{EF} + Y_{FG} = 0.$$

$$-\frac{8,000}{\sqrt{3}} \cdot \frac{\sqrt{3}}{2} + 0 - 1,000 + 0 + FG \cdot \frac{\sqrt{3}}{2} = 0.$$

$$FG = \frac{10,000}{\sqrt{3}}.$$

The Y_{FG} being positive (from the positive result), FG must be a compressive force; i.e., the member FG is in compression $\frac{10,000}{\sqrt{3}}$ pounds.

For the same point:—

$$\Sigma X = X_{GL} + X_{LD} + X_{DE} + X_{EF} + X_{FG} = 0.$$

$$\frac{8,000}{\sqrt{3}} \cdot \frac{1}{2} + \frac{8,000}{\sqrt{3}} + 0 + EF + \frac{10,000}{\sqrt{3}} \cdot \frac{1}{2} = 0.$$

$$EF = -\frac{17,000}{\sqrt{3}}.$$

The negative result shows that X_{EF} is negative. In accordance with this, EF is a tensile force. The member EF is, therefore, in tension $\frac{17,000}{\sqrt{3}}$ pounds.

It is seen that these results check those found by graphical means. It must be recognized, however, that the so-called graphical solutions taken up so far in these pages have not been entirely graphical. Instead of constructing the diagrams and finding the magnitudes of the forces by scaling the lengths of the lines composing the Vector Polygon, trigonometrical means have been used to get at these quantities. The solutions have, therefore, been partly analytical. The point of the discussion is that had purely graphical means been employed there would have been found an error in the magnitudes of the forces as compared to the values obtained analytically, but this error is so small that in practice it does not amount to anything. Analytical results are, of course, perfectly accurate.

If a set of forces is in equilibrium, the algebraic sum of the moments of the forces about any point is equal to zero.

Fig. 80 represents diagrammatically the method of arranging a system of levers in a weighing scale. Of

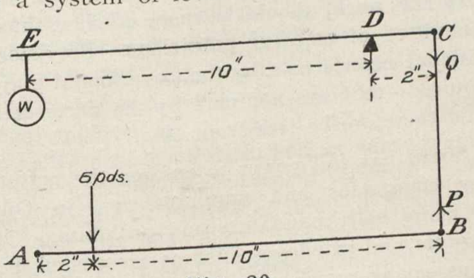


Fig. 80.

course, there are certain constructional details which cannot be represented in such a figure, but nevertheless this problem illustrates the principle involved in all weighing scales and machines for testing the strength of materials.

AB and EC are two levers, the former being hinged at A and the latter resting on a knife edge D. The vertical rod BC is connected to these two levers at B and C by pin joints to allow of free motion of the system.

A force of six pounds is exerted on the lever AB at a distance of two inches from the hinge A. What is the magnitude of the weight W placed on the upper lever at E such that the whole system is in equilibrium?

Consider the lever AB. It is acted upon by three forces; the vertical force of six pounds, an unknown vertical force P at B, and the reaction at the hinge A. These forces are in equilibrium; therefore, if moments be taken about any point, $\Sigma M = 0$.

Take moments about the point A.

$\Sigma M = (\text{reaction at } A \times \text{zero}) + 6 \times 2 + P \times 12 = 0 \ldots\ldots\ldots (1.)$

Since we do not know whether P acts upward or downward, the moment of P is assumed positive.

$$P \times 12 = -12.$$
$$P = -1.$$

This negative result shows that the moment of P about A is negative; i.e., P acts upward at B as indicated by the arrowhead, and is of magnitude one pound.

The rod BC exerts a tensile force at B. It must, therefore, exert an equal and opposite tensile force Q at its other extremity C; i.e., at C there is a vertical force of one pound acting downward as indicated by the arrowhead.

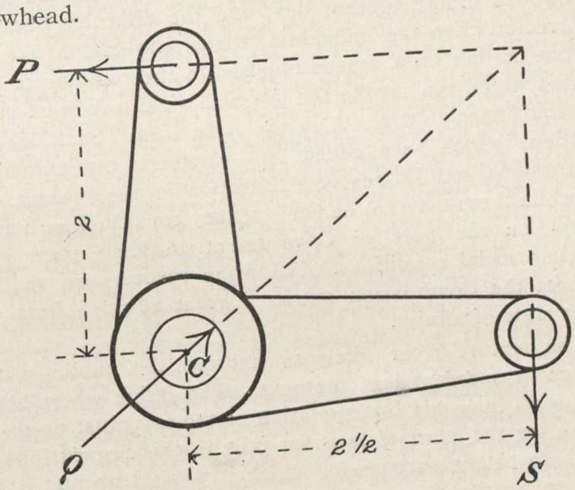


Fig. 81.

Consider the lever EC. It is acted upon by three forces in equilibrium, viz., the force W acting at E, the reaction of the knife edge at D, and the known vertical force acting at C. For this set of forces, ΣM about any point equals zero.

Take moments about D:—

$\Sigma M = Q \times 2 + (\text{reaction at } D \times \text{zero}) + W \times 10 = 0 \ldots\ldots (2.)$

Putting in the known value of $Q = 1$, we get:—

$$W \times 10 = -2.$$
$$W = -1/5.$$

That is, W is a weight of 1/5 pound, and acts in such a manner as to give a negative moment about D. W, therefore, acts downward.

The reader may question why the moments of P and W in equations (1) and (2) were written positive when his experience would most likely say that both these quantities should be negative in compliance with the convention of positive and negative moments. It must be kept in mind, however, that although experience says that P must act upward and W downward, thereby giving negative moments, it is dangerous practice to assume these self-evident facts in the first place. It is generally safer to assume these forces totally unknown and then by the reasoning of the problem deduce how they act. The moments of unknown forces are, of course, assumed positive, just as an unknown quantity in an ordinary algebraic equation is assumed positive.

Fig. 81 represents an ordinary bell crank.

If a force P of 100 pounds be exerted at the joint of the upper arm as indicated, what force S must be exerted at the joint of the other arm in order to preserve equilibrium.

GOVERNMENT BY COMMISSION—THE ONTARIO RAILWAY AND MUNICIPAL BOARD.

J. E. Parsons, B.A.*

The great arbiter as between citizen and citizen has for ages back been the law court, and in the days when the private citizen disputed with his neighbour the law court was a sufficient arbiter and an efficient means of redress for the majority of grievances. But conditions have changed and the court which would have been efficient then is efficient now in theory, but often only in theory. The court that was able to enforce British fair play between citizens of equal standing and importance in the community often lacks the foresight or jurisdiction requisite in dealing with the huge corporations of the present day, and the difficulty becomes still greater when the individual citizen who can invoke the law, but the law only, stands opposed to the combine or corporation which can invoke the law and wield unlimited influence and financial strength at the same time. Such are the conditions which have called into existence the numerous Commissions and Boards of Arbitration of the present day and, while these may not be perfect, they constitute an honest attempt on the part of Government to keep pace with changing social conditions. In some respects we venture to assert the Commission marks a great advance from the former state of affairs.

The feature most likely to impress the public is the increase in speed and promptness. The judge whose reputation rests upon his interpretation of the law must needs be careful, for the court of law that fails in this regard fails in the all important purpose for which it was set up and which alone can justify the court's existence. But the Commission rests upon a different basis; correct interpretation of the law is a desirable but secondary consideration with it, and the mass of decisions and rules of court are largely thrown aside. The Commission is not a court to interpret laws but a method of government; it is instituted for the purpose of disposing of certain work, and when that work is handed over to it, it should be able to despatch business with equal efficiency and greater despatch than formerly was attained in the courts. If it expedites the despatch of business in its own particular line it succeeds in justifying its existence even if it should occasionally err upon a question of law.

Then, too, it simplifies procedure. All things are simple after we have learned to do them, but even the experienced solicitor is often at a loss what process to invoke and what remedy to follow in the tribunals open before him. In the Commission all work in a particular line is classed together. It follows to some extent the principle of division of labour and the responsibility for a particular class of work is centralized at a point, i.e., the Board of Commissioners. A great step forward is attained when the average citizen can appear before a tribunal and state his case in common terms without fear of being thwarted by technicalities, which are to him alike meaningless and vexatious; often ready to entrap him and always present to burden him with fear.

But the greatest improvement of all in our opinion seems to be the utilization of expert knowledge. The Commission makes it possible to employ expert business men for work which none but experts in that line can be fully qualified to discharge. Our legislators with all due respect are amateurs. They are men for the most part without any particular training or education in governmental lines, while from them is expected proper fulfilment of the most important functions in the country. That democratic institutions are a blessing no Britisher will deny, but surely there should be some means of procuring for parliament skilled men able and willing to see and appreciate the manner in which laws must be enforced. We venture to assert that under existing conditions the average member of the legislature knows little and cares little as to the enforcement of the laws he has made. He can readily avoid responsibility by hiding behind the crowd. The like remark applies equally if not more strongly to the men who sent him there. The people muster (sometimes) to a public duty, and casting aside party prejudice insist upon some measure which they see is for the public good; but once the desired Act is placed upon the Statute books they drop the work, and returning to their daily rounds expect enforcement from some source they know not where.

Under the old regime the expert lawyers and engineers are outside of the courts and mostly outside of parliament; they formed a reserve to be used in attacking the legislation enacted but were not available for constructive work.

The Ontario Railway and Municipal Board consists of three members appointed by the Lieutenant-Governor, and replaces the former Railway Committee. The Railway Committee was necessarily chosen from the Legislature and, with the choice restricted, the abilities of the members and the possibilities of the Department suffered commensurately. The Railway Board is outside the political arena; further, with the world to choose from, we have the chance for larger men and have secured them.

In the Dominion Board we have secured an aggressive and practical judge as chairman. He is an expert who appreciates the responsibility that comes with power and does not shirk it. His legal experience is a great gain, especially when joined as it is with a colleague who is in truth a railway expert. The Ontario Board benefits similarly. The provision that no member shall hold stocks or bonds of, nor be otherwise personally interested in any particular railway company is a safeguard of impartiality. Certainly a board of experts such as these, bound to devote their entire time to that especial work, should be more efficient than the erstwhile committee of amateur politicians. Provision is made that additional experts paid by the government may be asked for if required—they are not paid by the party calling them and should therefore be free from bias.

The board has full power to enforce the performance of duties by companies and municipalities, in Ontario, its authority being both mandatory and prohibitory; it has full rights, powers and privileges such as are vested in the High Court, thus saving many wears delays in appealing to different tribunals; it may take the initiative of its own accord, whereas the courts acted only when appealed to and has certain powers conferred upon it exclusively by statute. The power to informally make, amend or annul its own orders is surely safely conferred upon a tribunal worthy of public confidence and gives great elasticity to the existing powers, and dispenses with otherwise unavoidable "red-tape" to the great assurance of laymen.

On our American railways possibly the greatest question of all is the safeguarding of life; the board may make regulations as to the means of passing from car to car, and of coupling cars, and for the protection and shelter of employees when on duty; the installation of guards and fenders is provided for as well as signals and other devices such as are satisfactory to the board. The jurisdiction as to ordering of protection for crossings and enforcing action by municipalities is much more simple and adaptable than any process of court, especially when accompanied as it is with full power to enter upon the premises of the company or municipality to

* Barrister-at-Law, 18 Toronto Street, Toronto.

enforce its rules by force or otherwise; the right of entry need not be often exercised but it is a valuable remedy in case of non-compliance with orders made.

The multiplicity of appeals is done away with. Appeals can be made to the Court of Appeal for Ontario but not as a matter of right; permission must be first obtained from the said Court of Appeal. Appeals to the Privy Council are confined to cases where the sum involved amounts to $4,000 and some other instances where public rights are in question.

SOCIETY NOTES.

Engineers' Club of Toronto

At the meeting of the Engineers' Club of Toronto, held on Thursday evening, November 18th, an interesting paper, dealing at some length with the practical side of producer gas plants, was read by Mr. Michael Chapman, A.M.I.E.E., of Toronto. Through the courtesy of Mr. Chapman, we hope to print his paper in full in our next issue.

Toronto University Engineering Society

At a meeting of the above society, to be held on Wednesday afternoon, December 1st, at 4 o'clock, Mr. T. Aird Murray, consulting engineer, Toronto, will deliver an address on "Modern Aspects of the Sewage Disposal Question."

Toronto University Engineering Society

At a meeting of the Civil and Architectural Section of the Engineering Society, University of Toronto, held on Wednesday afternoon, Nov. 17th, Mr. A. C. D. Blanchard, A. M. Can. Soc. of C. E., assistant city engineer of Toronto, delivered an interesting address on the "Design and Construction of an Intercepting Sewer," accompanied by views, showing progress work on the high level intercepting sewer in Toronto. After some reference to the topography of the city, Mr. Blanchard dealt with sewer design in general, outlining the scheme which has been adopted in Toronto. Speaking of the design of the interceptor, particular attention was paid to the calculations involved in estimating the probable population of Toronto and the probable amount of sewage that would be collected in 1930, that date being set as a reasonable time limit for present provisions. The difficulties encountered in connection with surveys were pointed out, and after a few words relating to specifications, the methods employed in the construction of the intercepting sewer at Toronto were described at some length.

Over two hundred were present, among them being Dean Galbraith of the Faculty of Applied Science, Toronto University, and Dr. Oldwright, who took part in the discussion. Mr. J. C. Murton, presided.

Toronto Section, American Institute of Electrical Engineers

The November meeting of the Toronto section of the American Institute of Electrical Engineers was held on Friday evening, the 19th inst., in the rooms of the Engineers' Club. Papers on the "Various Aspects of the Tungsten Lamp" and "The Tungsten Lamp for Street Lighting," were presented by Mr. G. S. Merrill and Mr. J. S. Hoit, both of the National Electric Lamp Association, Cleveland, Ohio.

Mr. H. W. Price, B.A.Sc., presided, and among those taking part in the discussion were Mr. K. L. Aitken, city electrical engineer, Mr. W. H. Eisenbeis of the Canadian Westinghouse Co., Mr. E. Richards, B.A.Sc., and Mr. Sweeny.

Prior to the meeting, an informal luncheon was served at the St. Charles Hotel.

American Society of Mechanical Engineers

The thirtieth annual meeting of the Society will be held in the Engineering Societies Building, 29 West 39th Street, New York, December 7 to 10. The entire social entertainment will be in charge of the members resident in and about New York, under the immediate direction of a local committee appointed by them, of which Mr. William D. Hoxie, is chairman. For Wednesday afternoon, December 8th, an excursion is planned which members and guests will be asked to attend in a body, and during the balance of the time there will be opportunities for smaller parties to visit places of interest. In the evening, there will be a lecture for members and guests upon the subject of Agricultural Machinery.

The professional papers assigned to the meeting are as follows: Tests on a Venturi Meter for Boiler Feed, Chas. M. Allen; The Pitot Tube as a Steam Meter, Geo. F. Gebhardt; Efficiency Tests of Steam Nozzles, F. H. Sibley and T. S. Kemble; An Electric Gas Meter, C. C. Thomas; Tan Bark as a Boiler Fuel, David M. Meyers; Cooling Towers for Steam and Gas Power Plants, J. R. Bibbins; Some Studies in Rolling Mill Engines, W. P. Caine; An Experience with Leaky Vertical Fire Tube Boilers and the Best Form of Longitudinal Joint for Boilers, F. W. Dean; Testing Suction Gas Producers with a Koerting Ejector, C. M. Garland and A. P. Kratz; Bituminous Gas Poducer, J. R. Bibbins; The Bucyrus Locomotive Pile Driver, Walter Ferris; Line-Shaft Efficiency, Mechanical and Economic, Henry Hess; Pump Valves and Valve Areas and A Report on Cast-iron Test Bars, A. F. Nagle.

In addition to the above papers there will be several valuable reports submitted by committees of the Gas Power Section.

Engineering Society, University of New Brunswick.

The annual dinner of the above society was held this week at Windsor Hall, Fredericton, N.B., the vice-president, Mr. J. B. Alexander, presided, and about eighty members of the society were present. It was probably the most successful function of its kind in the history of the society. After a seven course dinner had been enjoyed, the usual toast list was taken up and the various toasts were replied to by the following speakers: Chancellor Jones, Professors Stone, Stephens, Cartmel, Miller and Burchill, of the Engineering Department.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Copies of these orders may be secured from the Canadian Engineer for a small fee.

8584—November 5—Approving by-law of the Temiscouta Railway Company authorizing F. X. Belanger, general freight and passenger agent, to prepare and issue tariffs of tolls to be charged for all freight and passenger traffic carried by said railway.

8585—November 4—Approving plan showing proposed overhead crossing at mileage 13.5 in the mountain section of the C.P.R. in Province of British Columbia.

8586—November 4—Approving Standard Freight Tariff C.R.C. No. 5 G.T.P. Ry., applying between G.T.P. Ry. stations in Province Saskatchewan and Province Alberta.

8587—November 5—Approving and sanctioning location of the C.N.O. Ry. Co.'s. line of railway through unsurveyed territory in Sudbury Mining Division, 120 miles from Sudbury Junction, Ont.

8588—November 4—Directing conditions under which the Grand Valley Railway Company may place double tracking of its line of railway along Colborne Street, Brantford, and regrade revision at intersection of Colborne and Market Streets in said city.

(Continued on page 604).

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal President, George A. Mountain; Secretary, Professor C. H. McLeod.

QUEBEC BRANCH—
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—
96 King Street West, Toronto. Chairman, J. G. G. Kerry; Secretary, E. A. James, 62 Church Street, Toronto. Meet last Thursday of the month.

MANITOBA BRANCH—
Chairman, H. N. Ruttan; Secretary, E. Brydone Jack. Meets first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo. H. Webster; Secretary, H. K. Dutcher, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University College.

OTTAWA BRANCH—
Chairman, C. R. Coultee, Box 560, Ottawa; S. J. Chapleau, Box 203.

MUNICIPAL ASSOCIATIONS.

ONTARIO MUNICIPAL ASSOCIATION.—President, Mr. George Geddes, Mayor, St. Thomas, Ont.; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

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

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

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Hopkins, Saskatoon; Secretary, Mr. J. Kelso Hunter, City Clerk, Regina, Sask.

CANADIAN TECHNICAL SOCIETIES.

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

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

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Vice-President, Gustave Kahn, Toronto; Secretary-Treasurer, Alfred E. Uren, 62 Church Street, Toronto.

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

CANADIAN FORESTRY ASSOCIATION.—President, Thomas Southworth; Secretary-Treasurer, King Radiator Company, Toronto; Secretary, James Lawler, 11 Queen's Park, Toronto.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, Dr. W. Doan, Harrietsville, Ont.; Secretary, F. Page Wilson, Toronto.

CANADIAN MINING INSTITUTE. — Windsor Hotel, Montreal. President, W. G. Miller, Toronto; Secretary, H. Mortimer-Lamb, Montreal.

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

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 157 Bay Street, Toronto.

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

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

DOMINION LAND SURVEYORS.—Ottawa, Ont. Secretary, T. Nash.

EDMONTON ENGINEERING SOCIETY. — President, Dr. Martin Murphy; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

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

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

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

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, S. Fenn; Secretary, J. Lorne Allan, 15 Victoria Road, 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.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, A. F. Dunlop, R.C.A., Montreal, Que., Hon. Secretary, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

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.

AMERICAN TECHNICAL SOCIETIES.

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

AMERICAN MINING CONGRESS. — President, J. H. Richards; Secretary, James F. Callbreath, Jr., Denver, Colorado.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—President, John P. Canty, Boston & Maine Railway, Fitchburg, Mass.; Secretary, T. F. Patterson, Boston & Maine Railway, Concord, N.H.

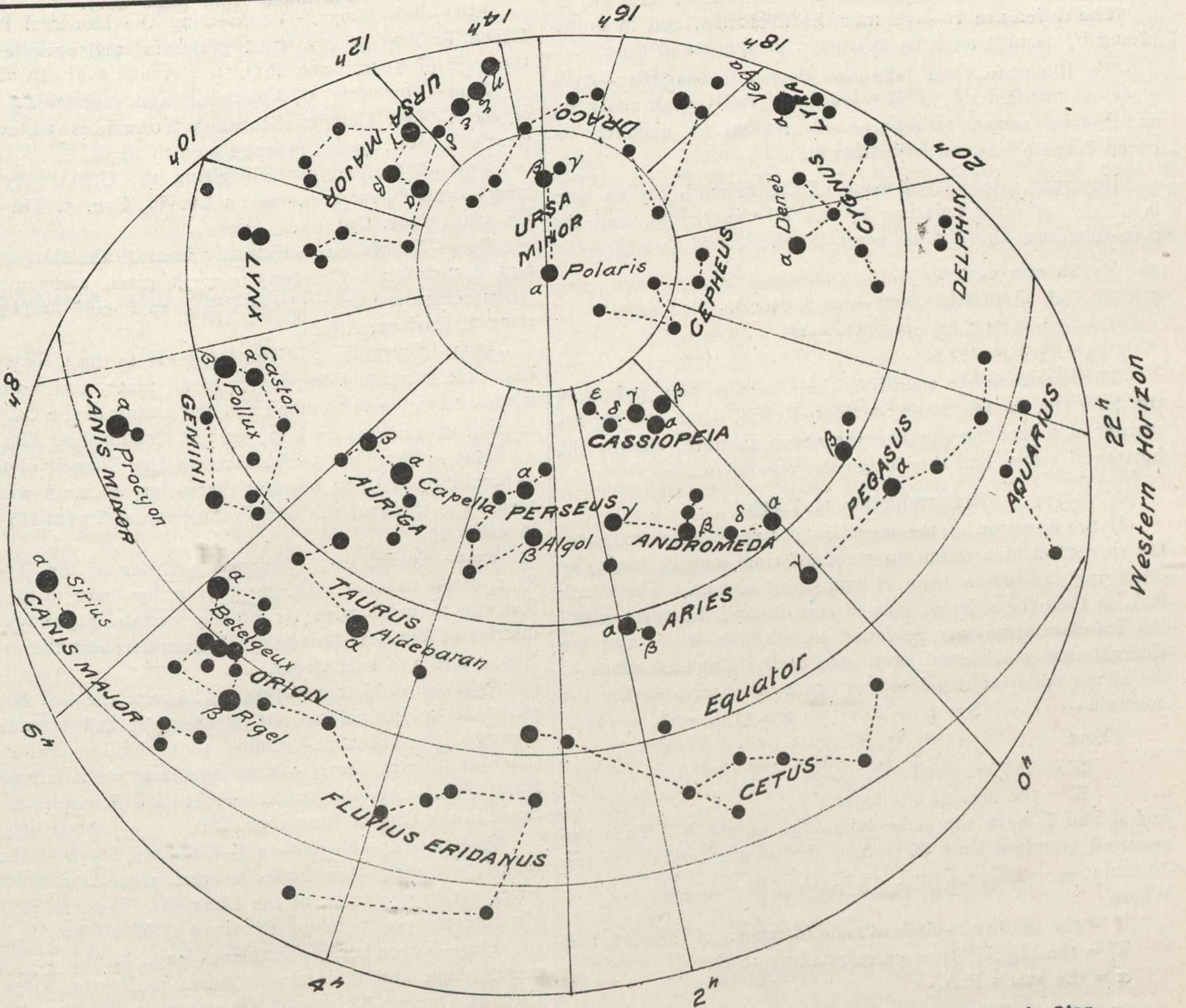
AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—President, Wm. McNab, Principal Assistant Engineer, G.T.R., Montreal, Que.; Secretary, E. H. Fritch, 962-3 Monadnock Block, Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Secretary, C. W. Hunt, 220 West 57th Street, New York, N.Y. First and third Wednesday, except July and August, at New York.

AMERICAN SOCIETY OF ENGINEERING-CONTRACTORS. — President, George W. Jackson, contractor, Chicago; Secretary, Daniel J. Hauer, Park Row Building, New York.

(Continued on page 50.)

ASTRONOMICAL PAGE



STAR MAP, SHOWING THE PRINCIPAL STARS, VISIBLE AT 10 P.M., DECEMBER 1st, IN LATITUDE 45° N.

L. B. Stewart, D.T.S.

The table below gives the apparent places of the brightest of these stars for December 15th at transit across the meridian of 5h W. of Greenwich.

Star	Mag.	R. A. h. m. s.	Decl. ° ′ ″
α Andromedœ	2.1	0 03 42.9	+ 28 35 40
β Cassiop.	2.4	0 04 21.0	+ 58 39 23
α Cassiop.	2.5	0 35 22.7	+ 56 02 48
γ Cassiop.	2.3	0 51 15.3	+ 60 13 57
α Ursæ Min. (Polaris)	2.1	1 27 07.7	+ 88 49 46
α Arietis	2.2	2 02 05.4	+ 23 02 17
α Tauri (Aldebaran)	1.1	4 30 45.4	+ 16 19 47
α Aurigæ (Capella)	0.2	5 10 02.6	+ 45 54 30
β Orioris (Rigel)	0.3	5 10 13.0	− 8 18 16
α Orionis (Betelguex)	1.2	5 50 18.1	+ 7 23 31
β Ursæ Maj.	2.4	10 56 24.5	+ 56 51 46
α Ursæ Maj.	2.0	10 58 10.5	+ 62 14 04
γ Ursæ Maj.	2.5	11 49 05.2	+ 54 11 34
δ Ursæ Maj.	3.4	12 10 57.6	+ 57 31 48
ε Ursæ Maj.	1.8	12 50 03.0	+ 56 26 44
ζ Ursæ Maj.	2.1	13 20 16.7	+ 55 23 34
η Ursæ Maj.	1.9	13 43 58.0	+ 49 45 36
α Cygni	1.3	20 38 19.6	+ 44 57 34
β Pegasi	2.4	22 59 23.2	+ 27 35 42
α Pegasi	2.6	23 00 15.2	+ 14 43 13

Determination of Azimuth by the Pole Star.

The following table gives the azimuth of Polaris on December 1st, 1909, for places in longitude 5h (= 75° W.) and at certain standard times T:

T	Sid. Time	Lat. = 44°		Lat. = 48°		Lat. = 52°	
		A	a	A	a	A	a
P.M. h. m.	h. m. s.	° ′ ″	″	° ′ ″	″	° ′ ″	″
8 00	0 40 56.5	0 19 55	−25	0 21 29	−27	0 23 25	−29
8 30	1 11 01.4	0 06 59	−25	0 07 32	−27	0 08 13	−30
9 00	1 41 06.3	359 53 56	−26	359 53 27	−27	359 52 52	−30
9 30	2 11 11.2	359 40 59	−25	359 39 30	−27	359 37 38	−29
10 00	2 41 16.3	359 28 23	−24	359 25 55	−26	359 22 50	−28
10 30	3 11 21.2	359 16 21	−23	359 12 57	−25	359 08 43	−27
11 00	3 41 26.1	359 05 07	−21	359 00 51	−23	358 55 32	−25
11 30	4 11 31.1	358 54 52	−19	358 49 50	−21	358 43 32	−23
12 00	4 41 36.0	358 45 47	−17	358 40 04	−18	358 32 56	−20

In this table azimuths are reckoned from the N. in the direction E.S.W. The quantity a is the error in the azimuth resulting from an error of 1m. in the time. It will serve to show the best time to observe if the watch correction is not well determined. The azimuth for any other latitude may readily be found by interpolation.

The standard time corresponding to any azimuth given in the table for a place whose longtitude differs from 5h, and for some other date, may be found by the formula:—

$$T' = T + (L - 5h)\ (1 - 0s.16) - d \times (3m\ 55s.9).$$

Where

T′ = the required time.

CUT HERE FOR REFERENCE.

T = the time for December 1st.

L = the longitude.

d = number of days elapsed since December 1st.

The difference L — 5h must be algebraic, and in multiplying by 0s.16 it must be expressed in minutes of time.

To illustrate this, take the following example:—At a place in latitude 49° 20′ N., longitude 80° (= 5h 20m) W, an observer wishes to take an observation for azimuth between 8 and 9 p.m. on December 8th.

Here the interpolated value of the azimuth for 8h 30m is 0° 07′ 45″, interpolating by second differences, and the corresponding time for the given longitude and date is:—

8h 30m 00s
+ 19 56.8 (= 20m — 20 × 0s.16)
— 27 31.3 (= 3m 55s.9 × 7)
=8h 22m 25s.5.

To determine the meridian the observer then points to the pole star at the above computed time, after setting his vernier at a reading equal to the above azimuth, clamps the horizontal circle, and then turns the vernier to zero.

Determination of Time.

If the direction of the meridian is known approximately, the correction of a watch on standard time may be found by observing the watch time of transit of a star. The star's R.A. is then the sidereal time of transit, and the corresponding standard time may be found as follows:—First find the sidereal time corresponding to one of the standard times of the above table for the date and place of observation by the formula: $S = S' + d \times (3m\ 56s.555) — (L — 5h)$.

Where

S = the required sid. time.

S′ = the tabular sid. time,

and d and L have the same meanings as above. Then the required standard time of transit of the star follows by the formula:— $T = T' + (\quad — S)\ (1 — 0s.16)$.

Where

T = the required standard time of transit of the star, and

T′ = the tabular time corresponding to S′.

α = the star's R.A.

To illustrate the use of these formulae, let us assume that the meridian transit of the star α Arietis is observed at the watch time 9h. 13m. 44.6s. at the same place and date as above; to find its correction on standard time.

		h.	m.	s.
Sidereal time, 9h. 00m. (table)	=	1	41	06.3
7 × (3m. 56s. 555)	=		27	35.9
		2	08	42.2
Difference of longitude	=		20	00
S	=	1	48	42.2
R.A. of star	=	2	02	05.4
α — S	=		13	23.2
13.2 × 0s.16	=			2.1
Equivalent mean time interval	=		13	21.1
T′	=	9	00	00
T	=	9	13	21.1
Watch	=	9	13	44.6
Watch fast	=			23.5

The methods described above do not take account of changes in the star places, but with ordinary field instruments and for short periods of time these are negligible.

RAILWAY ORDERS.

(Continued from page 601).

8589—November 4—Authorizing the Montreal Park and Island Railway to construct, maintain, and operate spur in the town of Rosemount, P.Q.

8590—November 5—Approving and sanctioning location of the C.N.R. Company through Townships 5-2 and R. 6 west 2nd Mer., Sask., mileage 0.00 to 16.38.

8591—November 4—Authorizing the C.N.O. Ry to construct bridge over a ravine on Lot 30, Con. 5, Tp. Whitby, Co. Ont., Prov. Ont.

8592—November 4—Granting leave to the Calgary Power and Transmission Company to erect, place, and maintain its wires across the track of the Canadian Pacific Railway Company at Exshaw, Alta.

8593—November 4—Granting leave to the Calgary Power and Transmission Company to erect, place, and maintain its wires across the telephone lines and siding of the C.P.R. Co., leading into loder lime kiln, west of Kananaskis, Alta.

8594—November 5—Authorizing the Council of the City of Lachine, P.Q., to lay and thereafter maintain water pipe across the track of the G.T.P. Railway at Twentieth Avenue in said city.

8595—November 5—Amending Order of the Board No. 8314, dated October 12th, 1909, granting leave to the G.T.P. Railway to cross with its railway certain highways in the district of West Saskatchewan by striking out the crossings Nos. 1 and 3 in said Order.

8596—November 9—Granting leave to the G.T.R. to construct an additional railway track upon and across Romeo Street, City of Stratford, Ont.

8597—November 13—Granting leave to the Grand Valley Railway to cross the tracks of the G.T.R. with its second track in the City of Brantford, Ont.

8598 to 8603—November 4—Granting leave to the Manitoba Government Telephones to erect, place, and maintain its wires across the track of the Canadian Northern Railway at six different points in the Province of Manitoba.

8604—November 9—Granting leave to the C.N.Q.R. to erect, place, and maintain its wires under the wires of the City of Quebec Telephone Company at Quebec Aqueduct, Parish of St. Sauveur, Co. Quebec, P.Q.

8605 to 8609—November 4—Granting leave to the Consolidated Telephone Company to erect, place, and maintain its wires across the tracks of the C.P.R. at five points in the Township of Caledon, Province of Ontario.

8610—November 4—Granting leave to the Bethesda and Stouffville Telephone Company, Ltd., to erect, place, and maintain its wires across the track of the C.N.O. Ry., Tp. Markham, Co. York, Ont.

8611—November 4—Granting leave to the Mt. Albert Tel. Company to erect, place, and maintain its wires across the track of the C.N.O. Ry at first crossing north of its station at Mt. Albert, Ont.

8612—November 5—Granting leave to the Bell Telephone Company to erect, place and maintain its wires across the track of the G.T.R. at P.C. ¾ mile east of Paris Junction, Ont.

8613—November 4—Authorizing the Corporation of the town of Berlin, Ont., to lay and thereafter maintain a sewer on Wilhelm Street across the track of the Elmira Branch of the G.T.R. in said town.

8614—November 10—Authorizing the C.P.R. to construct a station building (Standard No. 5) at Wilcox, Sask.

8615—November 5—Granting leave to the C.N.Q. Ry. to erect, place, and maintain its telegraph wires under the wires of the C.P.R. at Deschambault, Co. Portneuf, P.Q.

RAILWAY EARNINGS AND STOCK QUOTATIONS

NAME OF COMPANY	Mileage Operated	Capital in Thousands	Par Value	EARNINGS Week of Nov. 21 — 1909	1908	STOCK QUOTATIONS — TORONTO — Price Nov. 19 '08	Price Nov. 11 '09	Price Nov. 18 '09	Sales Week End'd Nov18	MONTREAL — Price Nov. 19 '08	Price Nov. 11 '09	Price Nov. 18 '09	Sale Week End'd Nov18
Canadian Pacific Railway	8,920.6	$150,000	$100	$1,993,000	1,651,000		184	177	465	178¼ 178	185 183	177½ 176¾	836
Canadian Northern Railway	2,986.9	....	....	357,900	257,600	....	....	....	....	....	....	....	....
*Grand Trunk Railway	3,536	226,000	100	885,456	846,743	....	*1st. pref. 103½, 3rd pref. 50½, ordinary 20½					....	....
T. & N. O.	334	(Gov. Road)	....	....	....	....	....	....	....	....	....	....	....
Montreal Street Railway	138.3	18,000	100	75,244	69,396	....	....	....	....	197 196½	208 206	206½ 206	176
Toronto Street Railway	114	8,000	100	76,482	66,786	....	123½ 123	123	110	107½ 106⅜	123 122¾	124½	80
Winnipeg Electric	70	6,000	100	....	....	170	184 183½	....	80	180	183	....	....

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

EARNINGS AND EXPENSES OF CANADIAN RAILWAYS.

	Total Earnings.	Operating Expenses.	Ratio of Exp. to % of Earnings.
Monc. St. Ry., Oct., '09	$ 354,006	$ 174,734	49.35
T. & N.O., Sept., '09	157,777	90,151	57.14
Cape Breton Elec., Sept., '09	22,000	11,410	51.86
G.T. of Can., Sept. '09	3,060,308	2,108,223	68.88
G.T. West., Sept., '09	521,090	364,763	70.00
Can. Atlantic, Sept., '09	184,443	160,223	84.57
Can. Nor. Ry., Oct., '09	1,384,200	903,500	65.26

ONTARIO ELECTRIC RAILWAYS.

From week to week we propose to give, on our page devoted to transportation interests, particulars of the equipment, mileage, and other information regarding the railways of Canada, together with a list of the officials. This series of articles commenced in our issue of October 1st.

Previously Given:—

Brantford and Hamilton Railway.
Chatham, Wallaceburg and Erie Railway.
Cornwall Street Railway.
Guelph Radial Railway.
Galt, Preston and Hespeler Railway.
London St. Railway.
International Transit Co., Sault Ste. Marie.
Kingston, Portsmouth & Cataraqui Elec. Ry., Kingston
Toronto & York Radial Railway.
Windsor, Essex & Lake Shore Railway.
Ottawa Electric Railway.

SOUTH-WESTERN TRACTION COMPANY, LONDON, ONTARIO.

President, F. G. Rumball.
General Manager, Mr. S. W. Mower.

Kind of Road: Interurban.

Length of Road, in miles:
Single track, 28.5.
Total in single miles, 28.50.

Character of Service:
Car equipment, 12 passenger, 2 freight, 1 locomotive.
Number of motors, two 93a westinghouse.
Power of motors, 60 horse-power.
Method of controlling, 202 Westinghouse.
Method of braking, air Westinghouse, automatic.
Gauge of track, 4-8½.
Weight of rails, 60 lbs.

Power:
Alternating current, 3-phase.
Voltage of transmission, 10,000.
Trolley voltage, 600.
Frequency of transmission for A.C., 25.

Note.—Three sub-stations each containing two 250 K.W. rotary converters (Westinghouse); six 125 transformers.

NIAGARA, ST. CATHARINES AND TORONTO RAILWAY COMPANY.

President, Frederick Nicholls, Toronto.
Superintendent, W. R. Robertson, St. Catharines, Ont.
Master Mechanic, William Pay, St. Catharines, Ont.

Kind of Road: Interurban, suburban or street railway.

Length of Road, in miles:
Total in single miles, 50.

Character of Service:
Car equipment, 36; type, open, closed semi-convertible.
Number of motors, 4 per car; power of motors, 50 h.p.
Method of controlling, K and multiple unit.
Method of braking, air.
Gauge of track, 4 ft. 8½ inches.
Weight of rails, 80 lbs.

Power:
Direct current, D.C.
Voltage of transmission, 11,000 A.C.
Trolley voltage, 625.
Frequency of transmission for A.C., 66 C.
Number of phases, 3.

TORONTO STREET RAILWAY.

President, Mr. William Mackenzie.
Manager, Mr. R. J. Fleming.
Superintendent, Mr. J. Gunn.
Purchasing Agent, Mr. A. M. Grantham.
Chief Engineer, Mr. William B. Boyd.

Length of Road, in miles:
Single track, 2 miles.
Double track, 56 miles.
Total in single miles, 114.

Character of Service:
Car equipment, No. C.G.E., 80.
Number of motors, 4.
Power of motors, 40 horse-power.
Method of controlling, series—parallel C.G.E. type K controllers.
Method of braking, storage air and hand brake.
Gauge of tracks, 4.10⅞.
Weight of rails, 70 and 90 lbs.

Power:
Direct current, 600 volts.
Alternating current, 110, 220 and 440 volts.
Voltage of transmission, 12,000.
Trolley voltage, 600.
Frequency of transmission for A.C., 25.
Number of phases, 3.

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.

HALIFAX.—Tenders will be received until December 6th, for 3,000 feet of 2½-inch rubber hose, to stand a pressure of 300 lbs. per square inch on delivery, and 200 lbs. in ordinary fire service. A 3-year guarantee is required. Bids submitted some time ago, for the same material, on another basis, were returned. Mr. F. W. W. Doane is city engineer.

Quebec.

ARTHABASKA.—The secretary-treasurer of the council of the County of Arthabaska will receive up to Thursday, December 9th, tenders for the construction of a steel bridge on the Becancour River, between the municipalities of St. Louis of Blandford and the township of Stanfold. Louis Lavergne, secretary-treasurer.

HULL.—Tenders will be received until Monday, 6th December, 1909, for pumping equipment. R. W. Farley, City Engineer.

MONTREAL.—Tenders will be received up to Wednesday, December 1st, on 1,000 h.p. water tube boilers, 200 lbs. pressure for The Saraguay Electric & Water Co. Mr. Chas. Brandeis, C.E., Montreal.

MONTREAL.—Tenders will be invited immediately by the St. Louis Council, whose secretary is Mr. Vincent, for tunnelling St. Lawrence street at the C. P. R. tracks. Further particulars may be obtained from the secretary or from Mayor Turcot.

MONTREAL.—Tenders will be received until Monday, November 29th, for the erection of an addition to Montcalm School, St. Hubert Street. Marchand & Haskell, Architects, 164 St. James Street.

Ontario.

COBALT.—Tenders will be received until Monday, December 6th, for grading required in connection with the construction of tracks at Cobalt, Ont. Further particulars are given in our advertising pages. Temiskaming and Northern Ontario Railway, 25 Toronto Street, Toronto.

COBOURG.—Tenders will be received up to Monday, the 6th December, for an 8-inch vitrified tile drain, about 2,000 feet in length and from 6 to 14 feet in depth. D. H. Minaker, Town Clerk.

TORONTO.—Tenders will be received until Wednesday, December 1st, for the work of All Trades in connection with the building of a large stone church on Bloor street east for St. Paul's Parish. Architect, E. J. Lennox, 161 Bay Street.

TORONTO.—Tenders will be received until December 7th for annual supplies, including:—Cement, gravel, paving materials, lumber, pipe, bricks, etc. Further particulars are given in our advertising columns. Mr. Joseph Oliver, (Mayor), Chairman, Board of Control.

Manitoba.

WINNIPEG.—Tenders will be received up to Tuesday, November 30th, for supply of 1,000,000 feet B.M. lumber required by the city of Winnipeg. M. Peterson, Secretary Board of Control.

Alberta

CALGARY.—Tenders will be invited by this municipality for six additional new steel cars of the pay-as-you-enter type. They are to be five feet longer than the cars now in use, and will be equipped with air brakes. Exclusive of the motors, it is expected that they will cost approximately $25,000, f.o.b. Calgary, for early spring delivery. Mr. J. T. Child is the city engineer.

WETASKIWIN.—Tenders will probably be invited at an early date for well drilling which will be undertaken by this municipality.

British Columbia.

VICTORIA.—Tenders will be received by the Vancouver Island Power Co., Limited, for a supply approximately 600 of cedar telegraph poles up to December 1st. A. Richardson, Purchasing Department.

VANCOUVER.—Tenders will be received by the secretary of the North Vancouver Ferries, Limited, until December 1st, 1909, for the furnishing of all materials, supplies, labor, tools, etc., necessary to construct and complete a reinforced concrete dock in North Vancouver in accordance with the plans, specifications, etc., prepared by George S. Hanes, B.A.Sc. Office of Engineer for the North Vancouver City Ferries, Limited.

CONTRACTS AWARDED.

Quebec

SHERBROOKE.—The contract for the iron work on the new bridge over the Magog River has been awarded to McKinnon, Holmes & Co. at $21,700.

SHERBROOKE—The city of Sherbrooke recently undertook the replacement of all their wooden bridges with modern structures in steel and concrete. The first affected is known as the Saw Mill Bridge, consisting of two approach spans of 60 ft. and 75 ft. and one centre span of 168 ft. Plans were prepared for the sub-structure and the contract was let to a local contractor. Preliminary designs for the steel superstructure were also considered and it was decided to accept one having a concrete floor and of very substantial construction throughout. On receipt of tenders from several bridge companies, the contract was awarded to MacKinnon, Holmes & Company, Limited, who are now taking the work in hand to push the same to completion in the early spring. As an alternative to the bridge with concrete floor, tenders were requested for one with a creosoted wooden plank and block pavement, but on comparison of prices received it was considered advisable to make the additional outlay in order to have the entire structure of a most permanent nature. The prices were as follows:—

Name of Builder.	Bridges with Wooden floor.	Bridges with Concrete floor.
Phoenix Bridge Co., Montreal	....	$27,500.00
Jenks, Dresser Co., Sarnia	$23,500.00	25,000.00
Structural Steel Co., Montreal	19,450.00	23,100.00
MacKinnon, Holmes & Co., Sherbrooke	19,750.00	*21,700.00

*Accepted.

The plans were prepared by MacKinnon, Holmes & Co., Ltd., of Sherbrooke, Que.

Ontario.

ORILLIA.—The Canada Foundry Company, of Toronto, were recently awarded a contract by this municipality for supplying water mains required for extensions here at $34.20 per ton, f.o.b. Orillia.

OWEN SOUND.—The Owen Sound Iron Works Company have been given a contract by the Electric Light Department for the construction of a smoke-box, having an approximate weight of 5,339 pounds, at $263.95.

PETERBORO'.—Messrs. MacGregor and Reid will probably be awarded a contract amounting to $2,500 for plumbing, heating and tiling in connection with the new public library here.

TORONTO.—The Temiskaming & Northern Ontario Railway Commission has awarded contracts for the construction of sixty-two new freight cars. The Dominion Car & Foundry Co. of Montreal, submitted the lowest tender, and will build the cars. This new addition to the rolling stock will comprise fifty forty-ton standard box cars, with steel under frames, and twelve cinder or general service cars.

TORONTO.—Contracts totalling $52,784 were awarded at a recent meeting of the Board of Education. Among them the following recommendations for the Logan Avenue school were made: Masons' work, Wickett Bros., $24,899; carpenters' work, W. Williamson, $12,695; plasterers' work, Hanna & Nelson, $3,414; painters' work, J. Phinnemore, $1,245; plumbers' work, F. Armstrong Company, $1,725; roofers and tinsmiths' work, A. B. Ormsby Company, $1,070; heating and ventilating work, J. R. Seager, $4,850; heat regulation, Johnson Temperature Regulation Company, $775; electric wiring, Hall & Dollery, $38; structural steel, Reid & Brown, $2,073. It was recommended that Jones Bros. & Company's tender for $400 for cupboards at Harbord, Jameson, and Riverdale Collegiates be accepted; also the T. Eaton Company's tenders for $110 for fifty stools in the Industrial Art Department of the Technical High School. The following tenders were recommended for Jones Avenue School: Electric wiring, Hall & Dollery, $50; heat regulation, Johnston Temperature Regulation Company, $477. The tender of the Charles Rogers Company for cupboards in nineteen public schools for $2,255 was also recommended.

Manitoba.

WINNIPEG.—The Board of Control recently considered the following tenders for sewers and water mains:—

	T. Jackson & Son.	Engineer.
Sewer, Morley Avenue	$ 980 25	$ 1,007 45
Sewer, Chalmers Avenue	3,585 60	3,635 50
Sewer, McIntosh Avenue	1,612 55	1,630 47
Sewer, Clifton Street	23,612 55	23,182 35
Water main, Poplar Avenue.....	458 40	425 84
Sewer, May Street	431 70	422 92
Sewer, Nassau Street	455 50	442 75
Sewer, McMillan Avenue	729 90	725 72

In each case the lowest tender will be accepted.

British Columbia.

VANCOUVER.—Bids for the construction of a bridge over False Creek were received on November 12th. The structure is to be about 3,375 feet long between abutments and is composed of a 264 ft. centre bearing, electrically operated, swing span, carried on concrete piers, which are to be sunk by the pneumatic process, and sixty-six deck plate girder spans varying from 35 to 80 ft. in length, and supported on steel bents resting on concrete pedestals of which sixty are to be placed on piles and fifty on earth. Approaches, each about 150 feet long, consist of concrete retaining walls and abutments with earth fill. The bridge carries two wooden sidewalks, each 6 feet wide, and a roadway 44 feet wide, paved with creosoted wood blocks on creosoted planks and ties. Two electric railway lines are at the centre of the roadway and the bridge will be lighted electrically. Tenders were received on the following basis: 1st.—For metal work and all other superstructure materials erected. 2nd.—For substructure complete.

The following were received for the superstructure:—
A—Dominion Bridge Co., Montreal, Quebec.
B—Canadian Bridge Co., Walkerville, Ont.
C—Evans, Coleman & Evans, Vancouver, B. C.

	A	B	C
Metal and machinery in swing span and gates, including light brackets, but exclusive of electrical equipment, per lb.	6.08c.	6 2/10c.	6½c.
Metal in trestle span and trestle bents, per lb.	4.44	4.27	5 4/10
Electrical motors for the operation of gates in swing span and controllers, etc.	$1,970	$2,000	$1,500
Creosoted timber, including piles and stones necessary for attachment, per thousand ft.	$50.65	$45.00	$50.00
Untreated native timber, per thousand feet	78.00	30.00	28.00
Untreated Australian hardwood..	78.00	80.00	75.00
Paving complete, per square yard	2.25	2.00	2.10
Draw protection piles per lin. ft.	.35	.35	.25
Electric lighting equipment, except brackets on substructure, complete	$8,500	$8,000	$10,000
Machine house on swing span..	500	600	750

The certified cheque for the Dominion Bridge Company, based on 10 per cent. of the estimate, was for $46,000; for the Canadian Bridge Company, $50,000, and for Evans, Coleman & Evans, $52,000. Roughly estimated, according to the quantities, the compilation works out at: Superstructure — Dominion Bridge Company, $458,864; Canadian Bridge Company, $439.210; Evans, Coleman & Evans, $519,305. The tenders for the superstructure are totalled on the basis of Australian hardwood being used to pier protection, which is optional.

For No. 2, substructure complete, tenders were received as follows:—

Palmer Bros. & Henning	$218,620
Armstrong & Morrison	224,480

The tenders were referred to the consulting engineers, Messrs. Waddell & Harrington, of Kansas City, Mo., who will make another estimate of the cost of the bridge from the quantities and the prices given and recommend the tenders for acceptance. The quotations for the metal per pound in the spans, which is one of the principal items, are appreciably below the figure for the metal in the last bridge.

RAILWAYS—STEAM AND ELECTRIC.

New Brunswick.

FREDERICTON.—The C. P. R. is to make a thorough and practical test of Grand Lake coal on their locomotives on freight trains running between McAdam Junction and St. John. If satisfactory an extensive development of the Grand Lake coal areas will follow.

ST. JOHN.—Delays have been met with in the building of the electric railway which is to run for twelve miles into Aroostook Junction to connect with the C.P.R., which will prevent its completion before the first of the year. Mr. Goold, of Presque Isle, chief owner of the road, recently said that the opening of the road had been delayed for about two months, chiefly by the wet weather. All of the grading was completed some time ago, and the rails are now on the ground, but work at the several bridges on the line has been held back. This is the first electric road in this part of America of standard gauge.

Quebec.

MONTREAL.—The C. P. R. is considering a proposal to prevent smoke nuisance in this city by operating trains within the city limits by electric power.

MONTREAL.—Another important link in the Canadian Northern Transcontinental Railway System will be opened on the 28th of this month. This comprises 265 miles between Ottawa and Quebec, and will furnish the shortest and most direct route between these two cities. The completion of this road was delayed owing to the Railway Commission's objections to their terminal facilities at Ottawa, but for the present temporary quarters will be used.

MONTREAL.—On November 16th the Dominion Railway Commission, sitting at Ottawa, heard the case respecting the subway in St. Louis, which is to cost $200,000. The C.P.R. will contribute $50,000, the Park and Island Railway will pay $15,000, while $10,000 will be taken from the parliamentary fund for the abolition of level crossings and the remainder will be provided by the town.

SHERBROOKE.—Mr. W. Hibbard, of Montreal, met the city council recently and made a proposition for a new company getting control of the street railway. They would extend the system throughout the city, and would ultimately run to Magog. He wanted the city to sell Westbury Basin power, now held by the city, at $22,000, and asked that a franchise be given for fifty years. During the last thirty years the city would come in for a percentage of the earnings.

Ontario.

CORNWALL.—The council of Cornwall Township and the Cornwall Electric Street Railway Company have formed an agreement by which the company receives a franchise to extend their line up the West Front road over Wood's Hill to the O. & N. Y. Railway depot. The line at present makes a detour by the Toronto Paper Company's mills. The straight line will be about half a mile shorter.

GUELPH.—It is understood that the Canadian Pacific Railway has made the city a most important proposition in connection with the dangerous level crossings in the city and this proposition will be considered at an early meeting. The proposition of the company is that it will protect the Eramosa Road and Heffernan street crossings by the erection of overhead bridges if the city will undertake the responsibility of protecting Allan's crossing.

GUELPH.—On Thursday, the 18th November, the Ontario Railway and Municipal Board ordered the city of Guelph and the Guelph Radial Railway Company, to forthwith construct a new four-span steel bridge over the Speed River on the Dundas Road, in accordance with the report of Mr. F. L. Somerville, C. E., upon good and substantial stone or cement piers. Arrangements were some time ago made by Manager Hackney and the money provided to rebuild the bridge, but it takes time to secure steel such as is intended to be used—the heaviest obtainable on the long spans and a little lighter on the shorter ones. Though efforts will be made to hasten it along, it is hardly likely the steel can be secured before January.

PORT ARTHUR.—To promote better service and faster running time in both freight and passenger departments the C.N.R. will, in the spring, construct many side tracks between here and Winnipeg. The existing sidings and spurs will be lengthened, this being necessitated by the fact that higher percentage engines now being used on first district can pull longer and heavier trains and require longer siding to contain the entire train when a meet is rendered necessary. When all this necessary improvement work is done much better running time can be made between Port Arthur and Winnipeg, and also between Port Arthur and Duluth. The laying of heavy eighty-pound steel rails between here and Winnipeg is practically completed, there only being about seven miles more to lay in the vicinity of Lazine.

ST. THOMAS.—The new subway under the Michigan Central Railway tracks at Ross Street, constructed at a cost of $60,000, was formally opened on Monday afternoon.

TORONTO.—Mr. J. W. Moyes, who was appointed to report on tube railways for Toronto, has recommended the establishment of a dual system of underground and surface railways to cost $4,485,000. The underground system would be 3¾ miles long. The outgoing section would be served by surface railways.

Alberta

EDMONTON.—Dirt will be made to fly on the Alberta and Great Waterways railway this fall. The men and the money are available and only adverse weather conditions will prevent a good deal of grading being done during the winter months.

EDMONTON.—For the first time in many months the street cars of Edmonton were operated on time the other day when one of the three new engines supplied by Messrs. Belliss & Morcom was set in operation. Lack of power has been responsible for the unsatisfactory service given during the past year. The new equipment promises to supply abundant power for some time to come.

FRANK.—The survey party in the employ of the Cariboo Hill Coal Company, running a railroad survey up the South Fork of the Old Man River to cross the main range via the North Kootenay pass, is now nearing the summit and it is expected the work will be completed before severe weather sets in. Engineer Winters, in charge of the work, states that as good progress as can be expected under rather unfavorable conditions is being made and that he expects to finish the survey to the summit at least. Contrary to the supposition that has been general with regard to the building of a railroad through the Kootenay Pass, which has been that a long tunnel at the summit would be necessary in order to get a reasonable grade, Engineer Winters says no tunnel will be necessary and that a very fair grade will be obtained. That it is a bona fide railroad and not merely a preliminary designed to head some one else off, is indicated by the fact that the road is being located as the work progresses, leaving only the cross-sectioning to be done. It is said that contracts will be let early in the spring for construction. The line will connect with the Crow's Nest road at Burmis.

British Columbia.

NEW WESTMINSTER.—The length of the new British Columbia Electric railway line to Chilliwack will be sixty-four and a half miles and will be bedded on a good grade. The sub-grade has been completed over two-thirds of the entire road. At the rate of one mile per day the rails, which are seventy-pound steel, have been laid to Langley Prairie. No grade on the entire road will be greater than two and five-tenths per cent. The power to operate the line will be supplied by the station at Lake Buntzen, coming over the high tension lines in its full voltage, to be reduced to operating voltage by the five substations located at Chilliwack, Sumas Mountain, Clayburn, Mt. Lehman and Cloverdale. The reduction stations will be reinforced concrete structures and will each represent to the company for the buildings alone an expenditure of $25,000 to $35,000, while the machines therein will be 300 to 600 kilowatt power. The system will be operated on standard time. The rolling stock will consist of a combination train, including freight cars. These cars will be operated under the multiple unit system and coupled by the A. M. M. type of air and the junction box electrical connection and will run jointly under one motorman, at the same time each car propelling itself. The new controller differs from that in use at present by being only about a foot square but having about three thousand connections with the group switch. For freight transportation the company has purchased three fifty-ton motor locomotives. One of these motors is in use at present having arrived about a week ago, and is giving perfect satisfaction.

VANCOUVER.—The survey of the Canadian Northern route to tide water is being rushed. An engineering party is now locating the line west of Chilliwack, about sixty miles east of this city. The line will follow the south bank of the Fraser all the way to a point opposite New Westminster. Another survey party is now locating the line down the main Thompson River, between Kamloops and Lytton.

SEWERAGE AND WATERWORKS.

Quebec.

MONTREAL.—The city's conduit was recently completed at a cost of three-quarters of a million dollars. The construction work occupied about two years.

British Columbia.

VANCOUVER.—The detail work in connection with the proposed sewage disposal system is completed and the money will probably be voted for at the January elections.

LIGHT, HEAT, AND POWER.

Ontario.

GALETTA.—The Galetta Electric Power Co. are now supplying the town of Arnprior with electricity. They recently installed considerable new plant, which was supplied by the Canadian Westinghouse Co.

TORONTO.—A meeting of the municipal engineers of Ontario and others interested in the proposals of the Hydro-Electric Power Commission was held in the City Hall, Toronto, on November 16th and 17th. Mr. R. A. Ross, C. E., of Montreal, who has been presiding at previous meetings, was absent through sickness, and Mr. P. W. Sothman, chief engineer of the Hydro-Electric Commission, occupied the chair. The afternoon of the first day was taken up with a report of the committee previously appointed to investigate the question of street lighting. Engineers expert on this subject also addressed the meeting. Mr. E. I. Sifton, electrical engineer of London, Ontario, presided at the meeting held on the second day, when standard transformer specifications and questions of thirteen-thousand-volt insulators and single versus three-phase transformers were discussed. The principal feature of this meeting, however, was a debate on the question of rates for incandescent lighting. It was decided that the method of charging best adapted for general use was one which bases a fixed monthly charge on the floor space of a house, together with a similar charge per k.w. hour. Power rates were next considered, and a committee was appointed to investigate the question. The next meeting is to be held in London, Ont., on December 14th.

Alberta.

CALGARY.—Superintendent McColl, of the city power house, has outlined plans for a new power plant.

RED DEER.—The town officials are negotiating with the Western General Electric Co. with a view to purchasing their plant.

FINANCING PUBLIC WORKS.

Quebec.

MONTREAL.—The real estate owners of Montreal will vote on December 21st on a $2,000,000 lighting plant by-law.

MONTREAL.—The council have passed a $16,000 new pavement by-law.

Ontario

GUELPH.—Guelph has made a sale of debentures at an unusually high rate to the Ontario Securities Company. The rate was above 109, being a lump sum of $54,674 for $50,000 debentures for the installation of the Hydro-electric distributing plant.

INGERSOLL.—The ratepayers of Ingersoll will vote on a by-law for a civic power distribution plant in January. It is estimated that the plant will cost $26,000. A plant for a lighting service would cost $50,000 more. If the by-law passes the existing plant will likely be bought out.

NIAGARA FALLS.—A by-law to borrow $11,000 to meet Centre Street paving work, was read a first, second and third time.

ST. MARY'S.—The by-law to grant a bonus of twenty thousand dollars to the St. Mary's & Western Railway was voted on by the township of Blanshard last Friday, and carried by a majority of four. A similar by-law was carried last May, but upon protest for irregularity was quashed.

SMITH'S FALLS—By-laws to provide $16,000 for waterworks plant and $46,000 for a new collegiate institute will be submitted at the next elections.

Manitoba.

BRANDON.—A by-law is ready to submit to the electors authorizing the council to borrow $10,000 to be spent on the three leading roads leading into the city from the north.

Alberta.

MEDICINE HAT.—The ratepayers will vote this week on a $9,000 by-law for a site for Alberta Clay Products Co.

British Columbia.

NANAIMO.—The council have adopted the waterworks by-law, 1909, and are reconsidering the local improvement by-law for the construction of permanent sidewalks.

NEW WESTMINSTER.—The ratepayers have passed a by-law for $398,000 local improvement debentures.

SANNICH.—The ratepayers will vote on a $7,900 by-law to provide for draining.

Debentures are offered for sale by the following municipalities:—

Ontario.

PETROLEA.—$14,535.80, pavements; $4,000, bridge; $2,000, local improvements.

STAMFORD TOWNSHIP. — $8,700, local improvements.

Saskatchewan.

YORKTON.—$40,000, high schools.

The following municipalities recently sold debentures:—

GLEN EWEN, SASK.—$1.000, waterworks. FERNIE, B.C.—$25,000. COLCHESTER NORTH, ONT.—$9,633. OUTREMONT, QUE.—$50,000, schools. CHATHAM, ONT.—$20,000, high schools. ORILLIA, ONT.—$143,000, sewerage, park, schools, etc. COUNTY OF ELGIN, ONT. —$20,000, house of refuge. MARKDALE, ONT.—$10,000, waterworks and fire hall. VICTORIA COUNTY, ONT.—$20.000, bridge and improvements. PORTAGE LA PRAIRIE, MAN.—$70,000, waterworks. NORTH VANCOUVER, B.C.—$35,000 and $17,474. ST. STEPHEN, N.B.—$100,000, waterworks.

COMING MEETINGS

American Institute of Architects.—December 14-16. Annual convention at Washington, D.C. Secretary, Glenn Brown, The Octagon, Washington, D.C.

The Nova Scotia Society of Engineers.—December 9th, Paper on the Improvements of the Telephone, by J. H. Winfield, the general manager, N.S. Telephone Company. Secretary, J. Lorne Allan, Provincial Engineer's Office, Halifax, N.S.

PERSONAL NOTES.

MR. JAMES GOODWIN, of Chicago, succeeds Mr. P. J. Slattery as manager of the Sherbrooke Street Railway Co., of Sherbrooke, Que.

MR. JAMES MILNE, M. Can. Soc. C.E., M. Am. Soc. M.E., recently resumed his consulting practice, and now has an office in the Loo Building, Vancouver, B.C. Having the benefit of many years' experience in connection with the development of power, the construction, maintenance and operation of electric railways and other municipal problems, Mr. Milne is prepared to handle work which is related to electrical, steam and mechanical engineering from the preparation of plans and estimates to the supervision of construction and operation.

OBITUARY.

MR. JOHN MACVICAR, a well-known railway contractor of Goderich, Ont., died at Toronto this week. Mr. MacVicar was sixty-nine years of age.

MR. CHARLES COURSOL, of Ottawa, who was in the engineering department of the National Transcontinental Railway and a former student of the Royal Military College, Kingston, died on Tuesday, November 23rd.

MR. J. C. WILSON, of J. C. Wilson & Company, mechanical engineers, Glenora, Ontario, died at Picton, Ont., on Friday, the 12th November, after an illness of some months. He was the son of the late Mr. Stewart Wilson, who came to Canada from Albany, N.Y., in the early part of the nineteenth century. On Mr. Wilson's arrival in Picton, he established the first foundry in Upper Canada, then known as the Phenix foundry, where the first plowshare was cast in Upper Canada. Mr. James Canniff Wilson was born in 1833, and on reaching the age of thirteen years his father purchased for him the property then known as "Stone Mills," some five miles east of Picton, on the shore of the Bay of Quinte, now known as Glenora, which comprised at that time a saw mill, grist mill, and woollen mill. The grist mill was operated by Sir John A. Macdonald's father for two years before Mr. Wilson got control. Even although young Wilson was only thirteen years of age when he first entered business he made a success of the venture. During the summer he operated the mills and in the winter months was a scholar at the McMullen Academy. The mills were burned about forty years ago and were rebuilt on a larger scale. In 1876 Mr. Wilson branched out into the manufacture of turbine water wheels and mill machinery, and built up a large and flourishing trade. A good part of the product being disposed of through a London, Eng., agency. Mr. Wilson conducted this business until seven years ago when he was succeeded by his son, Mr. F. S. Wilson, who now continues the business in the old firm name of J. C. Wilson & Company.

MARKET CONDITIONS.

Toronto, November 25th, 1909.

After weeks of soft or rainy weather, frost has come. Sleet and mud were not favorable to movement of cement and stone, but bricks have continued to show much activity in the city. Lumber moves fairly well and other building materials maintain activity and price in the city.

Stocks of iron and steel goods in the hands of merchants are much reduced, and with the increased activity of retail demand must soon be replenished, possibly at increased prices. American quotations are apparently going higher; so great is the pressure on steel mills there that they ask from 2 to 6 months' time to fill orders, according to description or dimension of goods. In builders' hardware and shelf hardware generally, the Ontario demand is brisk.

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

Antimony.—Demand active and price higher at $9.25 per 100 lbs.

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

Bar Iron.—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer Market well supplied.

Boiler Plates.—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 lbs.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 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. Demand is only moderate.

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 $18 delivered and $17 at works per 1,000.

Broken Stone.—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 60c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. The demand has been active for some weeks, and supply not equal to it; feeling is upward. Broken granite is selling at $3 per ton for good Oshawa.

Cement.—Manufacturers' prices for Portland cement are $1.40 without bags, or $1.70 including cotton bags for car lots on board car, Fort William or Port Arthur; the price at Toronto is $1.30 without bags, or $1.70 with bags. Smaller dealers get $1.35 to $1.40 per barrel without bags, in load lots, delivered in town. Demand is fairly steady. A good deal moving in filling former contracts.

Coal.—Retail price for Pennsylvania hard, $7.25 net, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $6.00. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.75 to $6.00; Reynoldsville, $4.90 to $5.00; Connellsville, 72-hour coke, $5.50.

Copper Ingot.—Demand quite heavy, and price advanced to 14¼c. Supply adequate.

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.—An improvement in demand of late, no change in price, which is $1.80 per 100 lbs. Much is being now used for lumber camps.

Fire Bricks.—English and Scotch, $30 to $35; American, $25 to $35 per 1,000. The demand is steady.

Fuses.—Electric Blasting.—Double strength 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, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet.

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, per 100 lbs.

Iron Pipe.—Repeat quotations of last week, as follows:—Black, ¼-inch, $2.03; ⅜-inch, $2.25; ½-inch, $2.63; ¾-inch, $3.28; 1-inch, $4.70; 1¼-inch, $6.41; 1½-inch, $7.70; 2-inch, $10.26; 2½-inch, $16.39; 3-inch, $21.52; 3½-inch, $27.08; 4-inch, $30.76; 4½-inch, $38; 5-inch, $39.85; 6-inch, $51.70. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.43; 1-inch, $6.35; 1¼-inch, $8.66; 1½-inch, $10.40; 2-inch, $13.86, per 100 feet.

Lead.—Prices steady outside. This market is steadier, and demand quiet, at $3.75 to $3.85 per 100 lbs.

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 without freight. Demand is good.

Lumber.—Prices continue steady, and city demand still active. We quote dressing pine $32.00 to $35.00 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to 45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22 to $24; shingles, British Columbia, weak, and rather over-stocked, $3 to $3.10; lath, No. 1, $4.40, white pine, 42-inch; No. 2, $3.75; for 32-inch, $1.60.

Nails.—Wire, $2.35 base; cut, $2.60; spikes, $2.85 per keg of 100 lbs.

Pitch and Tar.—Pitch, demand moderate, price so far unchanged at 70c. per 100 lbs. Coal tar fairly active at $3.50 per barrel.

Pig Iron.—There is fair 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 per ton. Producing plants are everywhere busy, and there is considerable business in prospect for 1910.

Plaster of Paris.—Calcined, New Brunswick, hammer brand, car lots, $2; retail, $2.15 per barrel of 300 lbs.

Putty.—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.05. Plasterer's, $2.15 per barrel of three bushels.

Ready Roofing.—Dealers report a large demand, the prices being as before, per catalogue

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 Bangor slate 10 x 16 may be quoted at $7 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less. Mottled, $7.25; green, $7. There is still a scarcity of good slaters and much demand for them.

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

Business steady; 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 per 100 lbs., according to size and quantity; if cut, $2.75 to $3 per 100 lbs.; 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.—We do not alter prices as yet; 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 good demand exists, and there is prospect of higher prices.

Sheets Galvanized.—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $2.90; 12-14-gauge, $3.00; 16, 18, 20, $3.10; 22-24, $3.25; 26, $3.40; 28, 3.85; 29, $4.15; 10¾, $4.15 per 100 lbs. Fleur de Lis—28-gauge, $4; 26, $3.80 per 100 lbs. Demand very active.

Tank Plate.—3-16-inch, $2.40 per 100 lbs.

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

Tin.—The feeling in tin is firm, and the price 32 to 33c. per lb.

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

Zinc Spelter.—A very active movement continues, and a large business is being done. Price very firm at $5.75 to $6 per 100 lbs.

CAMP SUPPLIES.

Beans.—Hand picked, $2; prime, $1.90.

Butter.—Dairy prints, 21 to 22c.; creamery rolls, 26 to 27c.

Canned Goods.—Peas, $1.00 to $1.50; tomatoes, 3s, 85c. to 95c.; pumpkins, 3s, 80 to 85c.; corn, 75 to 85c.; peaches, 2s, white, $1.50 to $1.60; yellow, $1.90 to $1.95; strawberries, 2s, heavy syrup, $1.90 to $1.95; raspberries, 2s, $1.90 to $1.95.

Cheese.—No old cheese on hand; new cheese, large, 12¾c.; twins, 13c.

Coffee.—Rio, green, 10 to 12½c.; Mocha, 21 to 23c.; Java, 20 to 31c.; Santos, 11 to 15c.

Dried Fruits.—Raisins, Valencia, 5½ to 6c.; seeded, 1-lb. packets, fancy, 7½ to 8c.; 16-oz. packets, choice, 7 to 7½c.; 12-oz. packets, choice, 7c.; Sultanas, good, 5 to 6c.; fine, 6 to 7c.; choice, 7 to 8c.; fancy, 8 to 9c.; Filiatras currants, 6½ to 7c.; Vostizzas, 8½ to 9c.; uncleaned currants, ½c. lower than cleaned. California Dried Fruits,—Evaporated apricots, 14 to 15c. per lb.; prunes, 60s to 70s, 7 to 7½c.; 90s to 100s, 6½c.; evaporated apples, 9½c.

Eggs.—New laid, 25 to 26c. per dozen, in case lots.

Lard.—Tierces, 15½c.; tub, 16 to 16½c.; pails, 16c. per lb.

Molasses.—Barbadoes, barrels, 37 to 45c.; Porto Rico, 45 to 60c.; New Orleans, 30 to 33c. for medium.

Onions.—$1.25 a bag.

Potatoes.—Best, 75c. a bag.

Pork.—Market uncertain. Short cut, $28 per barrel; mess, $26.50.

Rice.—B grade, 3½c. per lb.; Patna, 5½ to 5¾c.; Japan, 5¼ to 6c.

Salmon.—Fraser River, talls, $2; flats, $2; River Inlet, $1.55 to $1.75.

Smoked and Dry Salt Meats.—Long clear bacon, 14 to 14½c., tons and cases; hams, large, 14 to 14½c.; small, 15½ to 16c.; rolls, 14½ to 14¾c.; breakfast bacon, 17c.; backs (plain), 18 to 19c.; backs (peameal), 18c. to 18½c.; shoulder hams, 12c.; green meats out of pickle, 1c. less than smoked. Market very firm.

Spices.—Allspice, 16 to 19c.; nutmegs, 30 to 75c.; cream tartar, 22 to 25c.; compound, 15 to 20c.; pepper, black, pure Singapore, 14 to 17c.; pepper, white, 20 to 30c

Sugar.—Granulated, $4.85 per 100 lbs. in barrels; Acadia, $4.75; yellow, $4.45; bags, 5c. lower; bright coffee, $4.65; bags, 5c. less.

Syrup.—Corn syrup, special bright, 3½c. per lb.

Teas.—Japans, 20 to 35c. per lb.; Young Hysons, 16 to 35c.; Ceylons, medium, 16 to 45c.

* * * *

Montreal, November 23rd, 1909.

The pig-iron market in the United States is quiet and some sales have developed at lower prices. This remark applies to foundry iron. It would seem that speculators some time ago purchased heavily of southern iron to be held in store for a definite period and that this period has now expired and the owners are being compelled to move it out of store. In order to get rid of it they are prepared to accept lower figures than previously. This has upset the general market for the time being to the extent of about 50c. per ton. Steel-making brands are in good demand and are selling at well maintained prices. As a result of the concessions mentioned, the turn-over is exceptionally large, purchasers evidently feeling that this is an opportunity to cover their wants at prices which are not likely to be long repeated. The general trade for steel purposes is exceptionally good, all classes of finished and semi-finished goods being in good demand, and the outlook for the future being quite promising.

The English market is quiet and steady. There is practically no feature worth speaking of and prices vary between previous ranges. Demand from home and abroad continues steady, as previously.

In the local market, the most prominent feature is the closing of navigation. The final preparations for the laying up of the boats is now going on and inside of another week the streams may be coated over with ice. Metal reaching here by the last ships is now being moved off the docks as rapidly as possible and sent forward to customers. These supplies will help to keep Canadian foundries going for some time to come, but, as an evidence of the feeling that the market is likely to show further advances, enquiries are now being received for a heavy tonnage of pig-iron extending over the second and third quarters of 1910. The large buyers all over the country are beginning to enquire for future delivery, so that holders are maintaining the strong tenor of the market. The quotations on pig-iron, given below, are about the same as previously, but next week's figures will be for iron in store, as by that time practically everything will have been moved off the docks.

The remainder of the market, so far as quotations are concerned, is steady and unchanged, but it is expected that in another week there will be some alterations. Among other things, the tone of the market for bar iron and steel is very firm, and, although no changes have yet been registered, something is expected shortly. As for plates, etc., the market continues very quiet, and the tone is little more than steady.

Antimony.—The market is steady at 8 to 8½c.

Bar Iron and Steel.—The market promises to advance shortly. 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, $1.00 for 1 x ⅜-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; imported, $2.20.

Boiler Tubes.—The market is steady, quotations being as follows:—1½ and 2-inch tubes, 8½c.; 2½-inch, 10c.; 3-inch, 11¼c.; 3½-inch, 14 1-2c.; 4-inch, 18 1-2c.

Building Paper.—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square