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Volume 24 Toronto, May 29, 1913

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The Canadian Engineer

An Engineering Weekly

THE LAYOUT OF A SMALL RIVER CROSSING

By C. D. NORTON.

The completed bridge, as shown in Fig. 1, is 650 feet from ballast wall to ballast wall; five 40-foot towers being connected with six 75-foot D.P. girders; height of water-towers, 75 feet. An ideal location (Fig 1) made it difficult to lay out, owing to the steepness of the banks and to the fact that each abutment stood on a promontory; added to which there was 300 feet of water in the middle.

The location tangent was established and chainage between hubs checked by a rough triangulation, a topographical sketch made, and conditions determined the base line as shown. (Fig. 2). Hubs were set every 10 feet and a double one at 100 feet for plumbing down; each set of 10 being levelled, the total drop in the 200 feet being about 5 feet. This base line was measured with with a 100-foot band chain and the three angles were repeated four times on each quadrant. A tabulation showed any radical errors and the average for each angle was taken out to 15 seconds.

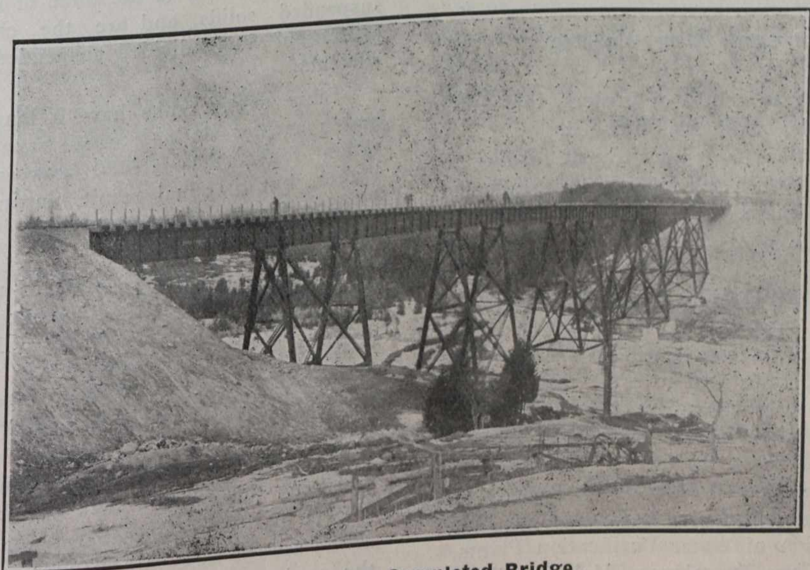


Fig. 1.—Showing Completed Bridge.

Having determined the distance between two hubs which were approximately 650 feet apart, this exact distance was staked and checked by the same method. At a later date, when the pond was dried, the distance taped was found to be .06 foot shorter than the distance triangulated, a discrepancy due to the fact that the heavy band chain could not be stretched to its proper length without supports. Six hubs were then set on banks for the line of the pedestals from each side was chained separately. The face of ballast walls and centre of pedestals was referenced at right angles by hubs set out closer than 100 yards, one in fact being one-quarter of a mile up the valley. This completed the layout.

The abutments were checked every 5 or 6 feet during erection, the carpenter being given the centre line and face of ballast wall.

The depths of the pedestals were approximately determined by soundings, and staked accordingly. After the footings were in, hubs were set on the centre and reference lines, an intersection obtained with fine fishing line, and these lines transferred to the footing, on which the base of the foustoum was staked out. When the form was built the top was checked in the same manner. After the concrete was finished centres were marked on the pedestals from the reference points and checked with tape. On all important lines, wherever possible, foresights were set to eliminate double centering and to dispense with having to send a man around the dam to give point.

The first levels were, of course, the check levels over the section, when bench marks were set on each bank and at water level. Bench marks were then set every 12 or 13 feet down the banks and levels taken four times. These were tabulated, showing the differences between back and foresights which was the difference in elevation between benches and established a definite relation between them independent of initial or accumulative errors, any radical difference was eliminated and a mean struck which gave the elevation for the bench marks. Afterwards, whenever levels were run, the work was checked on to the next bench mark and the book elevations marked on the same sheet, thus obtaining an average in which final elevations were correct to within .01 foot. To set levels for the bridge seats temporary pillars were set on each side of the abutment and the height, some 30 feet, taped up, a line joining the points at the top being checked with a carpenter's level.

Elevations were, of course, given for the top of the pedestals, but owing to the shrinkage of the concrete and the varying temperaments of the men who floated the tops, the finished work varied as much as .05 high or low. The base of the columns was marked on the pedestals, and levels taken at each corner. These were tabulated in sets of four for each pier, and a mean struck which gave the least chipping, a difference of .01 in 75 feet being inappreciable. With an improvised target rod (a pencil point on a picket) the four corners of each seat were chipped to .001 foot and then levelled by a stone mason, any low pedestals being chipped for to use a plate.

The foregoing may seem rather elaborate for a small bridge, but as neither the foreman in charge or the carpenter had done any large concrete work before it was none too much, and the end justified the means, for when the bridge

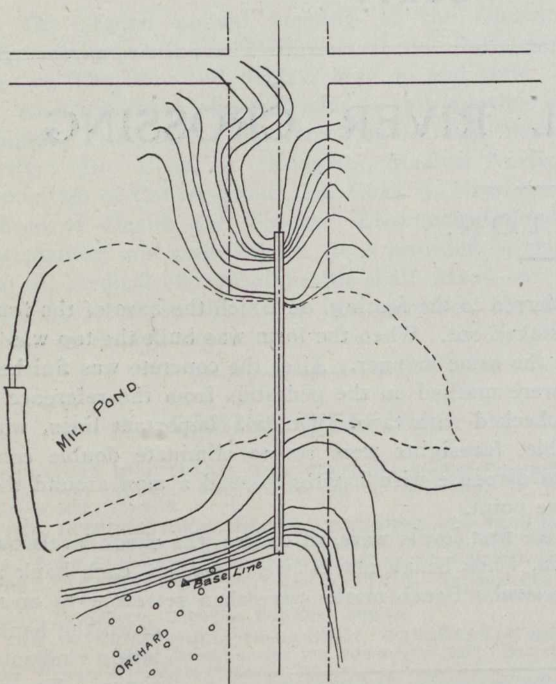


Fig. 2.—Layout of Small River Crossing.

company laid track, spiking to centre of girders, there was no need of relining when the bridge was finished.

The instruments used were a 5-inch transit reading to minutes, a 14-inch dumpy level, a self-reading rod graduated to half tenths, and a band chain.

AMERICAN WATERWORKS ASSOCIATION.

The thirty-third annual convention will be held at West Hotel, Minneapolis, Minn., June 23rd to 27th, 1913.

The following papers are scheduled: "The Diesel Engine for Waterworks," by Edward S. Cole; "Waterworks Special Franchises," by Henry DeForest Baldwin; "Reforestation and General Care of Watersheds," by Ermon M. Peck; "The Bacterial Count on Gelatin and Agar Media and its Value in Controlling the Operation of Water Purification Plants," by James M. Caird; "The Tuscaloosa, Alabama, Waterworks," by Prof. Edgar B. Kay; a paper on filtration, by George W. Fuller; "Charges for Public Water Service to Private Fire Protection Systems," by W. E. Miller; "A Reasonable Basis for the Determination of Charges for Private Fire Protection," by Leonard Metcalf; "Metering Private Fire Services at Kenosha, Wisconsin," by August Baltzer; "How a Private Fire Service Polluted a Public Water Supply and Some of the Consequences," by Robert J. Thomas; "Modern Filter Practice," by Nicholas S. Hill, Jr, "Gravity Water upply at the City of Manila, Philippine Islands," by H. E. Keeler; "Power for Pumping Derived from Refuse," by E. H. Foster; "Pumping Engines," by L. E. Strothman; "Ground Water Supplies," by Charles B. Burdick; "Rates and Rate Making," by Halford Ericson.

On Tuesday and Thursday evenings illustrated lectures will be delivered by Edward Wegman and Dr. William P. Mason.

There will be excursions on Wednesday and Friday afternoons.

NOTES ON SEWAGE DISPOSAL.

By Geo. W. Swinburne, M. Am. Soc. C.E.*

The liquid portion of sewage is not, to any appreciable extent, beneficially affected by being subjected to tank treatment. But, in addition to its dissolved impurities, sewage carries suspended solids, some of which can be eliminated by efficient tank treatment, and others which, under practical working conditions, are not depositable by sedimentation alone.

The operation in ordinary settling, or sedimentation, tanks is a comparatively simple one, since there are but two forces at work, the forward movement of the sewage and the force of gravitation acting on the suspended solids. These solids will be deposited at variable distances along the tank bottom, forming a gradually rising floor of sludge, diminishing the liquid capacity of the tank, increasing the rate of flow of the sewage, and finally causing a greater proportion of suspended matter to pass out with the effluent than is consistent with successful operation. When this condition is reached the tank should be put out of commission, emptied and cleaned.

In septic tanks the decomposition of the sludge results in the addition of a third force. It is often assumed that septic action results in the liquefaction of the organic portion of the sludge, but, while some liquefaction does occur, the result is essentially a gasification. These gases work in opposition to the force of gravitation acting on the suspended solids, and are the chief cause of the large amount of finely divided suspended matter found in septic effluents.

Since septic tanks have a longer sedimentation period and a greater sludge storage capacity than plain sedimentation tanks, the interval between cleanings is naturally longer, but the final result, putting the tank out of commission for emptying and sludge withdrawal, is the same in both cases.

Following a careful study of the results obtained with the two-story tank at the Lawrence Experimental Station of the Massachusetts State Board of Health and an exhaustive investigation of the conditions in which suspended matter is found in sewage, Dr Wm. Owen Travis, of Hampton, England, designed what is now known in England as the Hampton, or Travis, Hydrolytic Tank and in this country as the Hampton Sedimentation Tank. The results sought in designing this form of tank may be stated as follows:—

(1) To effect the sedimentation of the depositable solids of the sewage in such a manner as to maintain continuously the predetermined capacity of the sedimentation chambers.

(2) To increase the sedimentation efficiency and remove the liquid products of the decomposition of the deposited solids by causing a minimum proportion of the sewage to flow into and through the reduction chamber.

(3) To separate the opposing forces of gravitation and gaseous eruption by confining these operations to separate compartments.

(4) To provide for the removal of sludge at will and without interfering with the continuous operation of the tank.

The first tank of this type was constructed in 1904 at Hampton, England, to relieve the rapid clogging of the primary contact beds. An official report by Mr. J. H. Johnson, M.S., F.I.C., London, England, covering a period of six months' operation of this tank shows an average retention of 90 per cent. of the suspended solids of the raw

* Mr. Swinburne, to whom we are indebted for the compilation of the above notes, is chief engineer of the Sterilization Company, Newark, N.J.

sewage. Referring to a later and much larger installation at Norwich, England, Mr. Arthur E. Collins, Mem. Inst. C.E., City Engineer, Norwich, states: "The operation of the tanks in Norwich has been uniformly successful. The average removal of solids amounts to between 90 and 94 per cent. of the total contained solids of the crude sewage."

The tanks at Norwich are divided into three longitudinal compartments, of which the two upper are for the sedimentation of the sewage and the lower one for the collection and retention of sludge. The sedimentation chambers receive the entire volume of sewage, the greater portion of which traverses their full length and is discharged over weirs into the effluent channel. A small portion of the sewage descends through openings at the bottom of the sedimentation chambers, carrying with it the accumulated suspended solids, passes through the reduction chamber at greatly reduced velocity, and deposits its burden of suspended solids in the sludge pockets at the bottom of the chamber.

Any action in the reduction chamber will be similar to that in a septic tank, but in a more or less modified form, depending on the length of time the sludge is retained. With long sludge retention there will be the same formation and eruption of gas and resulting disturbance of the sludge, which, however, has no effect on the liquid flowing through the sedimentation chambers. Following such eruptions, the reduction chamber effluent will carry some of this disturbed deposited matter out of the chamber. These solids are eliminated in the small up-flow chamber through which this effluent passes.

Owing to the fact that English sewage is at least three times as strong as American sewage, it is commercially impossible to eliminate from American sewage by sedimentation alone as high a percentage of suspended solids as is stated above. All the available data indicates very strongly that under average American conditions the sedimentation chambers of two-story tanks should have a capacity of from one-tenth to one-eighth of the total daily flow of sewage. With an average retention period of from two and one-half to three hours the Hampton tank will show an elimination of suspended solids of about 65 per cent.

Sludge storage capacity should be determined in each case by such local conditions as climate, proposed method of sludge disposal or utilization, subsequent treatment of the effluent, etc.

The electrolytic treatment of sewage is not a new idea; Webster patented such a method of treatment in England nearly twenty-five years ago. Electrolytic sewage treatment works which seem to follow Webster's method in a general way are in operation at Santa Monica, Cal., and at Oklahoma City, Okla., but in neither case is any attempt made to clarify the sewage nor to obtain the benefit of the secondary, or time, reactions, which would materially reduce the cost of operation.

There are many cases in which a well-clarified effluent, if free from pathogenic germs, would meet all reasonable requirements. In such cases the sewage, or so much of it as may be necessary, can be subjected to an efficient preliminary electrolytic treatment and then passed through a Hampton tank to allow time for the secondary reactions and for clarification. Electrolytic treatment not only produces a powerful germicide, sodium hypochlorite, from the salts which are always present in sewage, but it also serves to coagulate the finely divided suspended solids, or colloids, and the simpler forms of dissolved organic matter, which can then be eliminated by sedimentation. Furthermore, since sedimentation is much more rapid after electrolytic treatment than under natural conditions, a material reduction can be made in the capacity of the sedimentation chambers without reducing the percentage of clarification.

This combination of electrolytic and tank treatment makes it possible to eliminate from 80 to 90 per cent. of the suspended solids of the crude sewage, make an appreciable reduction in the dissolved solids, and produce an effluent which is well clarified, odorless and free from pathogenic germs. The danger of such a plant ever becoming a local nuisance is reduced to a minimum.

DISPOSAL OF REFUSE IN TOWNS AND CITIES.

Refuse disposal is usually a serious problem for the small city or town to solve. In such cases public incinerators are not always economical and the ordinary dump needs careful regulation to prevent it becoming a nuisance.

Burning or burying is the most desirable method of disposing of ashes, rubbish, manure and garbage in cities. Of these, burning is the most sanitary, and no other means should be used in cities having a population of, say, 20,000, or more. Refuse incinerators are of two main types (1) the coal-fired or "low temperature," and (2) the high temperature. The latter is designed to handle mixed garbage without the use of coal. Very few of these have as yet been installed, and their advantages have not been entirely proven. For the coal fired incinerator a long-flaming coal of good quality is essential. This, of course, makes the cost of operation all but prohibitive for most small cities and towns.

In such cases, other means of refuse disposal must be obtained. To simply dump garbage in an unrestricted manner on some vacant lot should be classed as a criminal offence, and punished accordingly. The practice of burying refuse, where it is carefully carried out, is usually found to be cheap and at the same time effective.

The principle upon which refuse burial rests, especially as applied to garbage, is, primarily, a bacteriological one. The action of the soil bacteria is to mineralize the organic matter in the refuse. In order to prevent the occurrence of putrefactive or other objectionable odors the mineralizing process must be carried out in the presence of sufficient oxygen or air. To secure these conditions the following points should be observed: (1) The garbage should not be buried too deep, nor should it be spread in too thick a layer on the ground. (2) The ground used should be sufficiently porous and well drained to admit the air readily. (3) The garbage should be mixed with enough other refuse to prevent overloading the soil.

These conditions are obtained in different ways. In some cities the refuse is spread on the ground and then ploughed under. Another method is that of digging a trench, covering each day's collection of refuse with the soil, removed for the next day's supply. In any case, refuse that can be burned should be so treated and garbage and other organic waste can be more effectively handled by mixing it with other waste such as ashes, street sweepings, etc. It is claimed that 1.5 acres are necessary to handle each daily ton of garbage permanently. The soil can be re-used at the end of two years.—Conservation.

Three free scholarships, each covering four years' tuition in the Faculty of Applied Science at McGill University, have been offered by the Grand Trunk Railway Company to apprentices and other employees under twenty-one years of age, sons of railway employees. The competitive examination will be the regular university matriculation examination, beginning June 12th. The three candidates making the highest scores will receive the scholarships. Students will be required to enter the service of the company during vacation periods.

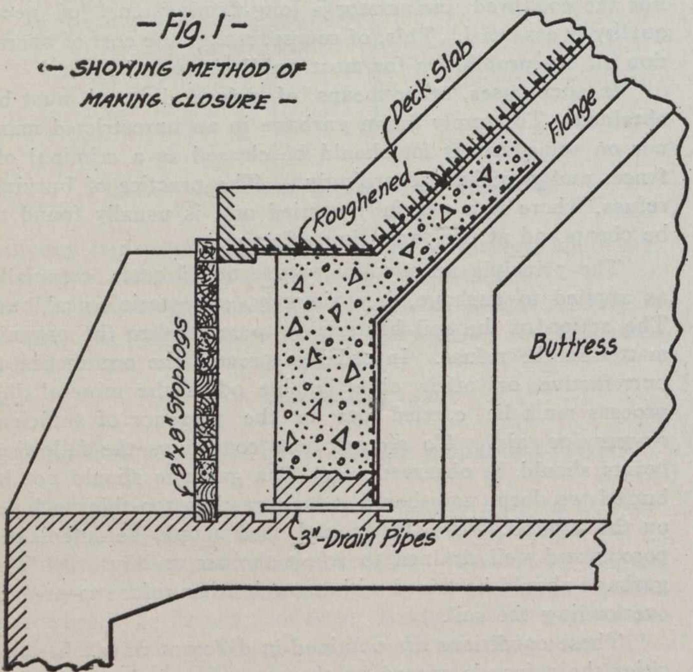
REINFORCED CONCRETE HOLLOW DAM OF BUTTRESS TYPE.

By J. K. Finch and W. F. Thoman.

Concrete-steel is a relatively new material and the design of structures involving its use has not yet reached that state of standardization which exists, for example, in structural steel work. Certain tables and rules have been devised but in the details of design much is left to the ingenuity and practical skill of the designer. The nature of the material and its method of fabrication are almost entirely responsible for this. The manufacture of steel is carried out in a shop under ideal conditions for fabrication and inspection, and its erection is merely a matter of assembling and putting together the various units that go to make up the structure. Reinforced concrete, on the other hand, is manufactured in place, in the field, sometimes under far more ideal conditions, and by labor that is, for the most part, unskilled. Its supervision should always be in the hands of experienced and competent men. Unfortunately, this is not always the case and oftentimes the caliber of the construction organization will have considerable influence in determining the details of design.

-Fig. 1-

— SHOWING METHOD OF MAKING CLOSURE —



The forms, or molds, for the concrete exert even a greater influence. The cost of the forms is usually from one-half to two-thirds of the entire labor cost in a concrete structure, and very often economy of materials must be sacrificed to the simplification of the form work. As a general rule, all details should be made as simple as possible. Where the erection is to be beyond the control or supervision of the designer, great caution should be exercised in designing and delineating small but important details which may appear unimportant to the man in the field. The monolithic character of concrete will also introduce stresses due to continuity which may sometimes be used to advantage, but must always be provided for. Contraction and expansion must also be taken care of by the designer and not left to the ingenuity of the erector.

In this and the following papers, the notation, formulæ, unit stresses, etc., recommended by the Joint Committee on Reinforced Concrete will be mainly followed.*

* Proceedings, Am. Soc. C.E., February, 1913, p. 117.

Four or five types of hollow concrete dams have been developed, but the most widely used and the original form is the buttress type, which is here discussed. This form is patented by the Ambursen Hydraulic Construction Company, Limited, of Boston, Mass.

The first dam of this kind was built at Theresa, N.Y., in 1903, and was designed by Messrs. Ambursen and Sayles, of Watertown, N.Y. Since that time, over 75 dams have been built, varying in height up to 150 feet and in length up to 1,200 feet.

It is not the purpose of this paper to discuss at any length the merits of this type but a brief summary of its advantages seems desirable.

Compared with the regular gravity section of stone or cyclopean masonry we note that the latter is usually designed in such a way that the resultant pressure on the base acts at or near the down-stream edge of its middle third. Here the water pressure is turned downward by the weight of the masonry alone, and it is readily seen that an increase in head on such a dam will cause the resultant to pass outside the middle third, producing tension at the upper toe and finally overturning the structure if it does not fail in some other was before this occurs. In the hollow type the inclined slab causes the water pressure to be directed downward at all times, and the resultant pressure can be made to cut the base at any desired point by varying the design.

The facility with which the base pressure may be reduced in intensity by spreading the base, and made uniform over the base by correct proportioning is one of the marked advantages of this type of dam. In some cases, where the river bed is a hardpan or cemented gravel, overlying impermeable strata, the dam may be built directly on this material, because of this fact, and no deep foundations need be used. Extreme caution should be exercised in using this form of construction, however, and in general the buttresses should rest on rock or its equivalent, and the cut-off wall should extend to impermeable strata below all possible underflow.

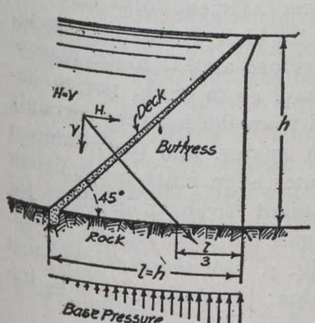
The danger of ice thrust is also eliminated, as an ice jam would be forced up the inclined slab and its weight distributed over the structure, or, if the water were high enough, would be forced over the top of the dam.

While the hollow dam will, in general, cost less than a masonry structure of the gravity type, and while there are many places where the easy control of base pressure in the former makes it available because the cost of the latter would be prohibitive, no fixed cost relation can be given. Reinforced concrete work requires steel and lumber, the cost of which may, in some localities, be excessive, making a gravity dam more economical.

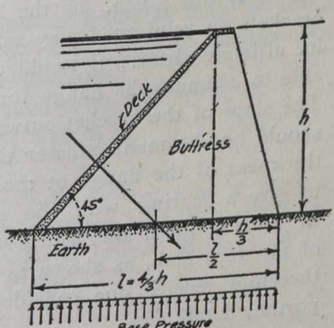
No actual failures have been recorded, but the oldest dam has been in service only 10 years. Cases have occurred in which the foundation has washed out under the dam, which has arched over the opening and remained practically intact. These serve to emphasize very forcibly the necessity of having the cut-off wall extend to a sufficient depth. It should also be remembered that the strength of the structure depends primarily on the imbedded steel, which must therefore be fully protected from rust. This can be done only by proper allowance for temperature cracks, by the use of expansion joints, and by using a concrete which will be essentially watertight.

Spillway.—Several types have been developed, depending on the head and on the foundation material. On ledge rock, a spillway section with a complete or part rollway is used when the fall exceeds 10 feet or thereabouts, depending on the quality of the rock surface and its ability to withstand the force of the falling water. On soft material, either a water cushion must be formed for low heads, possibly by slightly extending the base of the dam and placing a small barrier dam at its downstream edge, or a complete rollway, with or without an apron to prevent scour, must be used.

Construction.—The usual method is similar to that employed in the construction of masonry dams, but the required cofferdam is usually far less costly and of a more temporary character. The foundation and lower sections of the bulkhead are first constructed, and the entire flow of the stream is allowed to pass through this partially completed section while the upper parts of the buttress and slab are being erected and the remaining portions of the dam completed. The final closure is usually made as shown in Fig. 1, without employing any expensive cofferdam. This method is patented. The procedure in the erection, field joints, and forms will be discussed further on.



-Fig.2-



-Fig.3-

Slope of Deck and Shape of Buttress.—The deck slope is generally made 45 deg. The reason for this becomes clear by reference to Figs. 2 and 3. Fig. 2 represents a dam on a rock foundation where the resultant base pressure may be allowed to take the triangular form, i.e., the resultant may cut the base at or inside the middle third. This result must be obtained at the least cost. Neglecting the weight of the dam itself, and drawing the buttress with a vertical downstream face, which will evidently be the minimum practical form, it may be easily shown that a 45 deg. slope for the deck just satisfies this condition. A steeper slope would result in a little saving in the deck but would require an addition to the buttress on the downstream side to keep the resultant within the required limit. A greater slope would result in an increased slab and buttress. The relation, base equals height, therefore represents the economical proportions for this type of dam on a rock foundation.

On some foundations it is evident that it will be advantageous to have a practically uniform distribution of loading over the base. A brief consideration will show that this can best be obtained by applying an additional downstream section to the buttress, as shown in Fig. 3, giving a total bottom width equal to 1⅓ h. The uniform distribution of pressure could have been obtained, it is true, by decreasing the slope of the deck, but this would result in increasing the vertical component of the resultant water pressure and thus also the intensity of the base pressure, a condition not desired. It is therefore clear that the slope of the deck may be made 40 deg. for all conditions and, in softer material, the buttress may be given a downstream slope of between 0.25 and 0.33 of its height; this will bring the centre of pressure about the centre of the base, when the weight of the dam is considered in conjunction with the vertical component of the water pressure.

The top width of the buttress may be zero, but will generally be made 3 or 4 feet, to provide additional strength for ice thrust, where such is liable to occur, or to carry a walk across the top of the dam to facilitate inspection, etc. Where no ice is expected the walk may be carried on brackets, as shown in Fig. 2.

Buttress Thickness.—The buttress may have a tapering section, varying from a minimum thickness of 12 in. at the top to dimensions determined by the allowable pressure on the concrete, and shear at the different depths. The tapered section is, however, not so advantageous from the constructor's standpoint as a vertical section, increasing by offsets at intervals of 10 or 12 ft.; this plan offers a support for the bottom of the forms for each "lift." The minimum section should therefore be of 12-in. thickness for not over 10 or 12 ft., and should be increased in thickness 2 in. for each additional 10 or 12 ft. of depth, or as required by the working stresses in the concrete. A 1:3:6 concrete is commonly used for the buttresses, the allowable compression on which may be taken at 300 lb. and direct shear at 75 lb. per sq. inch.

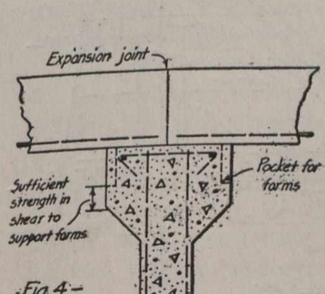
Struts.—These should be introduced at suitable points to brace the buttresses transversely. They should be placed a distance apart not over 15 times the thickness of the buttress and, to facilitate construction, should be placed at the levels where the offsets in the buttress occur. Their least dimension should not be less than 1/15 the distance between buttresses, and they should be reinforced to act as columns and carry their own weight as beams.

Spacing of Buttresses.—This will usually be between 14 and 18 ft., depending on the height and unit costs. As the distance, centre to centre of the buttresses is decreased, the span of the deck slab is decreased, and hence a saving in its cost results. More buttresses will be required, however. It is therefore clear that there must be some spacing which results in the greatest economy.

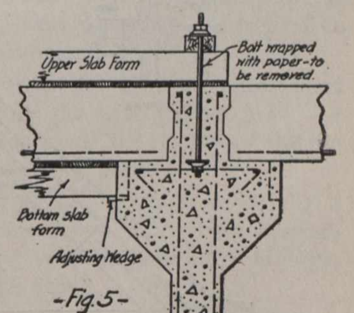
This economical spacing may be determined by the formula:

$$l^2 = \frac{370 + 17.5\,h}{\sqrt{\frac{h}{2}}}$$

in which h represents the average head and l is the spacing of buttresses. This formula can be readily derived by finding the volume of concrete and steel, and the area of form



-Fig.4-



-Fig.5-

work in the deck, buttresses and foundations in terms of h and l; applying to the same certain assumed unit prices and taking the first derivative of the total cost with respect to l. By equating this result to zero the value of l as above is found to satisfy the conditions of minimum cost under the units assumed. The unit prices will, of course, vary with local conditions but it will be found upon analysis of the formula that even under considerable variation in the unit prices the value of l will not change much. The prices assumed in this case include only the items affected by a variation in the buttress spacing, and were as follows:

Concrete in deck	14.0c. per cu. ft.
Concrete in buttress and foundation	12.0c. per cu. ft.
Steel in deck and foundation	1.9c. per lb.
Steel in buttress	2.0c. per lb.
Forms (labor only)	10.0c. per sq. ft.

Substituting in the above equation the average value of h, which is 18 ft. for the design hereafter considered, gives the economical spacing of 15 ft., which has been used.

Buttress Flanges.—Two methods are available for making the connection between buttresses and adjoining slabs. A continuous slab over the buttress would not be used, as expansion joints will be placed here to prevent cracks from forming in the deck. This point has already been discussed, and is of vital importance.

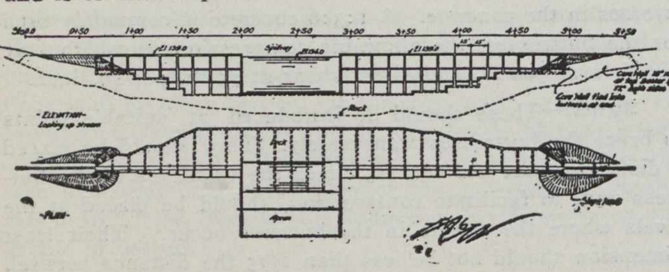


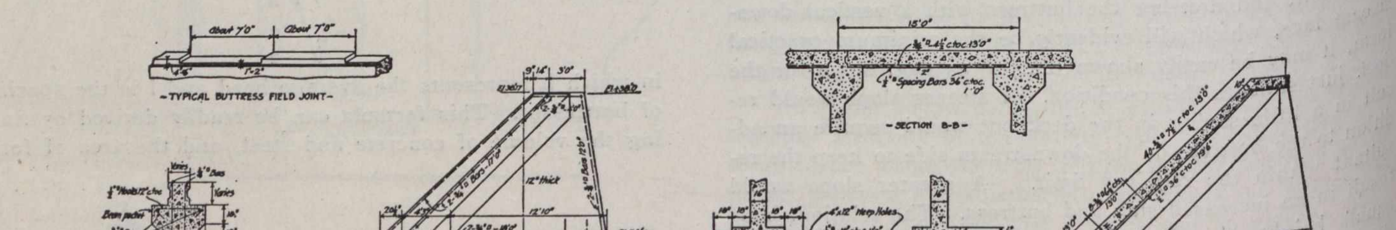
Fig. 6.

The type of joint shown in Fig. 4 is evidently very simple and would doubtless be preferred by some engineers, as it would be less costly than that shown in Fig. 5. The latter possesses some important advantages, however. Thus, the joints for expansion are doubled. The projecting portion between the slabs is cast with the buttress and not only furnishes lateral stability to the buttress from the slabs, but also furnishes a support for the top slab form and acts as a bulkhead when the slab is cast, thus saving this troublesome detail. It enables a bolt to be set in, as shown, to hold the outside form for the slab, said bolt being removed with the forms without leaving any hole through the slab. The slab span is also shortened by the greater projection of the flanges, and its cost is reduced, while the large mass of concrete thus concentrated in the flanges adds greatly to the stability of the structure.

The design of these flanges is largely a matter of judgment. It has been shown by tests of simply supported beams, with straight horizontal rods, that the length of support (overhang of the bracket or flange) must be greater than that required simply to keep the bearing pressure within reasonable limits, or the beam will fail in bond at the ends. It may also be shown by a simple computation involving the increase of concrete and steel in the projection, and the corresponding saving in the concrete and steel of the slab, that for economy the average projection may generally be made about equal to the average slab thickness.

If we attack the problem in another manner, that is, by computing the thickness required for shear, we shall generally arrive at about the some figures. Thus recent tests[1] have shown that a plain concrete bracket will take an ultimate shear of about 100 lb. per sq. in. on the section where it joins the buttress. The same tests prove conclusively that the hook form of reinforcement, such as is shown in the design herewith given, is the most efficient form and that brackets so reinforced may take as high as 400 lb. per sq. in. ultimate shear. It would therefore appear to be reasonable to compute the flange for, say, 40 to 60 lb. per sq. in. The slope of the bracket outward from the buttress certainly should not be made greater than 45 deg. and the minimum thickness of the flange at the outer edge must be sufficient to give a bearing with the required strength in shear for the ends of the beams which support the form for the bottom of the deck slab, as shown in Fig. 5. All these points must therefore receive due consideration in designing this important detail.

The flange may, of course, be decreased in size toward the top of the buttress, and this would be done in very high dams. In dams of moderate height, however, it will be seen that economy in forms makes it desirable to keep the projection the same throughout, and simply cut down the depth or thickness. This can be easily done, using the same forms throughout, if they are properly designed. In the design hereafter considered, the same projection is used throughout.



-Fig. 7-

The size of reinforcing rods is largely a matter of judgment. Tests show that the best form is the horizontal hook. Two vertical rods are run down the flanges and the smaller transverse bars are hooked over them. These hooks and rods serve the double purpose of reinforcing the projection

[1] Concrete-Cement Age, February, 1913, p. 68.

as a cantilever, and also in aiding to take up any tension in the direction of the slab, due to the friction between the slab and the bracket, which may occur if the slab contracts.

Deck.—The thickness of the deck slab should not be less than 10 in. at the top, to allow space for properly placing and tamping the concrete on the deck. This concrete should be a rich, dense mixture, usually 1:2:4, and should be mixed wet to insure the filling of all voids and the thorough coating and protection of the rods.

It will generally be found that if the thickness is assumed as 10 in. at the top, and is computed at the bottom of the buttress, that a straight line between these points will give a sufficient thickness at any depth. A change in deck slope at each lift may be made without any difficulty, so that economy will result if the thickness is computed at these points and the slope made uniform between them.

Slab Formulas.—The following formulas may be easily deduced from the thickness of the slab and the required amount of steel for bending at any depth.

Let w = weight of any liquid in lb. per cu. ft.

x = depth of liquid on slab in ft.

l = span of slab in ft.

Then the bending moment in the slab $= wxl^2 \div 8$ for a non-continuous slab, and with water at 62.5 lb. per cu. ft. $M = 7.898xl^2$. But from formula for reinforced slabs, $M = Cbd^2$, and we have

$$d = \sqrt{\frac{7.818xl^2}{Cb}} \quad \text{.....................(a)}$$

For a 1:2:4 concrete, with $n = 15$, $f_c = 600$ and $f = 14{,}000$ lb. per sq. in., $C = 8.50$ ft. lb. and $b = 12$ in. for a slab. Hence in non-continuous beams, d in inches $= 0.277\, l \sqrt{}$ ....(b)

Also from the formula $A_s = \frac{M}{f\,jd}$ we have $A_s = \frac{7.818xl^2}{f_s jd}$ per ft. width of slab, where A_s is in square inches. Now the spacing of the bars in inches to obtain this area is $S = 12 \times$ area of one bar $\div A$. Hence the spacing at any depth is:

$$S = \frac{12 \times \text{area of one bar} \times f_s jd}{7.818xl^2} = K\frac{d}{x} \quad \text{...........(c)}$$

where K is a constant when the size of the bars to use has been decided on, the other quantities being known.

The shear, as a measure of diagonal tension, may generally be taken at a somewhat higher figure than customary as the slab will be so thick in proportion to its span at the depth where the shear is high that considerable arching will occur. Taking this figure at 60 lb. per sq. in. we find: Reaction per inch of slab

$$= \frac{62.5lx}{2 \times 12} = \tfrac{7}{8} \times 60d = \tfrac{7}{8} \times 60 \times 0.277\, l \sqrt{x}$$

giving $x = 31$ ft.; that is, when the height of dam exceeds 31 ft. the shear in the slab neer the buttresses becomes the limiting factor. As the depth increases a slab of arched section may be used, giving a sufficient thickness of concrete at the ends that the shear will not exceed 60 lb. per sq. in., and the required steel is introduced for bending. An increase in the strength of slab to resist diagonal tension could, of course, be obtained by using stirrups. This would permit a shear up to 120 lb. but it would be very difficult, if not impossible, to place the stirrups properly in constructing the slab, hence this method is not used.

Foundation.—On firm ledge rock no spread footing may be necessary, but on softer rock a stepped-out footing can be used. By varying the width of footing the unit pressure may be made almost uniform, even with a buttress of the shape shown in Fig. 2. In some cases, the bases of the buttresses are stepped out, the thickness and amount of steel being computed, with due allowance to shear and bending, on the assumption that the spread acts as a cantilever, and the remaining space between buttresses covered with a reinforced floor which is computed as a continuous beam supported by the cantilever footings. Weep holes are placed at intervals throughout the base to prevent upward water pressure on it.

The angle of the resultant pressure on the base should also be investigated, and proper precautions taken to prevent sliding of the dam.

Spillway.—The length, elevation, and depth of probable flood flow having been decided on, it remains to take care of this flow so that no damage will result to the structure. The following formula has been used in designing the curve for the upper part of the spillway.[2]

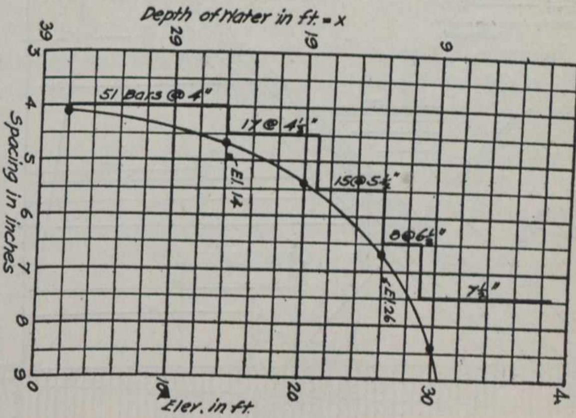


Fig. 8.

$$x^2 = 2.3 \times H \times y \quad \text{................(d)}$$

Where x = the offset in feet.

y = the distance below crest in feet.

H = depth of flood flow in feet.

It is believed that this equation gives a spillway curve such that the overflowing water will adhere to the spillway surface and no vacuum effect will be possible. In order to guard against this, however, vent pipes are introduced in each bay, as shown in the accompanying drawing.

No satisfactory method seems to have been developed for designing the lower curve of the ogee section. In the design given this curve has been made the reverse of the top curve, which seems to be a safe procedure.

The design of the curved spillway slab is essentially a matter of judgment, the thickness and reinforcing depending on the expected flood flow and the possibility of logs, ice, etc., being carried over the dam.

General Conditions.—The general layout and profile are shown in Fig. 6. The conditions for the design are as follows:—

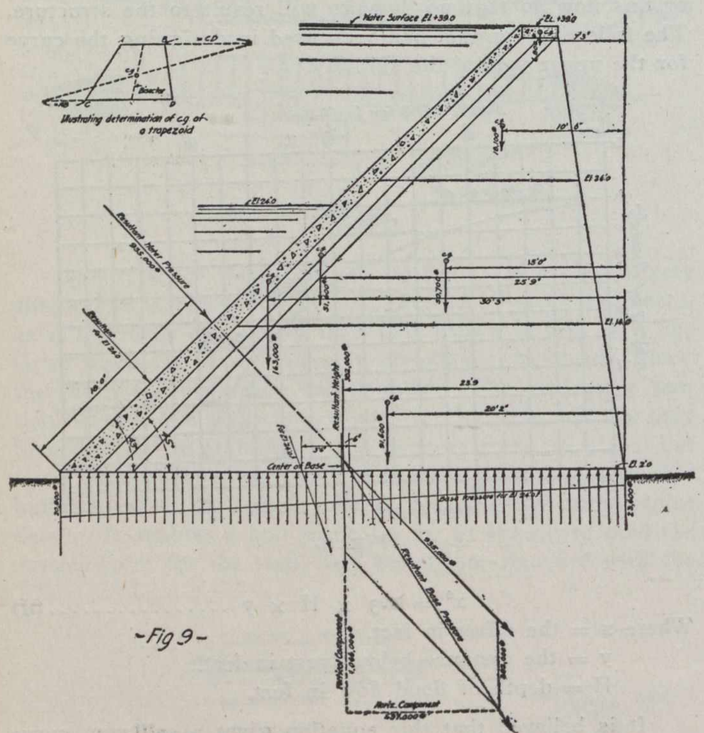
In order to illustrate the method followed in such a design, the river bed will be assumed as hardpan and the conditions such that the dam may be built on a spread foundation resting directly on the river bottom, provided the foundation pressure is made uniform and at an intensity not to exceed 2 tons per sq. ft. A full rollway section for the spillway, with downstream apron to prevent scour, is also desirable.

[2] Eng. Rec., October 24, 1908, p. 461.

Elevation of crest of spillway will be taken at + 36 ft.; maximum flood height 37.5 ft.; and crest of dam + 39 ft., making an allowance for waves, etc., of 1.5 ft. Dam will be designed for a head of water equal to the full height of dam and the spillway to pass a 3-ft. flood.

Unit stresses in lb. per sq. in.

	Deck and apron.	Buttress.	Footing.
Mixture	1:2:4	1:3:6	1:3:6
Concrete in compression	600 (bending)	300 (direct)	500 (bending)
Concrete in shear (direct)	—	75	75
Concrete in shear (diag. tension)	60	—	40
Steel in tension	14,000	—	14,000



-Fig 9-

The section at greatest depth only will be designed. For other depths, a similar section is used, the floor system being stepped up, as shown in Fig. 6, with step-up walls designed to assist the lateral earth pressure, and provided with pipe drains to prevent the possibility of water pressure.

Buttresses.—Width of base will be made about 0.3 greater than height (37 ft.) or 48 ft. Top width for walk, 3 ft. Built in three lifts of 12 ft., and thickness of 12, 14, and 16 in., as shown on Fig. 7. Reinforcing bars will be placed as shown to tie the buttress together, as it has been found from experience that they are necessary to prevent cracks. Struts will be used as shown, and door openings left in each buttress, with connecting slab, forming a passageway entirely through the dam.

Buttress flanges will be made with an overhang of 18 in. or about equal to the depth of slab. This is a little over the economical amount but inasmuch as it will be found later that the minimum thickness of the outer edge of the overhang must be about 16 in. in order to support the forms, this figure will be used, as it gives a proper proportioning. As a check, the shear should be computed at the centre of the flange, using about 50 lb. per sq. in. This will be found to check closely with the design given. The same forms will be used throughout, so the overhang will remain constant.

Slab.—Using a minimum of 10 in. at the top, the required thickness at elevations 2.0, 14.0, and 26.0 are computed by equation (b) and found to be 22, 19 and 14½ in. respectively, allowing 2 in. for protection. At elevation 2.0, however, the depth is 37 ft.; hence the shear, as a measure of diagonal tension, will control. This may be taken at 60 lb. per sq. in., a high value, which is permissible because the slab is so deep in comparison to its span that arching will doubtless occur. Hence

$$d = \frac{62.5 \times 12.16 \times 37}{2 \times 12 \times 60 \times \frac{7}{8}} = 22 \text{ in.} + \text{protection} = 24 \text{ in.}$$

and the slab will be made 24 in. thick.

The steel may now be computed from equation (c) which reduces to $S = 6.95\, d \div x$ if we use ¾-in. square bars. These bars are used as they will give a reasonable spacing (4 in.) at the bottom of the slab and may be used throughout with very little waste. It is a poor plan to use bars of different sizes in the deck, as there is a possibility of the bars being placed incorrectly. It is also preferable to make the change in spacing at the lift levels where the forms will be changed.

At el. 2	effective depth = 22 in.	x = 37 ft.	and S =	4.1 in.
" " 14	" " = 17.0 "	= 25 "	=	4.7 "
" " 20	" " = 14.75 "	= 19 "	=	5.4 "
" " 26	" " = 12.5 "	= 13 "	=	6.7 "
" " 32	" " = 12.25 "	= 7 "	=	12.0 "

Plotting these results we obtain the curve shown in Fig. 8, from which the spacing of the bars is taken as indicated.

Spacing bars ½ in. square, 36 in. on centres, will be used throughout the slab to hold and secure the reinforcing bars at the proper spacing, and will be lapped 2 ft. into each "lift" of the slab to tie the sections together.

It now remains to check the buttress design for shear and compression, determine the foundation pressure and design the footings.

The horizontal water pressures may be found from the formula $wx^2 \div 2$, which amounts, divided by the area of the buttress section at elevations 26.0, 14.0, and 2.0, give 22, 44 and 61 lb. per sq. in. respectively, which stresses are within the allowable.

Foundation Pressure.—Fig. 9 shows the graphical construction for determining the base pressure. The weights of the slab, flanges, and sections of the buttress are first computed, allowing 150 lb. per cu. ft. for the concrete. The centre of gravity of each section is then determined as shown, and the line of action of the entire weight of the dam is determined by taking moments about the toe. Thus:

	Weight.		Moment about toe.
Walk	6,800 lb.	× 7.25 =	49,000
Top lift buttress	18,100 "	× 10.5 =	190,000
Middle lift buttress	50,700 "	× 15.0 =	760,000
Bottom lift buttress	91,600 "	× 20.17 =	1,840,000
Slab	163,200 "	× 30.25 =	4,950,000
Flanges	51,600 "	× 25.75 =	1,328,000
Total	382,000 "	Tl. moment =	9,117,000

Distance from lower toe to line of action = 9,117,000 ÷ 382,000 = 23.9 ft.

The resultant water pressure per bay, which acts one-third up the inclined slab and at right angles thereto, (note that the slope of the front face of slab is about 43°) is found

$$\text{to be } \frac{62.5 \times 37}{2} \times 54 \times 15 = 935,000 \text{ lb.}$$

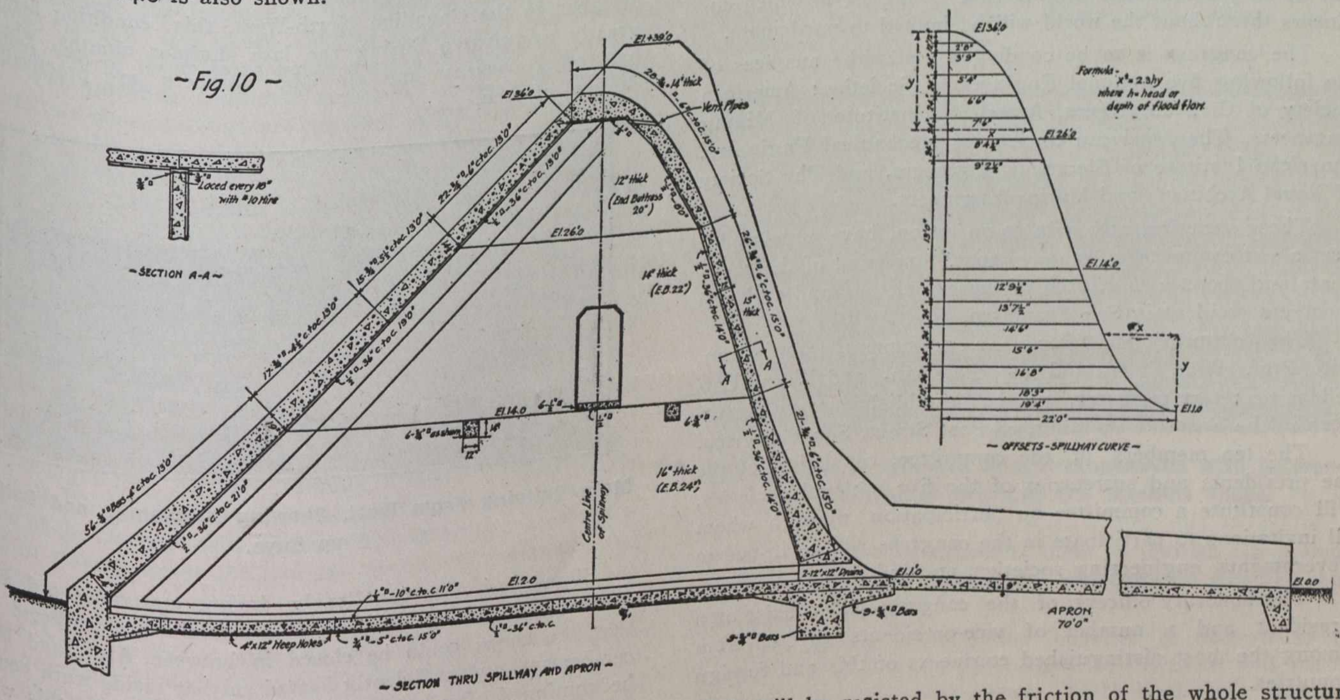
Combining this with the total weight of dam, as shown, the resultant is found to cut the base 0.5 ft. downstream from the centre. The total weight of dam plus 935,000 × cos 43° (or 684,000 lb., the vertical component of the water pressure) gives the total normal pressure on the base of 1,066,000 lb. Using the well-known formula,[3]

$$p = \frac{P}{l}\left(1 \pm \frac{6b}{l}\right)$$

where p = pressure on base in lb. per lin. ft.
P = total vertical load in lb.
l = length of base in ft.
b = distance resultant pressure to centre of base in ft.
we get an equivalent uniform load of 22,200 lb. per lin. ft. and p (max.) = 23,600 and p (min.) = 20,800 lb. per lin. foot.

As the width of buttress is 16 in. this represents a maximum compressive stress on the buttress of 23,600 ÷ (12 × 16) = 123 lb. per sq. in., which is entirely satisfactory. A similar computation for elevations 14.0 and 26.0 will also give results well within the limit of 300 lb. allowed.

The resulting pressure on the base with the water level at elevation 24.0 is also shown.



Footings.—A cross-section of the footing is shown in Fig. 7. It is designed as a simple cantilever footing having a width sufficient to transmit the load from the buttress to the soil at a reasonable unit foundation pressure. Thus, if we assume the width of cantilever as 10.5 ft. the load will be 2,250 lb. per sq. ft. The exact distribution of the foundation pressure is indeterminate and the unit pressure directly under the footing will probably be in excess of the above figure, but it is thought that this represents a safe design for the footing. The thickness of the cantilever next to the buttress will be controlled by shear, which may be taken at 50 lb. per sq. in., giving a required thickness of 2,250 × 4.58 ÷ 12 × 7/8 × 50 = 19½ + 2½ in. protection = 22 in.

The bending moment will be
M = (2,250 × 4.58 × 4.58) ÷ 2 = 23,600 ft. lbs.
From the formula A = M ÷ f_s jd; with f_s = 14,000, f_c = 500, n = 15, we have j = 0.884 and

$$A_s = \frac{M}{1030d} = \frac{23,600}{1030 \times 19\frac{1}{2}} = 1.17 \text{ sq. in. per}$$

or ¾ in. square bars, 6 in. centre to centre, will be required.

The points where the raises in the footing may be made so that the shear may not exceed 50 lb. can be found by drawing a line from the edge of the buttress at the top of the footing to the centre of steel at the edge of the cantilever. This gives a convenient raise of 6 in. with an offset of 18 inches.

The slab covering the space between the ends of the footings will be computed as a continuous beam with a span of 15 — 10.5 = 4.5 ft. The maximum load that could come on this slab would occur on the assumption that the foundation load is uniformly distributed over the entire foundation. This assumption would give a load of 23,600 ÷ 15 = 1,570 lb. per sq. ft., and the bending moment in the slab would be M = (1,570 × 4½ × 4½) ÷ 12 = 2,650 ft. lb., requiring an area of steel A_s = 2,650 ÷ (1,030 × 8½) = 0.30 sq. in. per ft., which can be obtained by using ½-in. square bars 10 in. centre to centre.

Stability Against Sliding.—The horizontal component of the water pressure will be 935,000 × sin 43° = 637,000 lb. This will be resisted by the friction of the whole structure on its base, plus the resistance of any projections that may be placed on the base for that purpose. Adding to the total weight already determined, 1,066,000 lb., the weight of the floor, which is 150,000 lb., we find that the coefficient of friction must be equal to 637,000 ÷ 1,216,000 = 0.52. This is a rather high value, and if any doubt exists of the ability of the foundation material to give this resistance to sliding, the dam should be provided with base projections of sufficient size to resist the unbalanced thrust. The 4-ft. cutoff wall, shown in Fig. 10 at the downstream toe, will aid in resisting sliding, but should not be counted on to do so as its function is simply to prevent possible backwash from undermining the floor.

Spillway.—The spillway design is given in Fig. 10. The formula used to compute the spillway curve has already been stated and it was also stated that the design of the rollway slab was largely a matter of judgment. The other features

[3] See Baker's "Masonry Construction," p. 473.

of the design are identical with those already discussed, and no further computations will be made.

Forms.—Wall forms will be built in panels, as shown, the area of the panel being determined by the fact that, even where derricks and cable-ways are available, conditions frequently arise that require the manhandling of forms; hence they must be within the lifting capacity of the number of men that can be conveniently grouped around them for that purpose. For this reason no form will exceed 800 lb. in weight.

All forms will be designed to resist the loadings due to pressure of water in the concrete for the full heights of each lift.

Stresses used will be based upon the ultimate unit stresses recommended by the Association of Railway Superintendents with a safety factor of three, which is ample for temporary work of this character.

INTERNATIONAL ENGINEERING CONGRESS, 1915.

In connection with the Panama-Pacific International Exhibition which will be held in San Francisco in 1915, there will be an International Engineering Congress, in which engineers throughout the world will be invited to participate.

The congress is to be conducted under the auspices of the following five national Engineering Societies: American Society of Civil Engineers, American Institute of Mining Engineers, The American Society of Mechanical Engineers, American Institute of Electrical Engineers, and The Society of Naval Architects and Marine Engineers.

These societies, acting in co-operation, have appointed a permanent committee of management, consisting of the presidents and secretaries of each of these societies, and eighteen members resident in San Francisco.

The committee has effected a permanent organization, with Prof. Wm. F. Durand as chairman, and W. A. Cattell as secretary-treasurer, and has established executive offices in the Foxcroft Building, 68 Post Street, San Francisco.

The ten members of the committee, consisting of the the presidents and secretaries of the five national societies, will constitute a committee on participation, through whom all invitations to participate in the congress will be issued to governments, engineering societies, and individuals.

The honorary officers of the congress will consist of a president and a number of vice-presidents selected from among the most distinguished engineers of this and foreign countries.

The papers presented at the congress will naturally be divided into groups or sections. During the congress each section will hold independent sessions, which will be presided over by a chairman eminent in the branches of engineering covered by his section.

The scope of the congress has not as yet been definitely determined, but it is hoped to make it widely representative of the best engineering practice throughout the world, and it is intended that the papers, discussions and proceedings shall constitute an adequate review of the progress made during the past decade and an authoritative presentation of the latest developments and most approved practices in the various branches of engineering work.

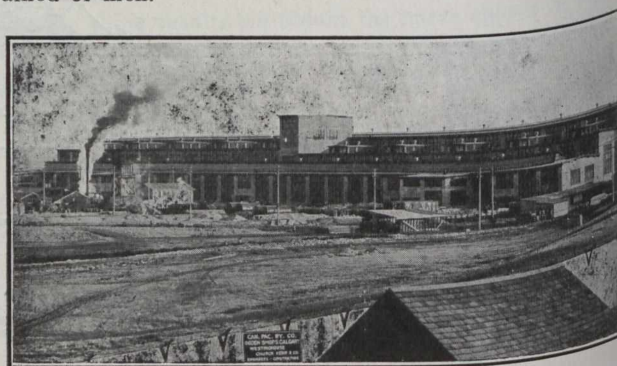
The papers, which will be collected and published by the congress, should form an invaluable engineering library, and it is intended that this publication shall be in such form and at such cost as to become available to the greatest possible number.

CANADIAN PACIFIC RAILWAY SHOPS AT OGDEN, ALBERTA.

The Canadian Pacific Railway has recently put in operation near Calgary, Canada, a large shop plant of more than ordinary interest by reason of its size, its complete and modern character, and the speed with which it was created.

The work was designed and built in its entirety by Westinghouse, Church, Kerr & Company, consulting and constructing engineers, of Montreal and New York, working under the direction of Mr. J. G. Sullivan, chief engineer of the western lines of the Canadian Pacific Railway, and Mr. N. E. Brooks, divisional engineer.

The shop location is at Ogden (named in honor of a vice-president of the railway), and is 4½ miles from Calgary and about 2,250 miles from Montreal. Its distance from those sections of the country where the greater part of the construction materials, machinery and equipment were produced constituted the first and one of the most important problems. A second important problem arose on account of the construction season being extremely short, owing to the high latitude, frost remaining in the ground until about April 1st and returning with snow as early as October 1st. A third very important problem was the comparative scarcity of labor in the Canadian North-West, this condition being greatly aggravated during the late summer months, when harvesting begins and all labor markets are practically drained of men.



Main Building From West, Showing Blacksmith and Boiler Shop Bays.

Plans had, therefore, to be drawn, materials ordered, deliveries made and complete field organization perfected so that the shops could be closed in between April and December 1st, and sufficiently heated so that inside work could be continued after cold weather had set in. How this was done will be seen by the following progress diagram:—

The shops consist in general of:—

Main locomotive shop (including erecting, machine, blacksmith and boiler shops).

Tender and wheel shop.

Pattern shop and pattern storage.

Foundry.

Storehouse and office building.

Material platforms and scrap docks.

Oil-house.

Carriage repair and paint shop.

Freight car repair shop.

Planing mill.

Boiler-house.

1,260-foot yard crane.

Miscellaneous structures, including transfer table and pit for coach shop, main hoist, wells, and water-tower, and all service systems, such as drainage, sewers, fire protection, water supply, etc.

Main Locomotive Shop.—This building is designed to contain the erecting shop, machine shop, blacksmith shop, and boiler shop.

The erecting shop is of a transverse lift-over type, and contains thirtyfive bays, each twenty-five feet between centres, and is 778 feet long by 75 feet wide. The entire area is served by two travelling electric cranes, carried on two levels. The 120-ton crane, furnished with two 50-ton trolleys, is carried on the upper level, and is used for transferring, wheeling and unwheeling locomotives and handling parts. One of the trolleys on this crane is equipped with a ten-ton auxiliary hoist for handling light material at a high hoisting speed.

Another ten-ton travelling electric crane operates at high speed, and serve the entire area of the erecting shop for handling material in that shop and tranferring same to the blacksmith shop and machine shop. The machine shop and the boiler shop are located in adjacent bays on either side of the erecting shop.

Provision is made on the crane columns in the erecting shop for attaching portable jib cranes for use in dismantling and erecting material on the front ends of locomotives. These cranes are placed where desired by means of the overhead travelling electric cranes.

Entrance for locomotives to the erecting shop is provided through four doors, located in the west side of the shop, two of these doors being located at either end.

For providing additional means for entrance of locomotives, six door openings are provided in the east wall of the machine shop, two of these being at the north end and four at the south end.

All of these entrance tracks are connected up with the erecting pits of the several stalls where they enter the building to permit of the locomotives moving into and out of the shop through these entrances should this movement become desirable or necessary.

The machine shop to contain heavy machine tools is located parallel with and adjoining the erecting shop on one side, and is 60 feet 9 inches wide and the same length as the erecting shop. A high-speed travelling crane of ten-ton capacity covers the entire area of this shop. Material can be brought into the shop through a door provided in the end of the building the material being brought up to the end of the machine shop by the travelling electric yard crane, which travels across the end and outside of the locomotive shop.

Space for the lighter machine tools is provided in a shop 60 feet 9 inches wide parallel with and alongside of the heavy machine shop and of the same length as that shop. An overhead trolley beam is provided on the bottom chord of the roof truss to permit of using a travelling electric trolley for handling material longitudinally in this shop. Provision has been made for a foreman's office elevated above the floor and having liberal glass surface in the walls so as to give the best possible view of the shop.

The blacksmith shop is located alongside of and parallel with the erecting shop on the opposite side from the machine shop. This building consists of two bays, each 332 feet long, 60 feet 9 inches and 50 feet wide, respectively.

Space is provided for heavy forging work, steam hammers, etc., in the building immediately adjoining the erecting shop.

The blacksmith shop will not be served by a travelling crane, but provision has been made for jib cranes to handle the material from steam hammers, forgings, etc.

In a building of lower cross-section alongside are located the furnaces, bolt headers and other blacksmith shop machinery. This portion of the shop is served by a trolley its full length to facilitate the longitudinal movement of material through the shop.

The space for the boiler shop is provided in a two-bay building, alongside of and parallel with the erecting shop at the end of the blacksmith shop, 352 feet long and the same width as the latter shop.

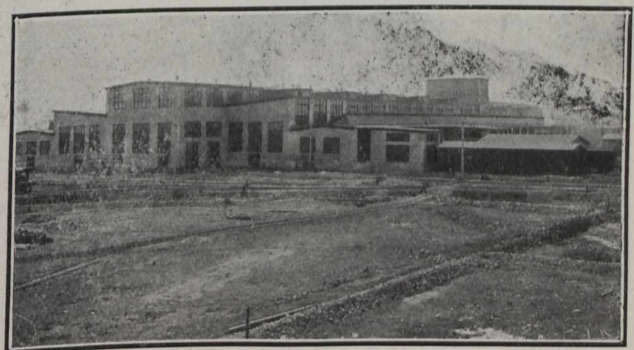
That part of the boiler shop immediately adjoining the erecting shop is provided with a 40-ton travelling electric crane equipped with two 20-ton trolleys serving the entire area of the boiler shop for handling the boilers and other material.

The riveting tower is located between two of the roof trusses in the end of the boiler shop, with a 25-ton crane for serving the hydraulic riveter.

In the outer of the two bays of the boiler shop space is provided for a flue shop and boiler shop tools. The entire length of this space is served by a 3-ton overhead travelling trolley for handling material through the shop. Space for a flue rattler is provided immediately outside of and adjacent to the low bay of the boiler shop.

An entrance track is provided through the outside wall of the boiler shop, on which boilers or other equipment going to this department can be delivered on cars under the travelling crane for unloading or may be loaded out for shipment in the same way. This facilitates the handling of boilers from steam shovels, pile-drivers, Lidgerwoods, etc.

Jib cranes are provided for serving the individual machines in the boiler shop where such service may be necessary.



Northwest View, Showing Roof Arrangements With Reference to Lighting of Erecting and Machine Shops.

The heating throughout is done by indirect fan system. For distributing the heated air underground concrete and tile ducts are used.

The general illumination consists of Cooper-Howitt lamps, with circuit and plug boxes for extension loop cords. Provision has also been made for incandescent lighting circuits for individual lighting at machine tools where required, and for outlet boxes for connecting extension lamp cords to provide lighting for the interior of the locomotive boilers on the erecting floor.

Toilets, lavatories, and metal lockers are provided in the various departments of this shop.

A suitable system of piping is provided for distributing live steam, compressed air, fuel oil, and water for fire protection, drinking and hydraulic pressure.

Outlets for compressed air are provided in duplicate in the sides of each of the engine pits to supply compressed air for operating pneumatic tools.

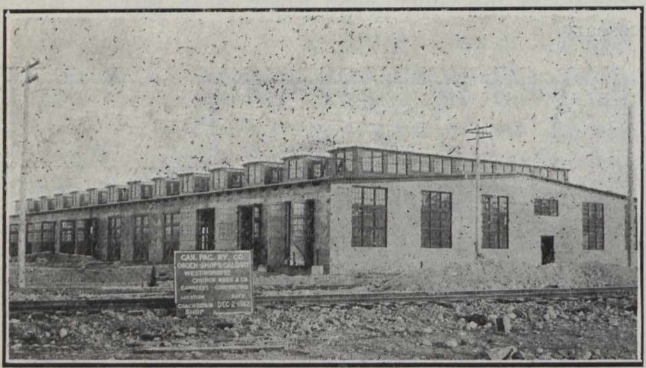
In the main locomotive shop the electrical feeders from the power company's transmission lines are carried in underground ducts, bringing the current at the voltage delivered by the power company, namely, 2,200 volts, to a sub-station located adjacent to and immediately outside of the low machine bay, the transformers for stepping down to 440 volts being located in this sub-station. In this sub-station two motor generator acts for supplying direct current are also located. The switchboard is also located in this sub-station for controlling the power and lighting circuits in the machine shop and for the tender shop and foundry. As far as possible distributing feeders are carried in conduit beneath the shop floor, thereby minimizing the amount of exposed wiring in the shops.

The building containing all of the above departments of the locomotive shop is constructed with structural steel frame carried on concrete foundations. The exterior walls up to the window-sill line are of concrete; above the window-sills of hollow tile, plastered.

Ample window area is provided in the side walls and in roof monitors and skylights so as to give sufficient natural lighting.

Good ventilation is obtained through ventilators in the monitors and skylights and by the use of swinging sash in the vertical walls.

With the exception of the blacksmith shop and a portion of the boiler shop, the floor throughout is constructed with a 1½-inch asphalt mastic wearing surface, which is underlaid with a rough concrete slab about six inches thick. In the blacksmith shop and a portion of the boiler shop the floor is of cinders.



Coach Repair Shop.

The roof sheathing is constructed of 2 x 4's, surfaced on one side and one edge and spiked together on edge, thus affording good fire-resistance qualities and materially reducing the heat losses. The roof waterproofing is four-ply tarred felt, pitch and gravel, with copper flashing. Suitable drain leaders are provided and connected into underground tiled drains to carry off the water from the roof.

The large skylight on the erecting shop bay is of steel bars, lead-covered with ribbed wired glass.

Tender and Wheel Shop.—This building is constructed with structural steel frame and with steel roof trusses, otherwise the general construction of the building is similar to that described for the main locomotive shop. It is an L-shaped structure, 263 feet by 80 feet wide, with L 180 feet long by 80 feet wide, and affords space for making repairs to locomotive tenders, steam shovels and other maintenance-of-way equipment.

That portion of the shop intended to receive the equipment to be repaired is spanned over its entire area by a 20-ton high-speed travelling electric crane equipped with two 10-ton trolleys.

Longitudinal tracks on 20-foot centres extend to the doors in the building wall.

A car-puller is installed for moving the equipment into and out of the shop.

A sufficient number of tracks extend through the rear wall of the building to facilitate the movement of material into the shop.

In the L portion of the building of lower cross section space is provided for steel tire wheel lathes, wheel and axle machinery and such other tools as are required.

A depressed track carried along the ends of the wheel storage tracks outside facilitates unloading and loading of wheels and axles.

The heating, lighting and service equipment is similar to that described for the main locomotive shop.

Pattern Shop and Pattern Storage.—Space for the pattern shop and pattern storage is provided in a separate building, located adjacent to the foundry, a fire-wall separating the pattern shop from the pattern storage.

The general construction of the building is the same as that of the other buildings—the roof of slow-burning mill construction. The structure is 162 feet long by 31 feet wide, is heated by the direct system, and lighted with keyless socket, marine type incandescent lamps. A sprinkler system is provided for fire protection.

Foundry.—The grey iron foundry building is 203 feet long by 80 feet wide, constructed with two bays. The frame is of structural steel, carried on concrete footings. The general construction is the same as that described for the other buildings, except that the floor is of the usual clay type used in foundries, and the roof over the cupola room is of corrugated asbestos.

The bay of higher cross-section is served over its entire length by a 10-ton high-speed travelling electric crane. Jib cranes, attached to building columns, are provided. These cranes are so arranged that they may be removed from one location to another if desired, being handled by the travelling electric crane. In the side bay of lower cross-section space is provided for core-making and shop moulding floor.

The charging floor for the cupola is located in the centre of the lower bay.

Heating is by the indirect fan system, with underground tile and concrete hot-air ducts. For general illumination flaming arcs are used in the high bay and ordinary arcs in the low bay, with outlet boxes for extension lamp cords.

Toilets, lavatories, and conveniences for the men are provided; also steam, air, and water service for fire protection and drinking purposes.

The location of this building alongside of and parallel with the travelling electric yard crane enables the unloading of scrap and pig-iron to be taken care of by the yard crane. This close proximity of the foundry to the yard crane also reduces to a minimum the handling of the castings from the foundry to storage, to the main shop, or in loading for shipment.

Storehouse and Office Building.—This building is 252 ft. 6 in. long by 60 ft. wide. One end of the building for a length of forty feet is carried up three stories, and contains offices on the second and third floors and a fireproof vault. The remainder of the building, for storehouse purposes, is two stories high and contains electric elevator, platform scales, material bins and shelving.

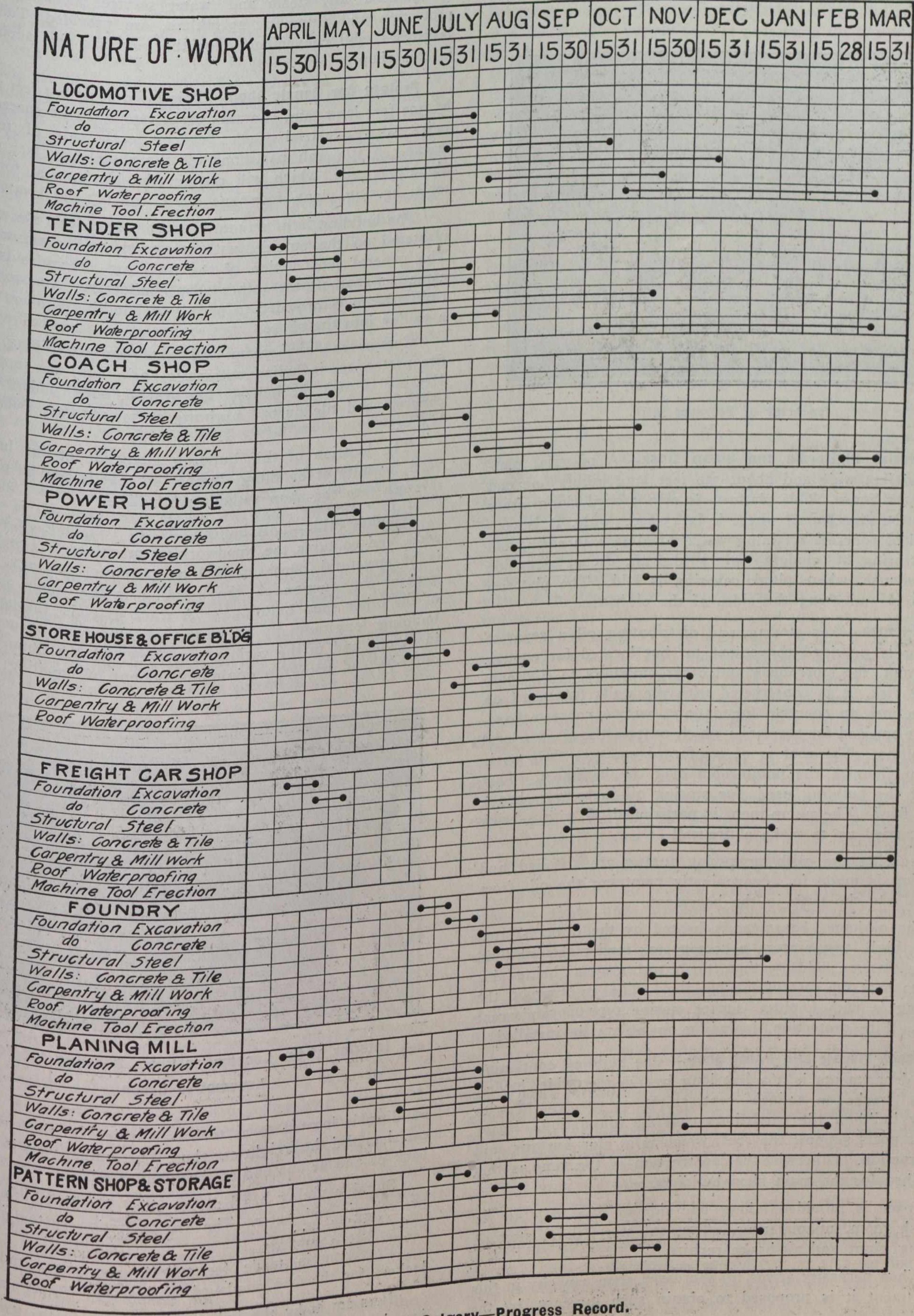
The wall are constructed of hollow-tile blocks on concrete foundations. The framing is of heavy timbers, with roof sheathing of two by fours, surfaced on one side and one edge, and spiked together on edge. The foundations are carried up to bring the floor of the storeroom to car door height.

The necessary toilet and lavatory facilities are provided. The offices are heated by direct radiation, the remainder of the building being heated by the indirect system. The lighting is by incandescent lamps. Fire protection is by automatic sprinklers.

The ground floor of the storehouse has an 1½-inch asphalt mastic wearing surface. The other floors throughout the building are of wood.

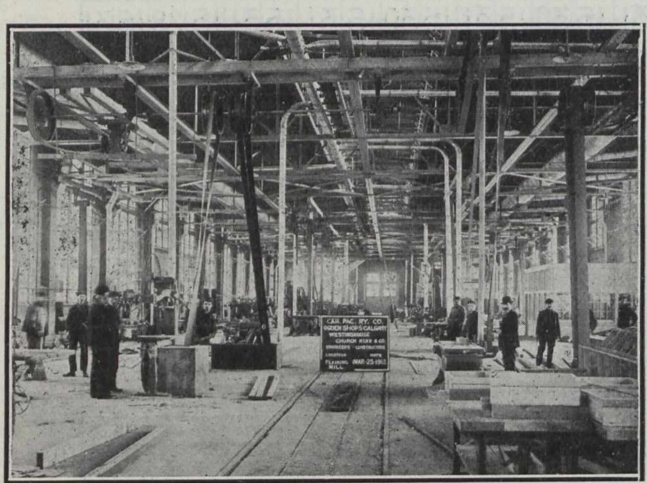
The window arrangement is such as to best accommodate the material bins and shelves without interference with good lighting.

The storehouse is located parallel with the main locomotive shop. The space between these two buildings is spanned by a high-speed travelling crane, which can be



C.P.R. Shops, Calgary—Progress Record.

utilized to handle all heavy material to and from the cars from the storage space that is provide between the storehouse and the erecting shop. The use of this crane practically eliminates manual handling of heavy material, and permits of handling numerous small parts in quantities when contained in suitable receptacles.



Interior of Planing Mill.

Material Platforms and Scrap Dock.—A material platform, 90 feet wide and about 350 feet long, abuts one end of the storehouse. This platform is also carried along either side of the storehouse, where it is 15 feet wide. It is constructed of concrete retaining walls, filled in with earth, and a topdressing of cinders covers the fill, except alongside of storehouse, where plank covering is laid. The platform extends to and along the sides of the oil-house.

Oil-house.—For storing and distributing oil a separate building is provided convenient to, but located far enough away from, the storehouse and other buildings to eliminate the fire risk. It is constructed with tile walls (plastered on the exterior) on concrete foundations, with a concrete basement at one end for the tanks which contain the oil, for local distribution. The roof is of reinforced concrete slab, as is also the floor of the pump-room over the basement. That part of the building used for storing oil in barrels has a cinder floor. The pump-room is partitioned off with a brick wall, carried up to make a fire-wall

Ten oil tanks, with measuring pumps, are installed, and provision is made for conveniently emptying the oil from barrels into the tank in the basement.

The oil-house basement is heated by the direct system to the high temperature necessary to render the oil fluid during extreme cold weather, the direct system being also used to heat the rest of the building. The lighting of the building is with keyless socket marine type incandescent lamps. Fire protection, including sprinklers, is installed.

Coach Repair and Paint Shop.—The building containing these departments is 362 feet long by 146 feet wide, having fifteen tracks on 24-inch centres. It is constructed with hollow building tile carried on concrete foundation. Heavy timber posts support the roof, which is of slow-burning mill construction. Otherwise the construction is the same as that described for the main shop building.

Space is provided along one side of the building for varnish room, upholstering, office, sub-store, paint storage, heating plant and air-brake repairs.

When necessity arises for increased shop capacity in this department it is proposed to obtain such increase by the erection of another shop on the opposite side of the transfer table.

Heating is by the indirect fan system, with underground concrete and tile ducts. Lighting is by incandescent lamps. Compressed air, steam and water service, including fire protection and automatic sprinklers, are provided Toilets, lavatories, and conveniences for the men are also supplied in this shop.

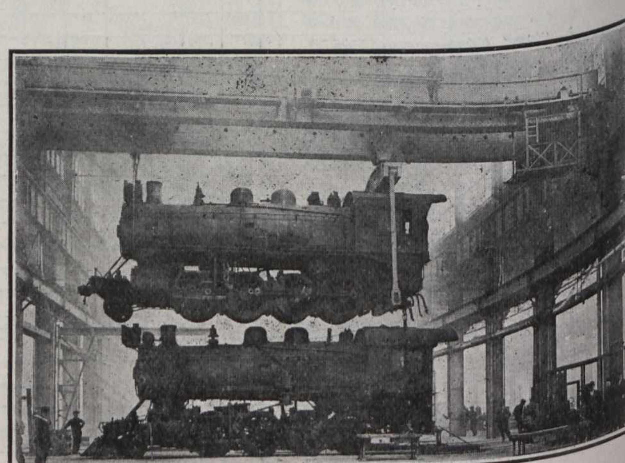
Freight Car Repair Shop.—This building is 231 feet wide by 303 feet long, and contains eight repair tracks spaced in pairs, with industrial track between each pair of repair tracks. A tile wall partitions off the shop, fifty feet wide along one side, which will contain the blacksmith forges, tools, heating plant, foremans office, toilets, and lavatories.

The building is of structural steel frame, with tile walls, plastered on the outside, with saw-tooth roof construction. The general construction of the building otherwise is the same as that of the other shop buildings. An overhead trolley beam is provided to permit of handling timbers with a trolley into the shop.

Compressed air, steam and water service piping, and fire protection, including automatic sprinklers, are supplied. Heating is with the indirect fan system, with underground concrete and tile ducts. Lighting is by 100-watt Tungsten lamps.

The location of this building alongside of the lumber yard permits of handling lumber so that it can be passed through into the shop without rehandling.

Planing Mill.—This building is 303 feet long by 80 feet wide, and contains the woodworking machinery. The frame is of structural steel, carried on concrete footings. The general construction of the building is the same as that of the other shop buildings. A track extends through the building longitudinally to permit of movement of material in at one end to the various machines and out through the opposite end with the minimum amount of handling. The



Interior of the Locomotive Shop, Showing 120-Ton Locomotive Crane.

building is located so as to be convenient to the passenger car shop and the freight car shop. The lumber yard is located back of and at one end of the planing mill.

Suitable piping has been provided for distributing compressed air and water. The fire protection system includes automatic sprinklers.

Provision is made for toilets, lavatories, and metal lockers for the men employed in this department.

Heating is by the indirect fan system with galvanized iron heating ducts. Lighting is by mercury vapor lamps.

Boiler House.—This building contains sufficient space for 21,000 horse-power water tube boilers that are required to provide steam for heating the shops and for other purposes for which steam is required throughout the shops. The building is constructed with brick walls carried on concrete foundations, with steel roof trusses and supports for coal bunkers. The chimney is of reinforced concrete, 200 feet high, with a minimum diameter of nine feet.

The overhead coal bunker for each boiler is divided by a reinforced concrete partition into two compartments to provide for storing and burning two kinds of coal. An overhead storage bin for ashes is provided, from which bin the cinders can be discharged by gravity into cars alongside of the building. A concrete dumping hopper is provided outside for dumping coal from cars. A pivot steel elevator raises and discharges the coal into the overhead bunker. A skip-bucket, with electric hoist, handles the ashes into the ash-bin.

The boiler units are 350 horse-power rating, and are set in three batteries of two each. Five of the boilers are equipped with chain grate stokers. The sixth boiler has the shaking grates to burn shavings and other planing mill refuse.

Space is also provided for three electrically driven air-compressors, each of a capacity of 1,500 cubic feet of free air per minute. Only two of these compressors are installed at this time.

Transformers and distributing panel are located in this building for transforming and distributing light and power current to the shop yard, freight car shop, planing mill, and coach repair shop. There is no direct current apparatus in this station.

Provision has been made for two incoming 2,200-volt lines, one of 2,000 k.w. and the second of 1,000 k.w. capacity for breakdown service.

The steam required for the steam hammers and other shop purposes during the summer time can be supplied by one boiler. The boiler capacity provided will afford one spare boiler during the extreme weather conditions when the maximum steam demand occurs.

Yard Crane.—A yard crane runway, 1,260 feet long, extends from the west line of the locomotive shop, and carries a 10-ton high-speed travelling electric crane with 80-foot span, serving the material yard and a portion of the storehouse platform and scrap dock. One of the storehouse tracks extends through under this crane, resulting in giving ample space for the storage of material alongside of the storehouse, foundry and locomotive shop. By this arrangement heavy material can be unloaded, stored, and rehandled to the shop or loaded out again by the crane for shipment, practically eliminating manual labor in the handling of all heavy material.

Miscellaneous Structures.—The transfer table for serving the coach shop is 75 feet long, of 150 tons capacity, equipped with electric motor, with concrete transfer table-pit 400 feet long, extending out far enough at either end of the building for providing entrance and egress at both ends.

The mess building is 269 feet 6 inches long by 31 feet 10 inches wide, of wooden frame construction, covered outside with sheathing, building paper and siding, and sealed on the inside with metal sheathing. It has a concrete floor, and contains a dining-room and lunch room for the workmen and a dining-room for the officials, together with kitchen and pantry. Sixty feet of the length of the building is carried up two stories to provide an apprentice schoolroom and quarters for the help. Heating is by the direct system and lighting with incandescent lamps.

There are also two small buildings located near the freight repair tracks for blacksmith shops and workmen's tools, and in one of them is a small toilet and office. Dry kiln material bins, plate and iron racks, coal and coke sheds are also provided.

For obtaining water for shop purposes there have been put down two eight-inch wells equipped with electrically operated pumps. To supplement this supply and to provide a main source of supply for fire protection the city of Calgary has brought down into the shop site to a point midway the length of the main shop building on the west side a 10-inch cast-iron water main. The shop service and fire lines are connected onto this main and into a steel tank of 125,000 gallons capacity, which is erected on a 70-foot steel tower, principally for use in connection with automatic sprinklers in the various buildings where these are installed. A complete fire protection system has been put in, with hydrants distributed about the shop yard.

The sewage system in the shop yard may be divided into the sanitary and storm sewers. The city of Calgary is furnishing the main sanitary sewer, beginning at the east line of the freight car shop and extending to the eastern boundary of the shop property. All the sanitary sewage lines from the various buildings are connected into this sewer. Storm sewers are provided where necessary to carry off the roof water from the buildings where the roof construction is such that this cannot be discharged on to the ground.

The location of the shops is about four and one-half miles east of Calgary, practically on the open prairie, and on the beginning of construction arrangements had to be made to house and board on the shop property a considerable quantity of labor. To this end, frame bunk-houses were built with two tiers of bunks on each side of the building, eight bunks long, each house having a capacity of 32 men. Stoves were placed in the centre aisle and benches along the sides of the lower tier of bunks On the coming of summer and as the labor forces were increased some of the men were housed in standard 12 x 14 wall tents, which accommodated four men each. A large mess-room and kitchen and store-room space was also fitted up with a capacity of feeding about 400 men at one time. Great care was exercised throughout the work in keeping the camp in a sanitary condition. This work was largely under the direction of doctors, who visited the camp each day to take care of all sickness, and an arrangement was also made whereby those who were employed on the work voluntarily contributed a small amount from their wages for the services of these doctors. This amount also included hospital service when necessary. Due to this care there was very little sickness on the job.

As there were no accommodations for men with families near the shops the railroad company put into temporary service a train to carry the men back and forth from Calgary, and several hundred men went back and forth on this train each day. This arrangement helped the situation considerably, especially as the season advanced and all kinds of skilled and unskilled labor became more difficult to obtain. A standing order was placed through several labor agencies in Calgary to send men daily to the job. As the work neared completion the bunk-houses and mess-house previously mentioned were turned over to the railroad to take care of their own men, who were at that time living in cars on the property. This, of course, released the cars and permitted their use at other points.

The progress schedule will show the prosecution of the work, but it should be again pointed out that it was not possible to break ground until April 1st, 1912, and by March 17th, 1913, the locomotive shop was in full operation. When the magnitude of the work is considered, as also its distance from the larger centres, it will be appreciated that a record for prompt performance has been established.

PHŒNIX BRIDGE AND IRON WORKS COMPANY

The Phœnix Bridge and Iron Works Company is making a new issue of bonds and stock this week, through the Quebec Savings and Trust Company. This stock has already been underwritten, and is now being distributed to the public. The offering consists of $750,000 of 6 per cent. first mortgage bonds, and of $800,000 of common stock. The bonds are being offered at 96 per cent. of par, and the stock at $50 per share. The offering is being made simultaneously in London and in Canada. Approximately $450,000 of the bonds and $405,000 of the stock have been taken firm. A new company has just been incorporated at Ottawa with a capitalization of $1,500,000. This company in every way takes the place of the company which has heretofore operated under the same title. After the present issue has been accomplished, there will remain in the treasury to provide funds for future expenses and for the general purposes of the company, $700,000 of the common shares of the company. All the bonds will have been issued.

The Phœnix Bridge and Iron Works Company has a plant situated in the centre of the manufacturing district of Montreal, where shipping facilities are all that could be desired. The concern manufactures and erects structural steel for bridges and buildings. The cost of delivery, owing to the central location of the concern, is smaller than in the case of most other companies. Operations have now been carried on satisfactorily since 1898, and save for an occasional year, earnings have shown a fairly constant increase, beginning with $51,000 in 1898 and progressing gradually to upwards of $600,000 during the past couple of years. The land owned by the company allows of an expansion to the works. The assets of the company, at the end of last year, including $25,000 which is being provided for improvements, amounted to $1,400,000, while total liabilities were but $57,000. This leaves a surplus of $1,243 against the present bond issue of $750,000.

Mr. James W. Pyke is president of the company, and Mr. T. Palmer Howard is general manager.

ABSENCE OF ROADS IS ECONOMIC LOSS

The improvement and maintenance of good roads in the rural districts is a vital problem in all parts of Canada. Inevitably, perhaps, the phenomenal development of railway and waterway navigation has largely overshadowed the necessity that exists for properly built waggon roads. However, it is steadily being more fully realized that the absence of such roads causes an economic loss of great importance to every citizen, and especially those of the rural districts.

Scientific progress is being made in many parts of Canada. The government of Ontario is spending large sums on roads in New Ontario. New Brunswick is enacting "good roads" legislation; and Saskatchewan, where railway development during the past few years has been phenomenal, is carrying out a comprehensive "good roads" policy.

Saskatchewan has appropriated $1,200,000 for highway improvement work during 1913. This is merely a continuation of the work commenced in 1905, and each year since then the government has expended from $200,000 to $700,000 a year on roads and bridges. The work has been carried out under the supervision of a board of highway commissioners, and assistance is granted through them to municipalities under certain carefully defined conditions, states Conservation. This assistance is confined to the building of bridges and trunk roads. The old statute labor system is discouraged as being uneconomical and inefficient.

In view of the scarcity of gravel and stone in many parts of Saskatchewan, extensive experiments have been carried out at provincial expense to ascertain the best means of constructing clay roads. It has been found that Saskatchewan clays burned at comparatively low temperatures produce an excellent surfacing material for graded roads. Owing to the reddish color of this burned clay these roads are known as "the red roads of Saskatchewan." Their cost, where underdrainage is not necessary, has been found to be from $2,000 to $2,500 a mile. This includes the cost of burning the surface clay. Where tile drainage of the grade is essential, the cost is increased by from $1,000 to $1,500 a mile. It is claimed that these roads stand up well under prairie conditions.

Another class of road that is being experimented with in Saskatchewan consists of a specially prepared clay grade covered with asphalt. If suitable to the conditions, such a road should prove popular in the smaller towns and villages.

INSTITUTION OF CIVIL ENGINEERS.

Many of our readers will be interested in learning that Col. H. N. Ruttan, city engineer of Winnipeg, as a result of the ballot for the election of officers for the next session of the Institution of Civil Engineers has been included. The list of gentlemen whose names appear as eligible for election is as follows: President, Mr Anthony George Lyster; vice-presidents, Mr. Benjamin Hall Blyth (Edinburgh), Mr. John Strain (Glasgow), Mr. George Robert Jebb (Birmingham), and Mr. Alexander Ross (London); other members of council, Mr. John A. F. Aspinall (Liverpool), Mr. John A. Brodie (Liverpool), Mr. William B. Bryan (London), Colonel R. E. B. Crompton (London), Mr. J. M. Dobson (London), Sir Hay Frederick Donaldson (London), Mr. E. B. Ellington (London), Mr. W. H. Ellis (Sheffield), Mr. W. Ferguson (Australasia), Sir Maurice Fitzmaurice (London), Sir John Purser Griffith (Dublin), Mr. C. A. Harrison (Newcastle-on-Tyne), Mr. Walter Hunter (London), Mr. Harry E. Jones (London), Sir Thomas Matthews (London), Mr W. H. Maw (London), Mr. C. L. Morgan (London), Mr Basil Mott (London), Mr. A. M. Tippett (South Africa), Sir Philip Watts (London), Mr W. B Worthington (Derby), Mr. Dugald Clerk (London), Mr. Robert S. Highet (India), Mr. Edward Hopkinson (Manchester), Mr. Frederick Palmer (London), and Col. H. N. Ruttan (Winnipeg).

LARGE STEAM PLANT.

Contracts for a steam plant of 60,000 k.w. capacity have been placed recently in New York by Messrs. Guggenheimer & Company, New York, for the Chile Exploration Company. The equipment at present comprises four 10,000 k.w. Siemens generators coupled direct to four 14,300 P. S. Zoelly steam turbines of Escher Wyss & Company manufacture, Zurich. These units will run at 1,500 r.p.m. when working with steam of 170 pounds pressure and 325° Centigrades superheat. Escher, Wyss & Company, Montreal, who are attending to the American business of their works, Zurich, have secured this order against competition from the foremost American and European makers on the strength of the low steam consumption of their turbine.

The plant is to be installed in Chile, and the power used for electric smelting of copper ore. The transmission line, which is of 200 miles length, will be for 110,000 volts pressure. Messrs. Siemens, Schuckert Werke have been awarded the contract for the whole of the electrical equipment.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER, AND THE CONTRACTOR.

Present Terms of Subscription, payable in advance

Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	$1.75 (7s.)	$1.00 (4s.)

Copies Antedating This Issue by More Than One Month, 25 Cents Each.
Copies Antedating This Issue by More Than Six Months, 50 Cents Each.
ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main 7404, 7405 or 7406, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C. Allum, Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Western Manager.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square, T. R. Clougher, Business and Editorial Representative. Telephone 527 Central.

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The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

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Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

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

Vol. 24. TORONTO, CANADA, MAY 29, 1913. No. 21

CONTENTS OF THIS ISSUE.

OIL ENGINES FOR MARINE SERVICE.

While Canada may not, perhaps, stand out conspicuously as a country that has shown very great development along shipbuilding and marine engineering lines, there has doubtless during the past few years been a great impetus given to the shipbuilding and marine engine industry in this country, and there is every reason to believe that this will continue to go on indefinitely. For that reason it is interesting to note the changes that have recently taken place, so far as the adaptation of the oil engine to marine purposes is concerned.

A report just issued by the committee of Lloyds' Register calls attention to the fact that the British Admiralty during the past year have placed contracts for marine oil engines greater in power than ever anything attempted. This report states that there are Diesel oil engines now being built for thirty-four marine vessels, these vessels ranging in tonnage from two to two thousand tons, and the engines of various types ranging in power from 750 to 120 brake horse-power per set. This report states that from January 1st, 1910, to the present time there have been completed in the United Kingdom under the survey of the society fifteen oil-carrying vessels and nineteen other vessels constructed with oil-fuel bunkers. This will give our readers some idea of the work that is going on looking toward replacement of coal by oil for marine purposes. It furthermore states that five large engineering firms on the Clyde are now in a position to make Diesel oil engines for the largest class of ocean-going ships. All along the line the demand for steamers with oil fuel furnaces is increasing very greatly. Not only in Great Britain, but in other countries, this subject has been given a great deal of attention. Russia stands out notably as a country in which this work has been attempted in the most vigorous manner, and altogether it looks as though the oil engine, so far as its application to marine purposes is concerned, is quickly coming into its own.

This development is not without significance and interest for those connected with the shipbuilding industry in Canada, as signs are not altogether wanting which point to bigger things being accomplished by the yards in Canada in the days that are to come.

THE COMMERCIAL TREND OF THE PRODUCER GAS POWER PLANT.

In investigating general problems that relate to the fuel resources of the country and in testing fuels belonging to or for the use of the Government, the Bureau of Mines of the United States has given considerable attention to the efficiency and economic value of producer-gas power plants. Its engineers during the past eight years not only have shown a very low fuel consumption per horse-power hour for these plants, but have demonstrated conclusively the possibility of utilizing commercially low grades of bituminous coal, lignite, and peat in plants properly designed for the use of those fuels. The anthracite plant has been recognized as a commercial possibility for several years, although the cost of the fuel used has in general restricted these plants to comparatively small units.

The commercial development of the producer-gas power plant in America has been largely within the past six or eight years. The feeling of doubt in the minds of many regarding the future of the industry has led the Bureau of Mines to publish in a brochure the results of their investigations. This feeling of doubt was fostered by the extensive introduction of the steam turbine and the increased interest in the oil engine. During the past three years the belief of many who were formerly firm believers in the gas producer has been that this type of power has reached its height of development, and that from a commercial standpoint it can no longer be regarded as a complete success.

The results of these investigations and the facts gleaned from an inspection of the summaries and charts presented are far from revealing the condition thought to be the case by those who have regarded the immediate downfall of the producer as inevitable.

It is probable that at the present time there are in the United States 900 or 1,000 producer gas-power plants, ranging in size from 15 horse-power to several thousand horse-power.

During the past three years the number of anthracite plants over 500 horse-power rating has increased 263 per cent., and the total horse-power represented by these plants has increased in the same period 242 per cent.

During the same period the number of bituminous-coal plants of 500 horse-power rating or less has increased 118 per cent., and the total horse-power represented by these small bituminous-coal plants has increased 89 per cent.

At the present time producer-gas plants representing nearly 85 per cent. of the total number of installations in this country are operating on anthracite.

Of the total horse-power listed, approximately 48 per cent. is derived from anthracite and nearly 52 per cent. from bituminous coal and lignite.

In 1909 the bituminous-coal plants averaged 12.5 times the size of the anthracite plants, but the introduction of the larger anthracite plants and of the smaller bituminous-coal plants makes the ratio for 1912 about 7.5 to 1.

The use of the small bituminous-coal producer is increasing, and an examination of the complete list of installations reveals several suction plants operating on bituminous coal. Their development is one of the most important steps in the producer field.

OTTAWA CONVENTION OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

Mr. Charles Warren Hunt, secretary of the American Society of Civil Engineers, sends us the following information in connection with the forty-fifth annual convention, which is to be held in Ottawa June 17th to 20th. In a recent issue we gave some information concerning this convention, and we are glad to be able to add to this, and trust that many of our readers will have the opportunity of visiting Ottawa during convention week:—

The headquarters of the society, secretary's office, etc., will be in the Chateau Laurier. All members attending the convention are requested to register in the secretary's office in this hotel as soon as possible after arrival in order that lists of those in attendance may be printed promptly for distribution.

The Eastern Canadian Passenger Association, the New England Passenger Association (with the exception of the Bangor and Aroostook Railroad and the Eastern Steamship Corporation) and the Trunk Line Association (with the exception of the New York, Ontario and Western) have authorized a reduced rate of one fare and three-fifths, on the certificate plan, for the round trip between any point in their territories and Ottawa. This concession is conditional upon the presentation of at least 100 certificates.

To obtain this rate a first-class through ticket to Ottawa, Canada (either limited or unlimited), must be purchased, and a certificate obtained from the ticket agent that such purchase has been made. If a through ticket cannot be purchased, then a local ticket should be obtained to the nearest point where a through ticket can be obtained for the remaining distance to the place of meeting.

Tickets for the return trip over that part of the route covered by such certificates will be sold, at three-fifths the highest limited fare, to those persons, and those only, who hold the certificates signed by the ticket agent at the point where through tickets to the place of meeting were purchased, and countersigned also by the secretary of the society, certifying that the holders have been in attendance at the convention.

Tickets on this plan cannot be purchased more than three days (exclusive of Sunday) before the time of meeting, and return tickets must be purchased within three days (exclusive of Sunday) after the date of adjournment.

Particular attention is called to the request made by the Passenger Associations that persons desiring to avail themselves of the reduced rates be at the offices for certificates and tickets at least thirty minutes before the departure of trains. Also that these rates are applicable only to through tickets to Ottawa, Canada.

Programme.

Tuesday, June 17th.—At 3 p.m. there will be a reception by the Premier, the Right Honorable R. L. Borden, and the mayor of Ottawa, at the Chateau Laurier.

Evening.—At 9 p.m. the president and officers of the society will hold an informal reception at the Chateau Laurier. Dancing may be expected.

Wednesday, June 18th.—At 10 a.m. the first session will be called to order, and the president will deliver the annual address, after which the business meeting will convene. The time and place for holding the annual convention of 1914, and several proposed amendments to the constitution will be considered, and other business transacted.

Afternoon.—Members and guests are invited to a garden party at the residence of T. C. Keefer, C.M.G., past-president, Am. Soc. C.E.

Evening.—There will be an illustrated lecture on Canadian engineering subjects in the ballroom of the Chateau Laurier. It is expected that the subjects covered will be: Transportation Routes in Canada, the Transcontinental Railway, Canadian Water Powers, Navigation, and Grain Elevators on the Great Lakes.

Thursday, June 19th.—The local committee will announce the programme for this morning at the business meeting.

Afternoon.—There will be a motor drive through the city, visiting the Parliament Buildings, Rockcliffe Park, Rideau Hall grounds, the Experimental Farm, the Chaudière, etc., and ending at 4.50 p.m. at the residence of one of the oldest members of the society, Sir Sandford Fleming, for afternoon tea.

Evening.—The Canadian Society of Civil Engineers will tender a reception to the members and guests of the American Society of Civil Engineers at the Chateau Laurier, with dancing.

Friday, June 20th.—The arrangements for Friday will be announced at the business meeting.

For those interested it should also be stated that the Royal Golf Club, which is within easy reach of the hotels by trolley, will be open to the use of our members during the convention.

S. P. Brown, M. Am. Soc. C.E., has invited all members who pass through Montreal to visit and inspect the new Mount Royal Tunnel of the Canadian Northern Railroad in that city.

TERMINAL PASSENGER STATIONS: THEIR DESIGN AND OPERATION.

By J. L. Busfield, B.Sc., A.C.G.I.

The definition of a terminal as given by the American Railway Engineering and Maintenance of Way Association, now the American Railway Engineering Association, is "an assemblage of facilities provided by a railway at a terminal or at intermediate points on its line for the purpose of assembling, breaking up and relaying trains," and also the definition of a passenger terminal is given as "the arrangement of terminal facilities for the handling of passenger business." These definitions clearly bringing out the fact that a passenger terminal is not only a station where all trains complete their run by stopping at a number of dead-end tracks, but refers equally well to a station where there

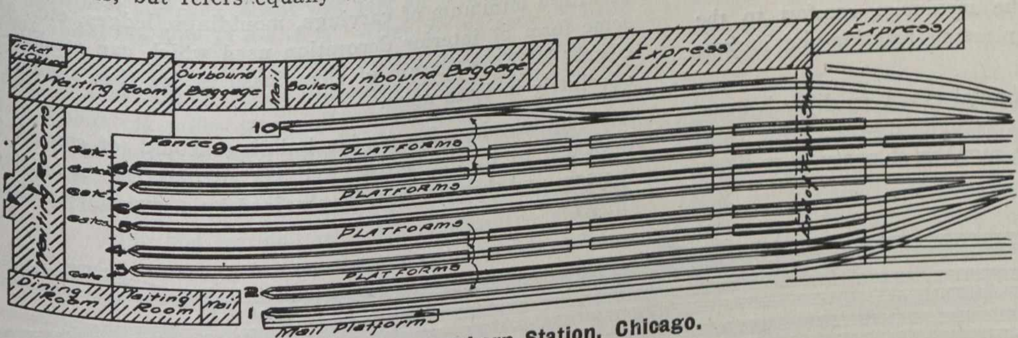


Fig. 1.—Dearborn Station, Chicago.

are a number of through tracks, and where possibly some of the trains pass right through the terminal without any other delay than what is necessary for taking on and setting off passengers and baggage. From this it will be seen that passenger terminals in general can be divided into two classes, viz., terminals of the dead-end type, and those of the through track type.

In a large city or town it rarely happens that a railway company is given very much choice in the selection of a site for a station, because it is tied down by the location of the railway and other controlling features. But wherever it is possible a terminal should be located as close to the hotel and residential district as possible, unless a very large suburban business is anticipated, when it is advisable to have the terminal closer to the business district. These features are well illustrated in the city of Montreal. The Grand Trunk Railway has its Bonaventure station situated about two minutes closer to the business district than the Canadian Pacific Windsor Street station, with the result that it gets about 75 per cent. or more of the suburban traffic to the Lake Shore where there is competition between the two railways, and on the other hand the C.P.R. station is more conveniently situated with regard to hotels, the residential and shopping districts, and again the Canadian Northern has selected a site right in the heart of the hotel and shopping district, and which is also within easy reach of the business section of the city.

Other factors which have also to be taken into account in the selection of a suitable location are the land available, its general size and shape; it should also be convenient and easy of access, and the question of the relative cost of buying the land and the cost of building have to be given consideration.

There are practically no railways with such unlimited resources that expense is no consideration, so, in selecting site, designs, etc., for a passenger terminal, the different possible projects have to be balanced against each other, and usually some desirable features have to be discarded, and the railway company, taking into consideration its resources available, determines which features are most essential to the welfare of the public and the improvement of the service as a whole.

The primary object of a railway's existence is transportation, consequently the railway's first attention must be given to the necessities of transportation, viz., the railway tracks, cars and motive power. In addition to these, of course, there are many accessories which are almost as important, and among these accessories are the numerous station buildings from the small one-man wayside station to the big city terminal which go to make up a big railway system.

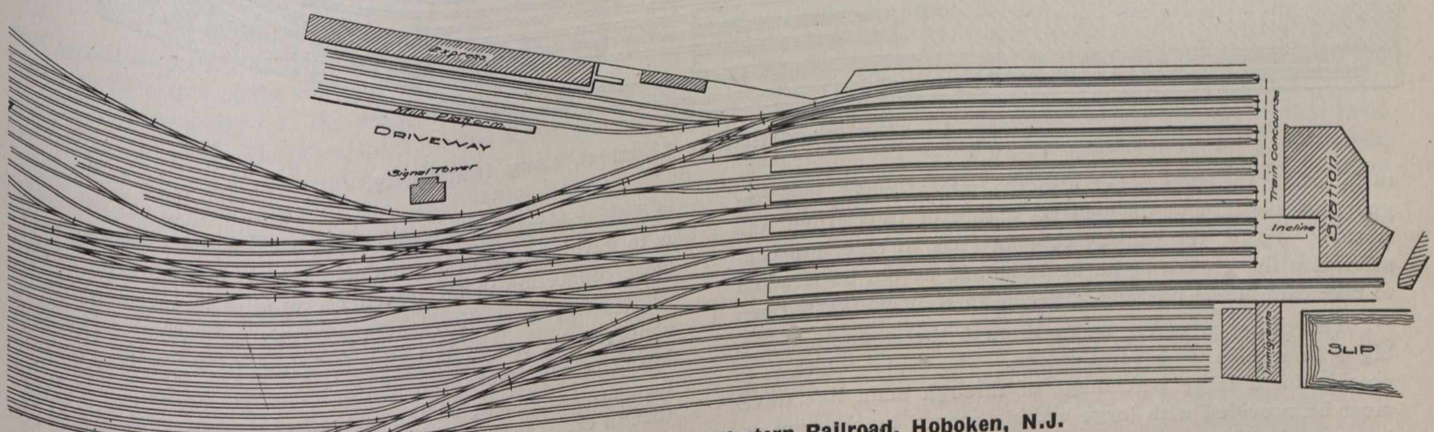


Fig. 2.—Delaware, Lackawanna and Western Railroad, Hoboken, N.J.

When the architects take over the design of a station building, they have to give consideration to the general character of the neighborhood and community in which the station is to be built. The general public usually require and demand that the station building should not only be up to the general standard of public and private buildings in the community, but that they should also set a higher mark for future developments of the community. To what extent the railway company will be controlled by the wishes of the community will depend largely on the resources of the railway and also on local conditions of competition, but it will be usually found that the interests of the railway and the public desires are very closely allied.

Limitations are imposed upon the architect, such as the size and shape of the land available, but everything should be subordinated by him to the convenience and comfort of the travelling public, and to the economic and efficient handling of the railway company's business.

Care should be taken that architectural effect should be subordinate to utility. The building should, of course, be made handsome and agreeable without undue expense, but sometimes stations have been designed with very beautiful and artistic effect, and with little regard for the convenience of the people who use it, and on the other hand some very plain and ugly buildings are the very best from the viewpoint of comfort and expeditious handling of passengers and the accompanying facilities. The ideal is obtained when a station is designed to give the maximum comfort to the public, and which also has a pleasing exterior and interior appearance.

The necessary size of a terminal is a very difficult question for the railway and architects to deal with. The controlling feature is not only the number of passengers likely to be using the station but also the rate at which they are going to use it, and the general nature of travel from the station. Again, the railway company has to take into consideration the growth of its business and design its terminal to take care of the business expected in 10 or 20 years' time.

The character of the traffic through the station makes a big difference in its general design. The station which is to provide for a large percentage of through main line travel must be provided with large waiting rooms, lunch counters, baggage facilities, etc., whereas a station with a large preponderance of suburban traffic should be designed to give easy and rapid access for large numbers of people between the platforms and streets. The suburban passenger has no occasion to stay any length of time and frequently only allows himself the minimum of time to catch his train. In a large terminal where there is a large quantity of both through and suburban traffic it is sometimes desirable to separate the two kinds entirely, avoiding considerable confusion and congestion. This is effectively done at the Grand Central station, New York, where the suburban tracks are kept below the main line. The fact that passengers will take the line of least resistance must also be kept well in mind. In a station with a large amount of through traffic there are always a great number of strangers who should be provided for in the way of indicators and sign-boards denoting waiting rooms, ticket, parcel and inquiry office, baggage rooms, etc. Lighting is also a very important feature, and the architect or engineer who designs a terminal with a maximum of daylight and with the best lighting at night without undue expense is to be praised.

Another detail which is sometimes lost sight of is cleanliness. With steam traction, locomotive dust and smoke are unavoidable, and in the interior, the building will be used by all sorts and conditions of men, women and children, so both in the selection of building materials and in also the interior decoration, this should be considered and the station designed with a minimum of carvings, mouldings, ledges, etc., and some form of interior decoration used which can readily be cleansed. This feature of cleanliness is one that should be absolutely insisted upon.

The exterior of a station building should, of course, be designed to be distinctive, and not to look like a hotel or factory, and this can best be obtained by a symmetry of lines and masses rather than by decorative features. A good idea is to have a clock in a prominent position, on account of the close connection in the traveller's mind of time and trains.

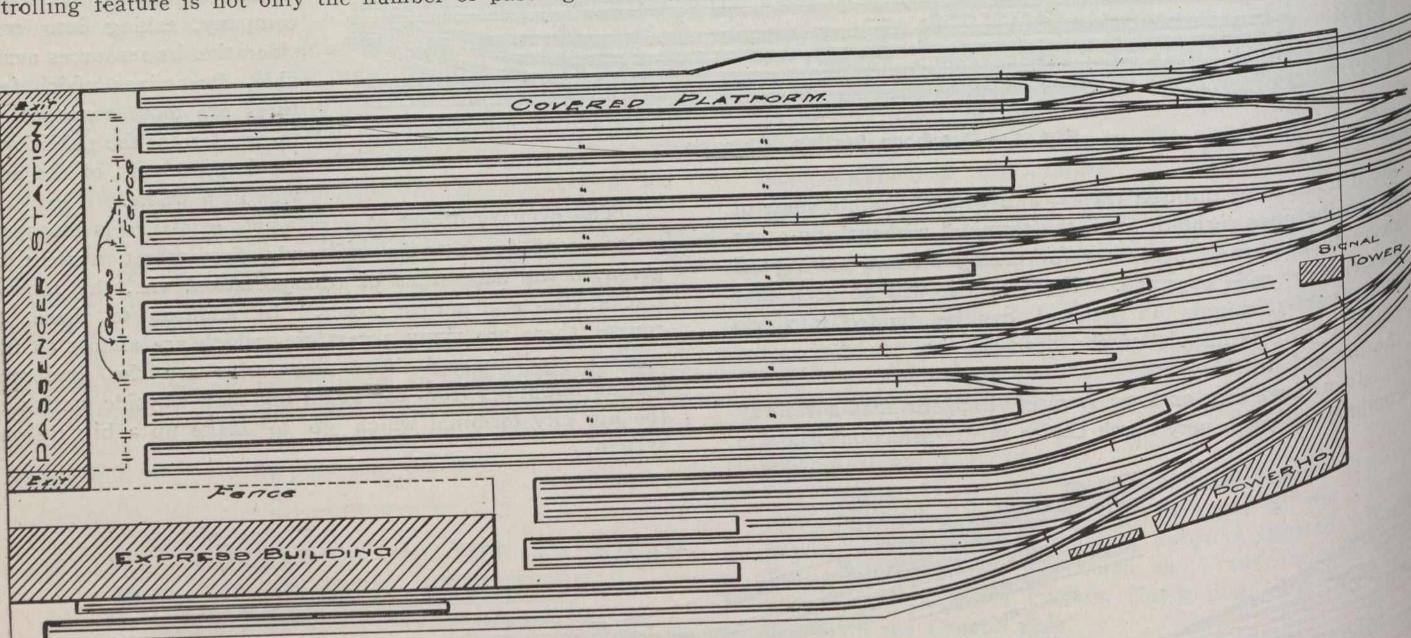


Fig. 3.—Long Island Railway Terminal, Long Island City.

In a great many cases the design and general size and shape of the terminal station building is dependent on the layout of the tracks and platforms at the station. These in turn are dependent on the method of operating the yard, so that in order to design the track layout the engineer must be thoroughly conversant with this method. This, again, is dependent on the nature of the traffic, number of trains handled and the rapidity with which they have to be handled, and also on the proportions of through and terminal traffic, and sundry other features which will be discussed in connection with some of the terminals of which a short description will be given.

With regard to the track layouts, terminal stations can be divided into three classes, namely, dead-end stations, through track stations and, thirdly, stations with both through and stub tracks.

In terminals of the dead-end class, the station building is usually located at the end of the tracks which is known as the headhouse type, or else it is located partly at the end and partly to one side of the tracks. The Dearborn (Polk Street) station at Chicago is a typical example of a terminal of the headhouse type. A plan of this station is shown in Fig. 1, and, as will be seen, there are two tracks which accommodate the business of the owners. The Chicago & Western Indiana Railroad and also its tenants, the Grand Trunk, Erie, Chicago-Indianapolis, Louisville, Wabash and Santa Fe Railways. The station is operated by the Chicago & Western Indiana Railroad.

Tracks 1 and 2 in Fig. 1 are mostly used for mail, but occasionally at rush times they are used for passenger trains. Tracks 3 to 8 are used generally for suburban and main line trains. Nos. 9 and 10 are used for express and baggage. The platforms average about 670 feet in length, and are 6 inches above the tops of the rails. After the passengers have disembarked from a train, the Pullmans and day coaches are hauled by a switching engine to the car storage and cleaning yards, about 5½ miles away, where they are cleaned and turned preparatory to their return journey. The baggage and express coaches are placed on tracks 9 and 10, and the mail coaches on track No. 1. On account of the number of companies using the station and the comparatively small number of tracks, no particular platforms are assigned for the arrival of trains, but they are simply put into whichever one may be empty at the time.

Another terminal of the same type, but considerably larger, is that of the Delaware, Lackawanna & Western Railway at Hoboken, N.J., illustrated in Fig. 2. At this terminal there are 127 originating and 118 terminating trains daily. These trains are handled on 14 tracks placed at 13 feet centres. There are eight platforms 20 feet wide and one 17 feet wide, 700 feet long and placed 9½ inches above the tops of the rails. After the incoming trains have been unloaded the main line locomotive, or sometimes a switch engine, takes the trains to the storage and cleaning yards. The outbound trains are made up in the coach yard and pushed towards the train shed, into which they are dropped by gravity. Each train is operated from a certain track in accordance with a regular schedule in the possession of all the station employees. Local express is handled from the express building by trucks to the various trains. The through express is all loaded into cars placed alongside the express building.

The Long Island Railroad has a terminal of the headhouse type at Long Island City. There are 135 outbound and 134 inbound trains handled at this terminal every day. There are 17 tracks in the train shed and seven others for baggage and express, as shown in Fig. 3. There are nine passenger platforms 14 feet wide and 760 feet long, placed 9 inches above the rails.

When an inbound train has been unloaded it is backed out by the main line locomotive to the car storage yard about ¼ mile away. It is here cleaned and switched and made up ready for its return journey. The express and baggage are handled on the south side of the station when in carload lots. The baggage cars are switched from the car storage yard as soon as the train is backed out of the train shed, and are taken by a switching engine to an express platform.

A station of the headhouse stub track type is that of the London, Brighton & South Coast Railway at Victoria, London, England. This station has a very novel arrangement of tracks which was designed by Mr. C. L. Morgan, chief engineer, to suit the peculiar local conditions. Some years ago the capacity of the station became too small to handle the amount of business the company was obtaining, so the question of remodelling and enlarging the station was brought up. In looking into this problem the railway company found themselves hemmed into a comparatively narrow site between Buckingham Palace Road on one side and the South Eastern and Chatham Railway on the other. A certain amount of widening was possible, but not enough for satisfactory results, consequently the station shown in Fig 4 was designed to meet the requirements. The novel feature of this arrangement is that the platforms are made long enough to accommodate two standard trains, and the tracks are so arranged that trains can arrive at or leave the inner end of the platforms without interfering with trains at the outer end. This is effected by placing groups of three tracks between the platforms at the outer ends, which are reduced with convenient switches and crossovers to two tracks at the inner ends. The old station originally accommodated six trains, whereas the new layout provides platform and track space for 18 trains.

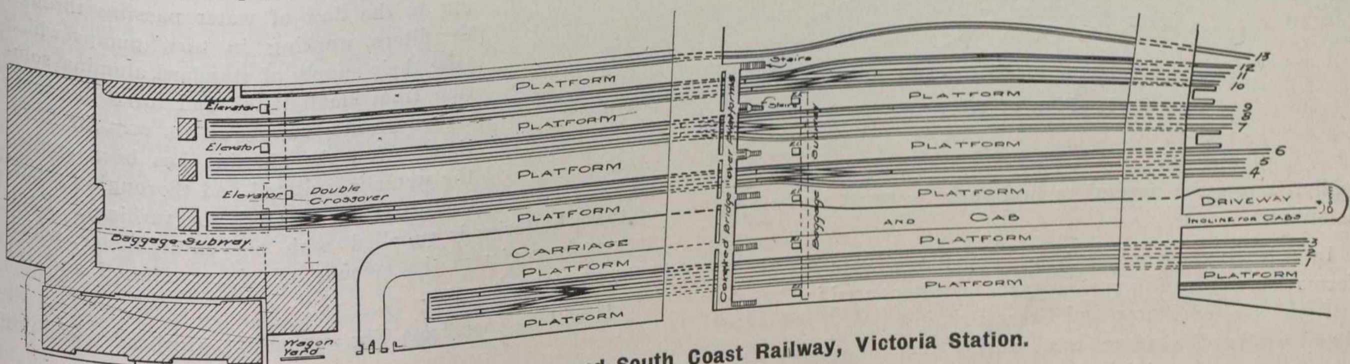


Fig. 4.—London, Brighton and South Coast Railway, Victoria Station.

The method of handling suburban trains during the rush hours is of interest. Supposing track No. 6 in the accompanying plan to be clear and an incoming train is allowed to enter right up to the inner portion. A following train can then run in behind it and stop at the outer portion of the platform. While this train is pulling in and unloading its passengers the engine of the first train can run around it and couple on the rear end, which now becomes the front end, and it is all ready to commence its trip via track No. 5 without interfering with the second train at all. An alternative arrangement is for an engine to wait on the middle track until the first train has pulled in, and then take the crossover and connect on to its rear end. After the first train has pulled out the second one can pull in to the end of the platform to take outgoing passengers, and its engine can run around it as before, or else the engine of the foregoing train will couple on to its rear end.

(To be continued.)

AN INTERESTING FILTER INSTALLATION.

Probably no one phase of municipal engineering has attracted so much attention during the past few years, at least in Canada, than that which has to do with the securing and maintenance of a proper and adequate water supply.

In Canada, where new municipalities are coming into being so quickly, and existing communities are growing so

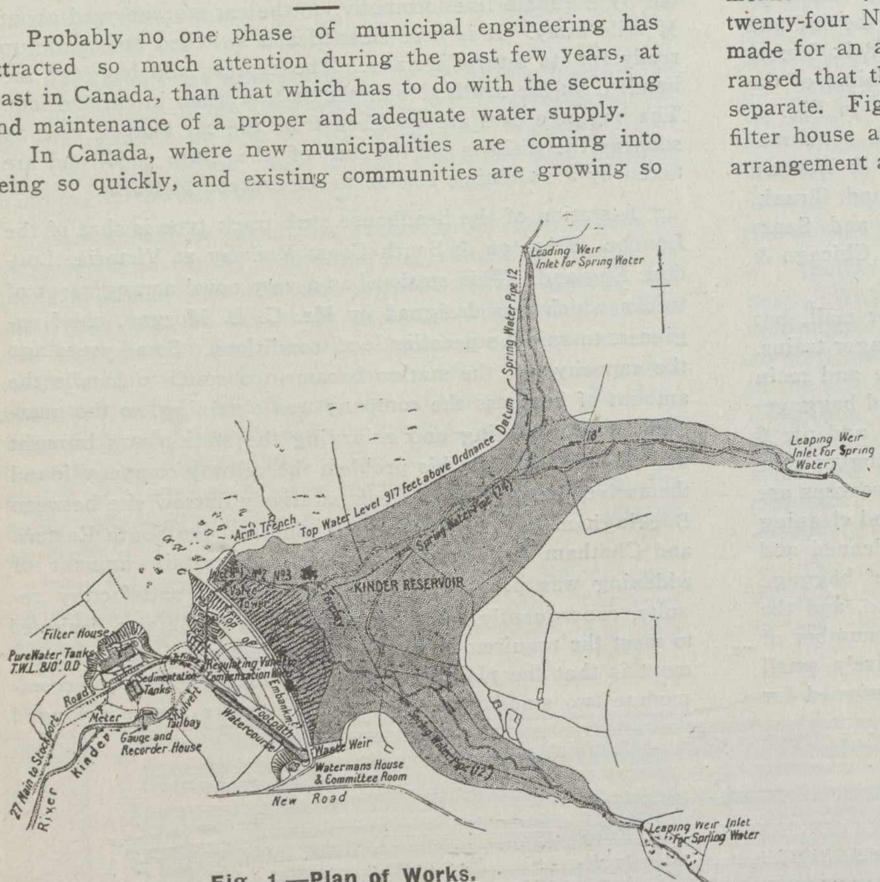


Fig. 1.—Plan of Works.

rapidly, it is quite natural to find such a great interest in this subject.

In order to place before the municipal engineers of Canada information concerning various types of filters used in Canada itself, the United States and Great Britain, *The Canadian Engineer* has, during the past few years, published descriptions of various filter installations. By studying the characteristic features of these various plants municipal engineers have been enabled to form some idea as to their relative values and thus be able to judge intelligently when brought face to face with the question themselves.

This particular article deals with an English installation, that at Stockport, which plant has a number of features which we feel sure our readers would like to be informed about.

The filtration plant proper is located at Kinder, near Stockport, named after the river upon which the reservoir is built. The engineers for the work were Messrs. G. H. Hill and Company, of Manchester. The reservoir in connection with this plant has a capacity of 515 million gallons, an area of 44 acres situated in the valley of the River Kinder. A plan of the layout will be found in Fig. 1.

The filter house, shown in Fig. 2, is built of common brick faced with stone work and is 180 feet long by 39 feet 6 inches wide, with an annex 39 feet 6 inches long by 35 feet 6 inches wide. Light for the filter house is secured by means of sky-lights in the roof. The installation called for twenty-four No. 5 Bell patent filters (provision having been made for an additional eight) and these batteries are so arranged that they can be operated as a whole or entirely separate. Fig. 3 shows a general view of the interior of the filter house and will give the reader a clear idea as to the arrangement as well as the interior construction of the house, methods of lighting, etc.

The filters consist of steel shells having hydraulically dished and flanged ends in which are placed pebble strainers which will allow the filtered water to pass through every passage, absolutely preventing the escape of filtering material. The filtering medium rests on the top of the strainer. Fixed in each shell and passing through the centre of the bed, is a hydraulic central shaft to which is connected a number of horizontal wash arms which in turn are provided with special valves and rakes. This hydraulic shaft is only used when the filter beds are to be cleaned. The two rows of four filters forming the batteries have specially constructed turbines, fitted on the end of the inlet pipe which revolve according to the flow of water passing through the filters, working in turn pumps which take their supply of standard alumina solution from small tanks and force the same into the water supply on its way for filtration. After the alumina has been applied the water is agitated and thoroughly mixed while passing through the turbines. Each of these batteries is supplied with a Venturi meter, which accurately registers the amount of water filtered and the amount of wash water.

It will be seen from Fig. 3 that the overhead travelling

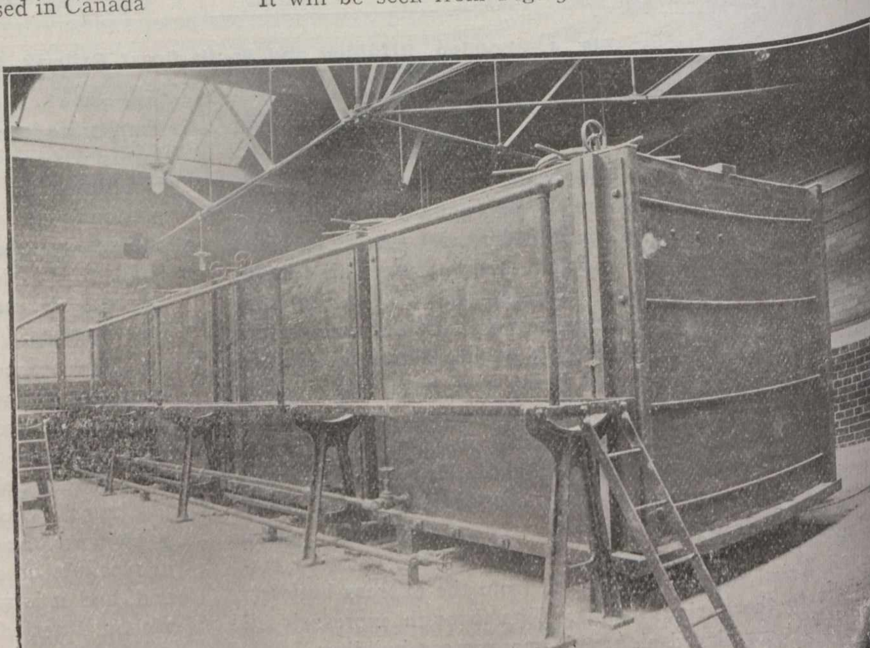


Fig. 4.—Alumina Tanks.

crane of suitable capacity is provided for, and in order to facilitate manipulation, the marine type of platform is arranged along the top of the filters.

Each of these filters has a diameter of 8 feet and has a capacity of 3,000,750 gallons per day of twenty four hours.

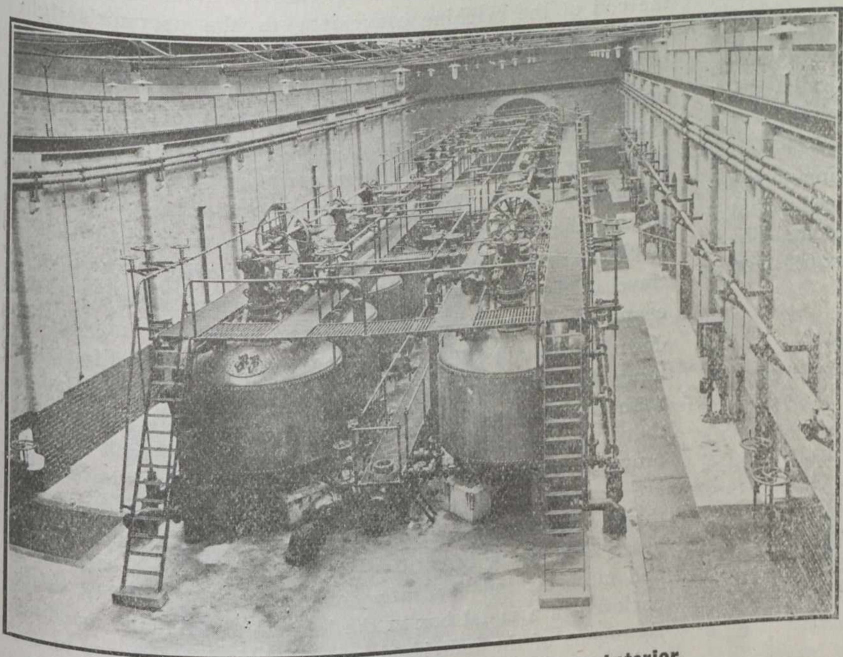


Fig. 3.—General View of Filter House Interior.

After passing through the filter, the water goes into two covered tanks in the adjoining house and with a capacity of 250,000 gallons each, which are purposely reserved for that purpose. These tanks serve to equalize the delivery of filter water to the trunk main and thus avoid direct draughts being made upon the filters themselves.

In the annex referred to are placed the lime and alumina tanks, as well as the machinery for actuating the washing mechanism of the filters and the electric lighting plant. The alumina solution tanks are shown in Fig. 4, and the gauge will be noticed at the nearest end of the tank just next to the ladder. These tanks have their own flow indicator and gauge and are so arranged that they maintain a constant supply to a distributing tank with a ball valve in the filter house.

Cleansing of the filters is done once every 24 hours and takes for the 24 filters about thirty minutes. This cleansing is accomplished by reversing the current of clean water through the filters, at the same time passing a current of

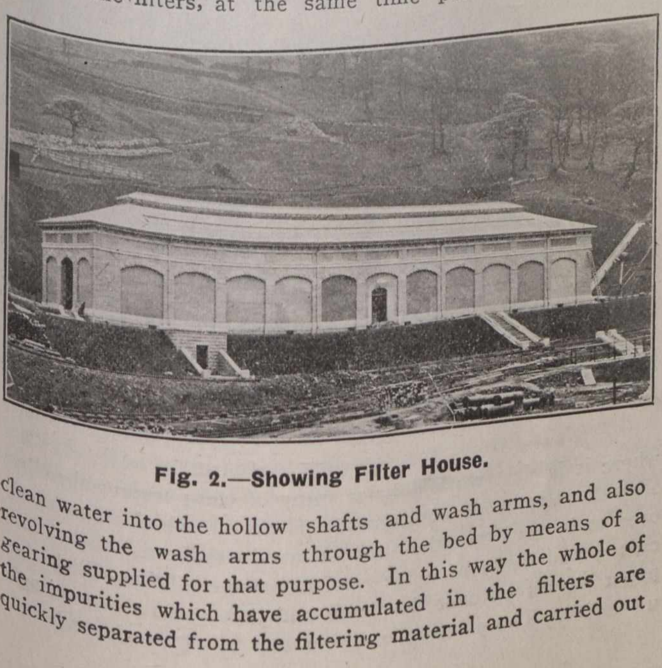


Fig. 2.—Showing Filter House.

clean water into the hollow shafts and wash arms, and also revolving the wash arms through the bed by means of a gearing supplied for that purpose. In this way the whole of the impurities which have accumulated in the filters are quickly separated from the filtering material and carried out through the washout valves and bell mouth to the sedimentation tanks. The quantity of wash water used is about three-quarters of one per cent. of the total amount filtered. After this is done the impurities in the wash water quickly precipitate in these tanks and the clear water is then discharged into the river. When cleansing is done it is only the filtered water from the other filters that is used for the purpose.

The process of washing out and stirring is continued until the water issuing from the washout tap is quite clear and free from dirt.

As showing the efficiency of the Stockport plant attached, we print herewith a report and test made by Sheridan Delepine, M.B., C.M.M.Sc., assistant director of the Public Health Laboratory, University of Manchester, under date of December 21, 1912. This report speaks for itself.

UNIVERSITY OF MANCHESTER.

December 21, 1912.
Public Health Laboratory,
York Place,
Manchester.

Sheridan Delepine, M.B., C.M.M.Sc.,
Assistant Director.
E. J. Sidebotham, M.A., M.B.,
Bacteriological and Pathological Section.
E. J. Sidebotham, M.A., M.B.,
J. E. Carver, M.D., D.P.H.,
S. M. Ross, M.D., D.P.H.,
Chemical Section.
H. Heap, M.Sc.

Received on 13th December, 1912.

Nature of sample...Water Where collected.Kinder Reservoir

Name of sender.Bell Bros. Address ....Ravensthorpe

UNFILTERED.

GGG

Quantitative Analysis	Average results of examination	
A, Acrobic micro organisms growing in 3 days in nutrient gelatine at 20° C. to 21° C.	No. of colonies in one gramme 15'43 grs. water	No. of kind Bacteria Recognizable
Non-liquefying bacteria	28	2
Liquefying	51 Total	8
	Total 139	
Other micro-organisms		
B. Anaerobic Micro-organisms		

FILTERED. Results of 3 examinations

AS ABOVE TOTAL 0

Analysis by **E. J. Sidebotham**

Remarks upon the meaning of the results of the analysis

The results are so perfect that comment is unnecessary.

Signed **SHERIDAN DELEPINE**

The Bell Filtration Company of Canada, Toronto, the Canadian company building the filters of the type herein described, have just completed the installation of a plant at Haileybury, Ont.

MODERN BLUE-PRINTING.

By P. M. Morgan.*

The Pease "Peerless" continuous blue-printing equipment prints, washes and dries the paper automatically, delivering the prints at the end of the dryer in a loose roll, free from wrinkles or distortions, and ready for immediate use.

So noiseless is this apparatus in operation, owing to the method used for electrically controlling the speeds, that there is no objection to placing it in the drafting room. The entire apparatus occupies a floor space of only 5½ x 6½ feet,

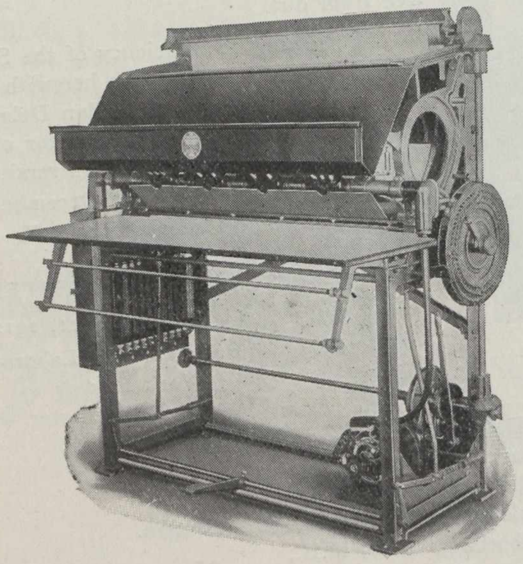


Fig. 1.

and there is no dirt or other objectionable features. It is easily possible for one operator to print, wash and dry 100 yards of blue-print paper per hour, the apparatus consuming during that time only 7 kw. of electric energy, 60 gallons of water, and 50 cubic feet of gas. Where a smaller outfit is desired it is equally practical to operate the machine for ten or fifteen minutes at a time and effect a considerable saving in the time and labor usually required in washing and drying. The printing machine can be used independently at any time if desired for an occasional print.

It can readily be seen that by placing this apparatus in the corner of the drafting room, the operator's time, when he is not engaged in operating the machine, can be used to excellent advantage for other work about the drafting room. These machines were designed for general practicability for all classes of electric printing, and with especial reference to low operating and maintenance expense. They are built in various sizes, to suit the largest or smallest engineering department.

Fig. 1 shows the machine ready for operation. The paper may be printed in sheets or in rolls as desired. Two spindles are provided underneath the feeding table for carrying different widths of paper. The tracings and paper are carried upward past a bank of arc lamps by means of an endless canvas belt. The tracings are returned direct to the operator's hand as he stands in front of the machine; which is a most important feature, as much saving of time is effected in this way. The exposed paper may be returned in the same way or pass over the top roll of the machine. The exposed paper may immediately be seen and the correct exposure obtained before any prints are spoiled, merely by moving the finger on the dial of the rheostat which is placed on the end of the machine convenient to the operator's right hand.

No transparent bands or expensive glass cylinders are used, but in place thereof a short segment of heavy plate glass, which is so mounted and adjusted that breakage is practically impossible. Tension springs at either end of the machine automatically take up the stretch of the canvas belt, so that the most perfect contact between tracing and paper is obtained at all times, while a special device prevents side travel of the belt. Fig. 2 shows the machine with the heavy enameled iron tracing tray pushed back and one lamp turned down on the table, illustrating the method employed for trimming the carbons and cleaning the globes. These arc lamps were especially designed for this machine. It will be noted that they are connected in at the bottom, and each lamp is provided with an aluminum reflector. The resistance coils are carried away from the lamps underneath the table, thereby producing a uniform light and largely reducing the heat. All wiring is encased in steel tubing, and each lamp and motor is independently connected, the switches being enclosed in a metal box at the left-hand end of the machine. By means of the individual connection it is necessary to use only a sufficient number of lamps to cover the width of the tracing being printed. No friction discs or belts are used for controlling speeds, all speeds being electrically controlled directly through the motor. Any possible speed can be obtained, from four inches per minute, which allows sufficient exposure for the slowest negatives or black line prints, up to six feet per minute, which our experience has demonstrated is as fast as the average run of tracings can be properly fed to secure the greatest efficiency from electric energy consumed. A fan is provided for circulating the air, as shown on the left-hand end of the machine.

Fig. 3 shows the blue-printer connected with the Pease automatic washing and drying machine. The paper passes over the top roll of the printing machine into the washer,

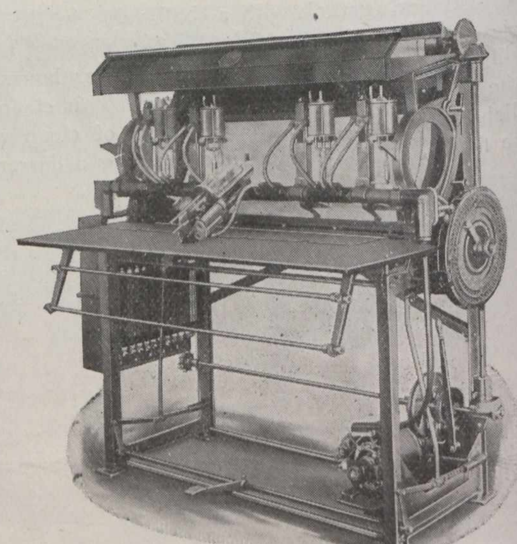


Fig. 2.

where it is first washed by a spray of clear water; then by a weak solution of bichromate of potash which is pumped over and over from the tank shown in the rear of the machine; and lastly by a spray of clear water, after which the paper passes up over the dryer and down into the winding-up device. The printing machine may be used independently

* Vice-president, The C. F. Pease Co., Chicago, Ill.

when desired by simply pulling out a clutch on the washing and drying machine.

When the apparatus is not in use it is customary to keep it threaded up with a strip of blank paper, one end extending onto the end of the feeding table of the printer, and the other end into the re-winding device. After the run is finished the leader is placed on one of the spindles under the feeding table, the sensitized paper is cut off a few inches beyond the

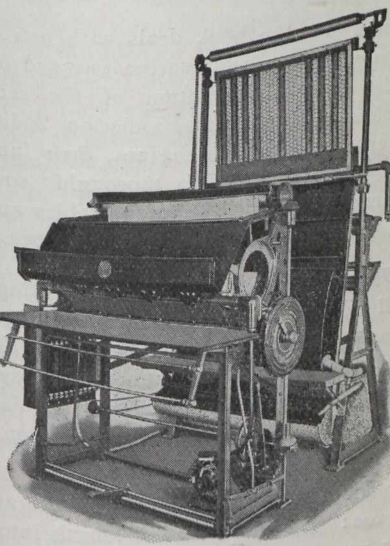
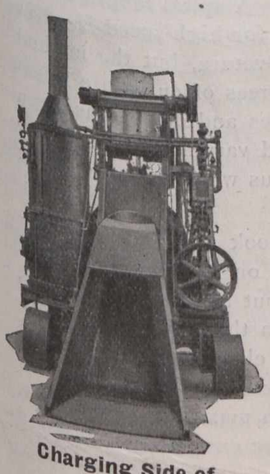


Fig. 3.

end of the last tracing, and the end is pasted onto the end of the leader, the machine being allowed to run until all of the prints have passed into the winding-up device and the leader is again in the machine ready for starting.

NEW STREET PAVER.

The Chain Belt Company, Milwaukee, Wis., announce that they are now manufacturing a paver. The machine is provided with a reversible traction drive so that it can be moved forward or backward by its own power. The traction drive is fitted with a friction clutch. It is connected to both rear wheels and is sufficiently powerful to propel the machine up an incline of 15 degrees.



Charging Side of Street Paver.

No platforms or runways are required and if the material is placed sufficiently close to the machine it can be shovelled directly from the supply pile to the open end power loader bucket. The paver is equipped with a boom 20 feet long and delivery bucket. The concrete is discharged from the mixer into the delivery bucket, which travels on a single boom. The boom can be swung at an angle of 180 degrees, and a street 50 feet wide can be taken care of. The boom bucket will hold a full batch of the mixed concrete and is provided with an automatic tripper. The gates open up automatically at any place where it is desired to deposit the concrete. When the bucket returns to the mixer, the gate closes automatically. In work where the road is less than 18 feet in width a gravity swivel chute may be substituted for the distributing boom.

ILLUMINATING ENGINEERING SOCIETY.

At a meeting of the Convention Committee of the Illuminating Engineering Society, held in Pittsburgh, Friday, May 16th, it was decided to hold the next annual convention in that city during the week beginning September 22nd.

The Convention Committee consists of Mr. C. A. Littlefield, New York Edison Company, chairman; Mr. P. S. Miller, Electrical Testing Laboratories, president of the Society; Mr. H. S. Evans, Macbeth Evans Glass Company, Pittsburgh, Pa.; Mr. W. A. Donkin, contract manager Duquesne Light Company, Pittsburgh, Pa.; Mr. D. McFarlan Moore, General Electric Company, Harrison, N.J.; Mr. M. C. Rypinski, Westinghouse Electric and Manufacturing Company, New York; Mr. C. J. Mundo, General Electric Company, Pittsburgh, Pa.; Mr. J. C. McQuiston, Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa.; Mr. W. J. Sterrill, United Gas Improvement Company, Philadelphia, Pa.; Mr. S. B. Stewart, Philadelphia Company, Pittsburgh, Pa.; Mr. T. J. Pace, Westinghouse Electric and Manufacturing Company, Pittsburgh, and Prof. H. S. Hower, Carnegie Technical Schools, chairman of the Local Section of the Society.

Mr. W. A. Donkin, of the Duquesne Light Company, was selected as chairman of the Local Committee on Arrangements, which will have charge of the Convention. Mr. J. C. McQuiston, of the Westinghouse Electric and Manufacturing Company, was appointed chairman of the Publicity Committee, and will make all arrangements for advertising the Convention.

It is expected that several hundred engineers from all parts of the country interested in lighting in its various forms will be present, and the progrmme, details of which have not as yet been completed, will consist, in addition to the technical sessions, of a reception and dance, several excursion trips and visits to various industries in Pittsburgh.

CHICAGO RAILROADS ON ELECTRIFICATION.

Eight of the steam roads which enter Chicago made a joint statement to the committee on railway terminals of the city council, on May 12th, and requested that action be deferred until another year on a proposed ordinance, which, while it does not specifically require electrification, under the police authority of the city orders an abatement of all the nuisances occasioned by the operation of locomotives. The statement points out that the railroad situation in Chicago "is entirely different from that in any other part of the United States where electrification of terminals has been attempted."

In order to keep pace with the development of their business, the Canadian Fairbanks-Morse Company, Limited, have had designed by Messrs. Pringle & Sons, Limited, of Montreal, a new building which will be situated at the corner of St. Antoine and St. Cecile Streets, that city. This building will be modern in every sense of the word and will be specifically laid out to adequately take care of the various departments of the business. It will have seven floors and a basement, and will be built of reinforced concrete with brick facing. An interesting feature of the building is that which makes it possible for a five-ton truck to run into the basement. The elevator equipment will consist of two freight and one passenger elevators. This building, when complete, will house the entire business, including the storage and demonstration rooms, as well as the repair shop, and will prove a very decided addition to Montreal's business buildings.

ENGINEERS' LIBRARY

Any book reviewed in these columns may be obtained through the Book Department of The Canadian Engineer.

BOOK REVIEWS:

BOOK REVIEWS.

The Gas, Petrol and Oil Engine. Volume 2. By Dugald Clerk, D.Sc., F.R.S., M.Inst.C.E., and G. A. Burls, M.Inst.C.E. Longmans, Green & Company, 39 Paternoster Row, London, Eng. 8 Vo., VII., 838 pages; 478 figures. Price, $7.50.

The name of Dugald Clerk is too intimately associated with the literature of the gas engine to require any comment, and Volume 2 of the Gas, Petrol and Oil Engine, produced in co-operation with Mr. G. A. Burls, M. Inst. C.E., is a fitting sequence to what he has previously produced. This book as a whole, will form a welcome addition to the library of anyone concerned with the development of internal combustion engines, while chapter three, dealing with igniting arrangements; seven, petrol engines; eight, some petrol engines described, and nine, on carburettors, will prove specially instructive to those interested in automobiles or motor boats.

As the authors state, Volume 1, "On the Thermodynamics of the Gas, Petrol and Oil Engine, Together with Historical Sketch" was published in 1909. The sequel to this, Volume 2, deals with practical problems of design, construction, and operation of these engines. Commencing with chapter one, the reader is shown the development of the four-stroke engine, and given the results of tests made on various types, while in chapter two a similar method is adopted with regard to two cycle engines.

Igniting arrangements are discussed under the following groups: (1) Flame method. (2) Incandescent method. (3) Methods depending on Catalytic, or chemical action. (4) Electrical methods.

Section two of this chapter treats on ignition in small, high-speed petrol motors suitable for motor cars and boats, and section three of sparking plugs.

Speed regulation, governors and governing methods are fully described.

Chapters five and six, on the various fuels used in internal engines, are more than ordinarily valuable. The various fuels are described and compared and the whole matter covered in a concise and thorough manner.

The remainder of the book deals with petrol engines, carburettors, heavy oil engines, marine gas and oil engines with an appendix on the acceleration of the reciprocating parts. The book as a whole forms a distinct addition to the literature of internal combustive engines, their fuels and accessories. The entire subject is thoroughly covered, the matter lucidly arranged, and the many tables and illustrations add much to an interesting and useful work.

The Practical Railway Spiral. With short working formulas and full tables of deflection angles, together with examples by L. C. Jordan, B.S., C.E., Principal of the Civil Engineering Department, Heffley Institute, Brooklyn, New York. Publishers, D. VanNostrand Company, New York. Illustrated; 155 pp.; 4 ins. x 6½ ins. Price, $1.50 net.

The author adopts as the rule for the close approach to the ideal in curves: Divide the spiral length into six equal parts; lay out 5 per cent. of the desired degree of curvature in the first part; in each of the next four equal parts of the spiral length attain 20 per cent. of the desired degree; and in the remaining portion of the length accomplish the remaining 15 per cent. This rule is given because of the objection to the ordinary spiral on the grounds that the grade of each rail due to run-off is curved at the ends where it joins the track grade, and that due to the play in gauge the outer wheel flange in leaving the tangent for the curve strikes a blow against the rail as it is brought against it for curvature. Whether the rail will improve the riding qualities of the track can only be determined by trial.

The tables in the book are all for the six-cord spiral for lengths of 150, 225, 300 and 450 feet. A spiral length of 150 feet for ordinary curves and 300 feet for high-speed is advocated regardless of the degree of curvature, but the method of using other chord lengths and degrees of curvature is explained on the basis of constant angles and deflections for a constant ratio of length to radius and varying angles or deflections in the ratio of length to radius when the ratio is not constant.

The author brings out in the book the present inconsistencies in the use of spiral curves on American railways, and recommends a carefully worked-out and practical spiral, as described above. It is designed on the principle of limiting the rate of tipping or run-off of elevation at the end of the circular curve to two inches per second of time, elevating the outer rail for centrifugal force to a maximum of 6 inches, and limiting the speed for the sharper curves to correspond with the length.

Apparently the author would like to standardize in practice and get away from the inconsistencies in practice of the railways, some of whom vary the length of spiral with the degree of curvature, some with the amount of super-elevation, some with the speed of the fastest trains, and some design the length of the spiral from a bending of two of the above causes.

The book, in its tendency to standardize practice in spirals is deserving of all success. We believe it will prove of interest and value to all railway engineers.

Specifications for Street Roadway Pavements. By S. Whinery. Published by the McGraw-Hill Book Company, New York. Size, 6 ins. x 9 ins.; cloth, 116 pp. Price, $1 net.

This is the second edition of this work, the original edition having been issued in 1907. The work will be found of exceedingly great interest to those who have to do with the construction and maintenance of pavements as, in addition to a large amount of information on specifications specifically, which is included in Part I. of the book, Part II., comprising 26 pages, is devoted to instructions to inspectors on street paving work and will be found of great use. Practically all types of pavements are dealt with and the specifications submitted covering these pavements will be found very valuable to city engineers and municipal authorities in general. The book contains very copious foot-notes and altogether the work is one which will be welcomed by all those interested in the question of road construction and maintenance.

Natural Rock Asphalts and Bitumens. By Arthur Danby. Publishers, Constable & Company, Limited, London, Eng. 244 pp.; 4¾ ins. x 7¼ ins.; cloth bound; illustrated. Price, $2.50 net.

The author opens with the statement that beyond the occasional articles in the technical journals and the pamphlets issued by the manufacturer, producer or seller of asphaltic materials there is no English work that is at all modern covering this subject. The book deals with the geology, history, properties and industrial applications of natural rock asphalts and bitumens, and contains a great deal of information that will appeal to any and all who have to do with the production, sale or use of these materials for any purposes whatsoever. The book goes into the geology of rock asphalts and bitumens; the sources of rock asphalt and bitumens; history and ancient uses of each of these materials; where to test and analysis, physical properties of rock asphalt. The use of rock asphalt for mastic work is given a special chapter. Altogether the work is one that is thorough, full of interest on a subject which is to many comparatively little known, and will prove exceedingly useful in making clear to many who are using these materials just what they are. The author has omitted unnecessary technicalities. Tests have been kept as simple as possible and the book should find a large sale because the subject is most ably handled. The author has clothed an otherwise dry subject with an interest that holds the reader's attention in a peculiar manner.

Transmission Line Formulae. By H. B. Dwight. Published by the D. VanNostrand Company, 25 Park Place, New York. Cloth; 137 pages; 28 figures; 17 tables. Price, $2.00.

The object of this treatise is to compile a set of instructions for engineers which will enable them to make electrical calculations for transmission lines with the least possible amount of work.

The book may be divided into two parts. The first five chapters are designed for those who have an ordinary acquaintance with alternating current calculations. The second section is for reference and contains the mathematical derivation of the formulae used in transmission line work. A transmission line regulation chart is presented for use in determining transformer regulation and efficiency.

The volume is clearly written and the formulae should prove invaluable to electrical engineers interested in transmission work.

Railroad Construction. By Charles Lee Crandall, M.C.E., and Fred Asa Barnes, M.C.E. Publishers, McGraw-Hill Book Company, New York. 321 pp.; 6 ins. x 9 ins.; cloth bound; illustrated. Price, $3.00 net.

This work, so the authors tell us in their preface, had its beginning in some notes on railroad construction which were first prepared about twenty-five years ago and issued in mimeograph form for the use of students at Cornell University.

The first chapter of the book takes up railroad construction generally and covers estimates; right-of-way; outlines of construction; clearing; shrinkage; overhaul; etc. Chapter two is devoted to earth work and contains a number of illustrations of well-known earth removing equipment, such as steam shovels, scrapers, graders, plows, dump cars, etc. Chapter three deals with the subject of rock excavating, principles of plasting, explosives, etc. Chapter four takes up the subject of tunnelling in which the various methods used in different countries are described and illustrated. Other chapters of the book cover the subjects of masonry, culvert work, foundation, track material, trestles and bridges, estimates and records. At the end of each chapter is given a table of references which will doubtless be found exceedingly useful to railroad construction engineers. There is a very full and complete cross index which forms a valuable feature of the book, as too many books are spoiled by the absence of a comprehensive and serviceable index.

Asphalt Construction for Pavements and Highways. A pocket book for engineers, contractors and inspectors. By Clifford Richardson, M.A.S.C.E., F.C.S., consulting engineer. Published by McGraw-Hill Book Company, 239 West 39th Street, New York. Size, 7 ins. x 4½ ins.; flexible binding; pp. v + 155. Price, $2.00 net.

This book, as the author states, is written with a view of supplying necessary and helpful information in regard to asphaltic concrete and asphalt broken stone pavements. It has created a demand for highway engineers, contractors, and inspectors who are schooled in this work far in excess of the supply, and the result has been that many of them do not realize the importance of careful attention to details which is necessary to insure complete success in this line of work. The author states that the pocket book has been prepared with the hope of insuring better work in the future than has been done in some cases in the past. Its form has been selected so it can be readily carried in the coat pocket for reference on all occasions.

The book is made up of seventeen chapters and an index which should be a great help in rapidly locating desired points of information. Chapters I. II. and III. are very brief, making in all a total of eight pages, and are titled: Introductory, Broken Stone, Foundation. Chapter IV. deals with "The Intermediate Course." Chapters V., VI. and VII. are on Mineral Aggregate-Filler and Dust-Native Bitumens. Chapters VIII. and IX. are on Fluxes and Cement. Chapter X. is the longest in the book, containing about fifty pages, and is on Surface Mixtures. Chapters XI., XII. and XIII. deal with Maintenance and Repair, The Plant, Work Upon the Street. Chapter XIV. is advice to engineers, contractors and inspectors, and is made up of suggestions to the above three and to citizens. Chapter XV. is upon Preparatory Work; Chapter XVI., Methods for Examination of Bituminous Materials and Mineral Aggregates; Chapter XVII. contains instructions for taking samples and specimens for examination; Chapter XVIII., reference Tables.

The book should prove very handy to contractors and inspectors and to engineers not fully posted upon asphalt pavements and highways. It places simply and concisely before the reader the principles and reasons for the best highway practice and should prove very serviceable in the field for which it was intended.

Rainfall Reservoirs and Water Supply. By Sir Alexander R. Binnie, M. Inst. M.E., F.G.S., F.R.M.S., M.R.I. Publishers, Constable & Company, Limited, London, England. Size, 5¾ x 8½ ins.; cloth; 157 pp.; illustrated. Price, $2.50.

This book is founded upon the Chadwick Trust Lectures delivered by the author at the Institution of Civil Engineers in February, 1912. The object of this treatise is not so much that it might be regarded as a treatise on waterworks engineering, but more particularly to illustrate some of the salient points connected with what the author regards as one of the most difficult branches of engineering. The book deals with the questions of water and water supply in their broadest aspects, and goes into the question of the sources of supply; gravitation versus pumping; drainage areas; rivers and pumping works; aqueducts; conduits; intensity of floods; evaporation, etc. The chapter on filtration contains a number of illustrations of mechanical filters, including the Bell, the Mather and Platt, and Ransome filters. The book is fully illustrated and will doubtless prove of great interest to all students of the subject. A feature of the book which deserves a special commendation is the full cross index. It enables one to find in the minimum of time just what he wants. The book contains 56 plates and tables, and the data gathered together are drawn from various parts of the world, but particularly from Great Britain. The book will have a very special interest for Canadian engineers, in that its author was recently in Canada, having been called in company with Dr. Houston by the city of Ottawa to report on the water problem as applied to that city.

Reinforced Concrete Bridges. By Mr. Frederick Rings, M.C.I., M.S.A., C.E. (Ger. Inst.) Architect and Consulting Engineer. Published by Messrs. Constable & Company, London, England. Size, 7¾ ins. x 11 ins.; 186 pp. Price, $6.25 net.

The book is devoted specifically to the use of reinforced concrete with special reference to bridge work, and includes what to the author seems the most important features and facts the designer of bridges should be acquainted with. The bridges illustrated comprise a large variety of types common to the bridge engineer. The book discusses the advantages and disadvantages of reinforced concrete for bridge work. The question of waterproofing materials to be used, etc., is taken up in the introductory chapter. The succeeding chapters are devoted to Bending Moments, Stresses and Strains; Loads on Bridges and External Stresses; Culverts, Coverings, Tunnels, etc.; Beam Bridges; Calculation of Girder Bridges and Work Examples; Design of Arched Bridges and Abutments; Examples of Arched Bridges; etc. The work is most profusely illustrated by very excellent photos and line engravings, and will doubtless be welcomed by bridge engineers interested in reinforced concrete design and construction as a valuable addition to the literature on the subject. It contains a number of folding diagrams and from pages 158 to 181 there are a series of tables which will be found exceedingly useful to bridge engineers generally.

Rules and Regulations for Inside Electrical Installations. This is a book of rules issued by the Hydro-Electric Power Commission of Ontario and contains 129 pages. It discusses the subjects of installation work, wiring electric plants, grounding, maintenance and operation, and also instructions on resuscitation from electric shock. The book is illustrated and will be found of special interest to everyone who is connected with the installation or operation of electric plants of any kind whatever.

PUBLICATIONS RECEIVED.

Canadian Peat Society.—Illustrated journal issued by Canadian Peat Society, Castle Building, Ottawa, Ont.

United States Department of Agriculture.—Monthly list of publications as received by the department, Washington, D.C.

Ore Dressing and Metallurgical Laboratory.—Bulletin 160. Issued by the Mines Branch, Department of Mines, Ottawa.

Revenues and Expenses of Steam Roads for January, 1913.—Bulletin No. 50. Issued by Interstate Commerce Commission.

Annual Report of the Philadelphia Bourse.—Twenty-second annual report as presented by the directors' meeting of May 13, 1913.

Canadian Forestry Journal.—Sixty-four page journal dealing with forest conservation. Issued by the Canadian Forestry Association, Ottawa.

American Society of Mechanical Engineers.—Illustrated journal published by the society, May, 1913. Address, 29 West 39th Street, New York.

Specification of Peebles' Standard Turbo Alternators.—Specifications of alternators. Issued by Bruce, Peebles & Company, Limited, Edinburgh.

Mine Inspector of the Territory of Alaska.—Report of mine inspector for the fiscal year. Issued by the Department of the Interior, Washington, D.C.

Forest Service Investigations.—Illustrated review of the work conducted by the Forest Service; issued by Henry S. Graves, United States Department of Agriculture.

Patents.—Illustrated official journal of patents of Great Britain, April 9, 1913. Issued by the Patent Office, Southampton Building, Chancery Lane, London, W.C. Price, 6d.

Forest Conditions.—Illustrated bulletin issued by T. W. Dwight, M.F., Department of the Interior, Canada, on forest conditions in the Rocky Mountains forest reserve.

Selection of Explosives.—Illustrated bulletin on the selection of explosives used in engineering and mining operations. Issued by the Department of the Interior, Bureau of Mines, Washington, D.C.

American Railway and Bridge Building Association.—Proceedings of the 22nd Annual Convention, held at Baltimore, October, 1912. 9 ins. x 6 ins.; 295 pp.; numerous illustrations. Price, $1. Apply C. A. Lichty, secretary, 26 West Jackson Boulevard, Chicago, Ill.

Good Roads.—Hearings before the Joint Committee in the Construction of Post Roads, January 21st, 1913. Part I.; 9 ins. x 6 ins.; 220 pp. Apply A. W. Prescott, secretary, Joint Committee on Federal Aid in the Construction of Post Roads, Washington, D.C.

Tests of Reinforced Concrete Buildings Under Load.—An interesting, illustrated bulletin on the tests of three large buildings, by A. W. Talbot and W. A. Slates. Copies may be obtained from the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

Report on the Tractions Improvement and Development of the Toronto Metropolitan District.—A most exhaustive report taking in all phases of transportation as it affects Toronto and outlying districts. The text of the report covers present traffic conditions; car lines recommended; cars and service requirements; costs and returns. Contains twenty-six photographs and drawings. Forty-eight 6 x 9 ins. pages.

Reconnaissance Along the National Transcontinental Railway in Southern Quebec.—Interesting booklet written by John A. Dresser and published by the Department of Mines. Deals with the general geology, description of land formations and topographical character of the Laurentian and Appalachian highlands and the St. Lawrence lowlands.

The Concrete House and Its Construction.—A practical working volume containing important details involved in the construction of concrete dwellings. Nicely illustrated, showing interior and exterior views of noted concrete houses. Issued by the Association of American Portland Cement Manufacturers, Land Title Building, Philadelphia, Pa.

Producer-Gas Power Plant in the United States.—By R. H. Fernaed. Is a nicely illustrated bulletin dealing with the present status of the producer-gas power plant, fuel-testing, blast-furnace and coke-oven gas plants. Also the views of manufacturers, owners and operators of producer-gas plants, and has attached map showing graphic distribution of producer-gas plants in the United States. Issued by the Department of the Interior, Bureau of Mines, Washington, D.C.

The Reading Iron Company, of Reading, Penn., send us Bulletin No. 10, which is devoted to an illustrated description of the Illmer gas engine, which engine possesses a number of new features. The engine is intended primarily for driving electric generators, pumps, rolling mills and other heavy duty service operating at a reasonable load factor. To those interested in the subject we would strongly advise them to send for a copy of this bulletin and we are sure it would be gladly sent by the manufacturers.

Bulletin of Revenues and Expenses of Steam Roads in the United States.—This is a pamphlet prepared by the division of statistics and covers the revenues and expenses of railways during the month of February, said railways reporting to the Interstate Commerce Commission. In the bulletin will be found operating revenues and expenses of large railways and their principal subsidiaries showing whose total operating expenses exceed one million dollars. The pamphlet contains 36 pages, 9 ins. x 12 ins.

Torquay Water Undertaking.—This is an illustrated description of the new filtration plant at Torquay. Issued by the Candy Filter Company, Limited, of London, by which firm the installation was carried out. The plant has a capacity of two and a half million gallons per day and the sketch of the work done is written by Samuel C. Chapman, water engineer of the municipality of Torquay. The pamphlet contains twelve pages, one half-tone illustration and two diagrams, one showing the layout of the filters and the other a cross section.

Good Roads.—Tables showing in condensed form for ready reference and comparison, data regarding the highway systems of the leading nations of the world and statistics bearing upon federal aid in highway improvement in the United States. Compiled by the Hon. J. Bourne, Jr., chairman of the joint committee on federal aid in the construction of roads for the United States Congress. Revised print, March 20th, 1913. 12 ins. x 9 ins.; seven folded charts. Apply A. W. Prescott, secretary, Joint Committee on Federal Aid in the Construction of Post Roads, Washington, D.C.

Expert Evidence.—Verbatim report of a discussion held at a meeting of the American Institute of Consulting Engineers, Eugene W. Stern, secretary.

A most exhaustive discussion on the subject referred to above is contained in the fifty-eight pages of the pamphlet and will well repay any engineer who may have the privilege of reading the same. In as much as there is a good deal of opposition to the present methods of securing expert evidence in legal cases, it is an exceedingly interesting subject, and one that is of great importance to the engineering profession. The following well-known engineers took part in the discussion: Mr. Rudolph Hering, Mr. Gustav Lindenthal, Mr. Cary T. Hutchinson, Mr. L. B. Stillwell, Mr. Sanford Thompson, Mr. Frank H. Waterman, Mr. Livingston Gifford, Mr. Alfred Noble, and Mr. E. W. Harrison.

The discussion was full of information that should be brought to the attention of every engineer who is likely to be called upon to give expert evidence where cases are before the courts, and where engineering knowledge is needed. It makes good reading.

CATALOGUES RECEIVED.

All Famous.—Illustrated pamphlet, 10 pages. Issued by the Heine Safety Boiler Company, St. Louis, Mo.

The Universal Crane and Excavator.—Illustrated catalogue; 15 pages. Issued by the C. O. Bartlett & Snow Co., Cleveland, Ohio.

American Vanadium Facts.—Illustrated catalogue published by the American Vanadium Company, 341 Vanadium Building, Pittsburgh, Pa.

The Hardy Simplex Hammer Drills.—Illustrated catalogue showing three types of drills. Issued by Mussens, Limited, 318 St. James Street, Montreal.

Blacksmithing and Drop Forging.—Illustrated bulletin dealing particularly with heavy forgings. Issued gratis by the Tate-Jones & Company, Inc., Pittsburg, Pa.

Bayer Railway Speed Recorder.—Illustrated catalogue, giving description and instruction for applying and operating recorder. Issued by the Chicago Pneumatic Tool Co., Fisher Building, Chicago.

The United States Graphite Company's Products.—Illustrated catalogue issued by the United States Graphite Company, Saginaw, Mich. Deals with the company's graphite products and is intended to serve the trade as a convenient reference.

The B. Greening Wire Company, Limited, of Hamilton, send us a copy of their catalogue which contains a very full and complete illustrated description of their various specialties. It also contains an historical sketch of the business which was started 'way back in 1858. The catalogue contains 228 pages, is fully indexed, and contains among many other things a number of interesting tables which will be of interest to all those who use wire goods of any description.

Text Book on Corrosion.—An interesting bulletin published by the Stark Rolling Mill Company, of Canton, Ohio, sole producers of Toncan metal. Contains interesting technical information on the introduction of mild steel, rust and corrosion, chemical electrolysis, conservation of metals, efficiency, elimination of corrosion, and value of galvanizing steel. Is nicely illustrated, showing prominent installations of Toncan metal, and is a complete compendium of all necessary information in reference to sheet metal.

The Great Market Street Paving Contract is the title of on interesting booklet issued by the United States Wood Preserving Company. Copies will be sent to interested persons on request by the Canada Creosoting Company, Canadian Pacific Building, 1 King Street East, Toronto. The booklet tells how the Market Street Merchants' Association of Philadelphia, Pa., decided to use wood block when they investigated the problem of repaving Market Street after the street had been torn up for the construction of a subway. The report of the committee and a report by a firm of paving chemists, newspaper clippings, illustrations of streets, etc., are included.

COAST TO COAST.

Toronto, Ont.—Chief Engineer F. A. Gaby, of the Ontario Hydro-Electric Commission, reached this city after a five months' flying tour of the continent. His mission, which was to gather electrical data towards the more efficient operation of a power and lighting system, he claims was very profitable. Much technical information dealing with power production was gathered and this will be embodied in a report for submission to the commission. "Ontario leads in transmission lines," was the comment he made on the problem of distribution. He told of a scheme closely resembling that of the province which had been formed in Sweden and was now on a running basis. The same ideas of carrying power to homes and farms were used, but whereas in some ways their operation was an improvement, he declared that the transmission line system here outclassed any he had seen. He stated that little public ownership on a large scale was apparent, but that several thriving cities, especially in Germany, managed their own systems. France, Germany, Switzerland, Holland, Sweden and England were visited and their leading electrical plants inspected.

Toronto, Ont.—The good roads programme of York county was brought before the Ontario cabinet recently and is at the present time obtaining consideration. After the usual system by which the government advances one-third of the amount raised by the city and county, the $300,000 voted two years ago has been expended. Now, in view of the plans of the government as to a broader policy for old Ontario, it is a question how far roadways should proceed under the old standard. York county, which was represented by Lionel H. Clark and Engineer James, has voted for additional expenditure, and seeink ratification from the minister of public works, the best method to pursue under the circumstances is being debated in cabinet. It is understood that if the present plan goes through, the sum of $100,000 will be asked of the government.

Montreal, Que.—That the $2,000,000 floating drydock placed here last fall is likely to prove to be a white elephant is confessed by shipping authorities. It was thought that shipowners would use the dock for all repairs needed by vessels, but it has been found that no company will put a ship in the dock while there is the slightest chance of sending it to British ports for repairs. A case in point is that of the Elder-Dempster steamer "Benguelo," which will get a much-required scraping when she gets to South Africa, where the work can be done by cheap black labor. As the shipping companies are getting cheaper insurance by reason of the dock being here, it is suggested that while they will not use it, they are not entitled to the advantage and that it should be taken to Quebec.

Victoria, B.C.—Arrangements are in view for a thorough investigation of the water supply of Victoria as derived from Elk Lake, the examination to be made of water from points both at the entrance and exit of the filter beds at Beaver Lake. Until recently only chemical analyses were possible. While these tests are sufficient to detect any organic impurities, it has been impossible, until the city possessed a laboratory where bacteriological experiments were possible, to know what amount of bacteria was passing through the sand, and in fact, to what extent the filter beds were discharging their office. When these tests have been made it will be possible to determine whether the sand is effective, and what percentage bacteria is detained in the beds in process of filtration. A series of systematic tests is proposed by the city analyst on behalf of the water commissioner.

Vancouver, B.C.—Vancouver has lost more than $450,000 in business this year through not having a commercial drydock, but two groups of engineers and financial men are arranging to supply the need, according to statements made recently at the meeting of the Board of Trade in connection with report given upon the recent visit to Ottawa of Mayor Baxter and Mr. W. A. Blair, secretary to the board. Mr. Blair gave statistics regarding boat repair work which went to Esquimalt and Seattle the first three months of the year, but which, in his opinion, would have come to Vancouver had there been a drydock here. Six passenger boats which call at Vancouver had gone to Esquimalt for repairs totalling $226,000, and $75,000 had been expended there upon smaller craft. Seattle has obtained $150,000 through work on other boats which call here. Mr. Blair prefaced his report by the statement that the delegation did not go to Ottawa to form a company to build a dock, but to strengthen the hand of Mr. H. H. Stevens, M.P., in presenting the claims of the city for the establishment of a drydock and a grain elevator. After citing his figures with reference to the loss of business to Vancouver, he said the delegation was informed no naval dock would be built for several years, and the delegation then devoted attention to the question of the commercial dock. As a result they obtained assurance that the drydock subsidy would be changed to favor the financing of such an enterprise. Change of the Act will not be made until next session, but if a bona fide company makes a proper showing the interest will be increased by an order-in-council to 4 per cent. on $6,000,000 for thirty-five years on progressive estimates, and the action ratified by legislation. Mr. Blair said he had good reason to believe that a drydock would be built soon, and that it would be a credit to the promoters and to the city. Mayor Baxter said that since his return representatives of two groups considering the building of a dock had been in conference with him.

Ottawa, Ont.—The Board of Railway Commissioners, being impressed with the large number of accidents occurring at level railway crossings (crossings of one railway by another) which are not protected by signal system with or without derails approved by the board, are asking that railway companies subject to the jurisdiction of the board, show cause, in writing, within thirty days, why an order should not issue requiring such railway companies to install and complete, within three years from date of such order, an interlocking system to be approved of by the board for the protection of all level crossings which are not so protected between tracks of steam railways and between tracks of steam and electric railways.

Peterborough, Ont.—City Engineer Parsons has returned from Toronto, where he went to look into the sewage disposal question respecting Peterborough. Mr. Parsons waited upon Dr. McCullough, chief of the provincial board of health for Ontario, and ascertained the latter's views regarding a suitable plant for this city. The provincial board of health favor the use of Imhoff tanks either with the treatment of the effluent by chlorination, or by sprinkling or intermittent filters. The scheme will have to be worked out with a view of determining the probable cost, not only the first cost, but also the question of maintenance. Mr. Parsons also visited the Toronto engineering department, but was unable to obtain anything that would be applicable to Peterborough. The next move will be to prepare plans and submit them to the provincial board of health engineers for their approval.

Vancouver, B.C.—Preliminary work for the construction of the Georgia-Harris viaduct is rapidly progressing to a point where citizens can readily observe tangible indications of a prompt completion of the project. The contractor already is receiving on the ground the lumber for constructing the form work for the superstructure at the Harris Street end. The steel shoes for the six concrete caissons to be sunk in False Creek are expected to arrive soon, and plans have been devised for sinking the large cylinder down to hard pan. All of the thirty-six footings in Harris Street, from Main Street to False Creek are in place. Some of the footings have been sunk to a depth of fifteen feet and the steel for the remainder of the footings has been delivered on the job. The excavation has begun for the retaining wall at the foot of Georgia Street, and for the various piers through the Canadian Pacific Railroad property. The sinking of the cylindrical caissons, 12 feet in diameter and 40 feet long, will be started as soon as the steel shoes now in transit arrive. The concrete cylinders will be eight inches thick. The steel ties and tracks will be laid in the concrete as it is poured for the various sections. The viaduct, of concrete construction of the Turner mushroom system, will be 2,880 feet long, sixty-six feet wide, and will carry a 53-foot roadway having double tracks in the centre. Various electrical conduits will cross the structure which will be erected along the outer edge, which will be provided with six-foot walks. Massive concrete railings will be erected along the outer edges, which will be provided with 54 ornamental lamp standards of fluted columns made of concrete.

Victoria, B.C.—"Battleships versus Good Roads" would be a good topic for debate among certain enthusiasts for improved highways in the United States, according to George E. Daniels, the well-known authority on automobiles, who has some very decided views on the comparative advantages of well-constructed highways over huge navies, and it is his opinion that greater benefit to the country at large can be obtained through a good roads movement than through a plan to increase the equipment of the navy. "I am perfectly sincere," says Mr. Daniels, "in declaring my preference for the good roads propaganda over the agitation for more vessels of war. I believe that the American Congress, instead of increasing the naval appropriation for the sake of building up a large navy, should spend these millions on national turnpikes. It seems to me there is sound reason for this preference. There is no greater factor in the creation of progress and prosperity affecting our people at large than good roads. It would be silly to assert that good roads are merely to increase the pleasure of a favored few. There is nothing that has a greater economic significance than roads well maintained, for they open up the country so that its fullest commercial development is possible. Moreover, they are the arteries of civilization and without them whole districts stagnate. In this connection they have a distinct ethical value. In general they promote the peace, prosperity and happiness of a country and should therefore receive consideration long before we consider increasing our naval prestige. It is rather humiliating to think that the old countries of Europe, so far behind us in many ways, have learned this and appreciate good roads. When it comes to highways, we are sadly behind Europe, as anyone who has travelled abroad and also through our own states knows full well. It seems curious that we who are such a practical people and presumably so keen for progress and material success should so flagrantly neglect this great factor. Therefore, I say, the time is at hand to boost the good roads movement."

Winnipeg, Man.—Providing the engineering problem is feasible and the cost not too great, Shoal Lake will be the source of supply of the Greater Winnipeg water district. A large majority of the members of the city council attended a meeting of the fire, water and light committee held recently, and after hearing a very satisfactory report on Shoal Lake water from the three consulting engineers, it was unanimously decided that the consulting experts should not be asked to go to Winnipeg River, but that if it is found advisable, they may later be asked to make a supplementary report on the Winnipeg River from data contained in existing reports. The question of filtration of Shoal Lake water was raised by all three of the experts who explained that while it was by no means necessary it might be regarded by the citizens as advisable. They made it plain that Shoal Lake water is pure and soft, and from the hygienic standpoint absolutely clean, but they explained that suspended vegetable matter might cause a slight taste or smell. Engineer Fuertes declared that Shoal Lake water is better than New York has used for 20 years. The members of council lost no time in deciding that there would be no filtration in the meantime and that Shoal lake water is quite good enough as it is. The formal motion, put forward by Controller Midwinter, read: "That the board of consulting engineers be instructed to report on the best means of supplying the Greater Winnipeg water district with Shoal Lake water, with estimate of cost and general plan of work." At the same time it was agreed that should the report not prove as favorable as is anticipated, the engineers should later make a supplementary statement on the feasibility and cost of a supply from the Winnipeg River. Mr. J. H. Fuertes, New York; Frederick P. Stearns, of Boston, and Mr. Hering, are the consulting engineers.

PERSONAL.

R. HUNTER, assistant engineer of the Beach pumping station, at Hamilton, Ont., has resigned to take up a position at Welland, Ont.

DR. JAMES DOUGLAS, of New York, graduate of Queen's, has sent Dean Goodwin a cheque for $25,000 for the establishment of tutorship in the School of Mining.

W. H. RANDALL, superintendent of the waterworks maintenance and distribution of Toronto, will attend the annual meeting of the American Waterworks Association, which meets in Minneapolis, Minnesota, from June 23 to 26.

MR. H. A. DONOVAN, who has been connected with the electrical department of the Winnipeg Electric Railway Company, of Winnipeg, Canada, has been appointed assistant electrical engineer of the company, succeeding Mr. E. A. Graham, resigned.

MR. D. R. KENNEDY, electrical superintendent of the British Columbia Electric Railway Company, of Vancouver, B.C., has resigned his position, and Mr. W. H. Fraser, who has been connected with the electrical staff of the company, has been appointed in his place. Mr. Kennedy will spend the next few months travelling through the States and the Dominion, inspecting various electrical plants.

MR. D. McD. CAMPBELL, city engineer of Sydney, N.S., has resigned. Mr. Campbell entered the service of the city as a member of the city engineer's department in 1900, and was appointed to the position of city engineer in 1908. It is understood that Mr. Campbell is to engage in private practice as a consulting engineer. The board of works of the city of Sydney accepted his resignation with a good deal of regret and so expressed themselves.

ARCHIBALD CURRIE, C.E., graduate of Glasgow University, and member of the Institute of Civil Engineers of London, Eng., at present city engineer of Westmount, Que., has been appointed city engineer of Ottawa. Mr. Currie has had a wide experience, holding positions in Scotland, England, China (during the Boxer trouble), and South Africa. He has been city engineer of Westmount since 1911, and has given general satisfaction since his appointment. He will commence his duties at Ottawa on June 20.

CAPTAIN A. W. GRAY, assistant highways commissioner of Ontario, has been appointed highways commissioner for the parks branch of the Department of Interior, Ottawa. The position is a newly created one and the object of the government is to establish a series of fine highways through the public parks of the west for automobiles and for horses. Captain Gray is an engineer of high standing and has had many years of experience in the work of highways construction. He is an expert in his particular line and the appointment is regarded as an excellent one. He will probably make his headquarters in Edmonton, Alta.

OBITUARY.

ARCHIBALD GUTHRIE, prominent railway contractor, died May 18th, at Chicago, following an operation. Deceased was 77 years old and was born at Lanark, Ont., and received his education there, entering the contracting business, and at the time of his death was senior member of the firm of A. Guthrie & Company. He gained distinction in early northwest railway extension, and carried to completion some of the most pretentions plans in railroad building in the country.

COMING MEETINGS.

CANADIAN ELECTRICAL ASSOCIATION.—Annual Convention will be held in Fort William, June 23, 24 and 25, Secretary, C. E. Bawden, Birkbeck Bld., Toronto.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

THE CANADIAN FORESTRY ASSOCIATION.—National Convention will be held in Winnipeg, Man., July 7-9. James Lawler, Secretary, Canadian Forestry Association, Canadian Building, Ottawa.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa

NATIONAL ASSOCIATION OF CEMENT USERS.—Tenth Annual Convention to be held at Chicago, Ill., Feb. 16-20, 1914. Secretary, E. E. Kraus, Harrison Bld., Philadelphia, Pa.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—176 Mansfield Avenue, Montreal. President. Phelps Johnson; Secretary. Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

MANITOBA BRANCH.—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-Jack, 83 Canada Life Building, Winnipeg. Regular meetings on first Thursday of every month from November to April.

OTTAWA BRANCH – 177 Sparks St. Ottawa. Chairman, R. F. Uniacke, Ottawa; Secretary, A. B. Lambe, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings,

QUEBEC BRANCH—Chairman, A. R. Decary; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, E. A. James; Secretary-Treasurer, A. Garrow. Meets last Thursday of the month at Engineers' Club.

CALGARY BRANCH—Chairman, H. B. Mucklestone; Secretary-Treasurer, P. M. Sauder.

VANCOUVER BRANCH—Chairman, G. E. G. Conway; Secretary-Treasurer, F. Pardo Wilson. Address: 422 Pacific Building, Vancouver, B.C.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; Address P.O. Box 1290. Meets 2nd Thursday in each month at Club Rooms, 534 Broughton Street.

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION—President, Mayor Lees, Hamilton. Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—President, George Thompson, Indian Head, Sask.; Secy-Treasurer, E. Hingley, Radisson. Sask.

THE ALBERTA L. I. D. ASSIOCATION.—President, Wm Mason, Bon Accord, Alta. Secy-Treasurer, James McNicol, Blackfalds, Alta.

THE UNION OF CANADIAN MUNICIPALTIES.—President. Chase. Hopewell, Mayor of Ottawa; Hon. Secretary-Treasurer, W. D. Lighthall, K.C. Ex-Mayor of Westmount.

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Councillor Siddall, Port Elgin; Hon. Secretary-Treasurer. J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. MacMillan, Warden, Antigonish, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Bee, Lemberg; Secy-Treasurer, W. F. Heal, Moose Jaw.

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor Planta, Nanaimo, B.C.; Hon. Secretary-Treasurer. Mr. H. Bose, Surrey Centre, B.C.

UNION OF ALBERTA MUNICIPALITIES.—President, F. P. Layton, Mayor of Camrose; Secretary-Treasurer, G. J. Kinnaird, Edmonton, Alta.

UNION OF MANITOBA MUNICIPALITIES.—President, Reeve Forke, Pipestone, Man.; Secy-Treasurer, Reeve Cardale, Oak River, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. W. Lines, Edmonton; Hon. Secretary, W. D. Cromarty, Edmonton, Alta.

ALBERTA ASSOCIATION OF LAND SURVEYORS.—President, L. C. Charlesworth, Edmonton; Secretary and Registrar, R. W. Cautley, Edmonton.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, A. C. Garner, Regina; Secretary-Treasurer, H. G. Phillips, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BRITISH COLUMBIA SOCIETY OF ARCHITECTS.—President, Hoult Horton; Secretary, John Wilson, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

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

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, The Thor Iron Works, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa; Secretary, C. E. Bawden, Birkbeck Bld., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, Hon. W. A. Charlton, M.P., Toronto; Secretary. James Lawler, Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary. H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

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

CANADIAN STREET RAILWAY ASSOCIATION.—President, Patrick Dubee, Montreal; Secretary, Acton Burrows, 70 Bond Street, Toronto.

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

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

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, F. C. Mechin; Corresponding Secretary, A. W. Sime.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

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

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp; Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

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

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

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NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. K. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S

ONTARIO ASSOCIATION OF ARCHITECTS.—President, C. P. Meredith, Ottawa; Secretary. H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, N. Vermilyea, Belleville; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, J. S. Dobie, Thessalon; Secretary, L. V. Rorke, Toronto.

TECHNICAL SOCIETY OF PETERBORO.—Bank of Commerce Building, Peterboro, Ont. Peterboro. General Secretary, N. C. Mills, P.O. Box 995, Peterboro, Ont.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary J. E. Ganier, No. 5. Beaver Hall Square, Montreal.

QUEEN'S UNIVERSITY ENGINEERING SOCIETY.—Kingston, Ont. President, W. Dalziel; Secretary, J. C. Cameron.

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