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Contents of this issue on page 915

The Canadian Engineer

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PLATE GIRDER BRIDGES IN RAILWAY CONSTRUCTION

PART I.

PREVALENCE DUE TO ADVANTAGES OVER OTHER DESIGNS —TYPES OF PLATE GIRDER SPANS IN USE—DIMENSIONING AND STRESS CALCULATION—VARIETY OF LOADS

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THE builders of iron and steel bridges for more than sixty years have maintained that steel bridges properly designed, with good material, efficiently maintained, and used according to the intention of their designers, have in every case proved entirely satisfactory and capable of indefinite endurance and that any cases of disaster have been due to some defect in the construction, to derailment, or other accidental occurrences which bring upon certain members unforeseen strains which they were not intended to carry.

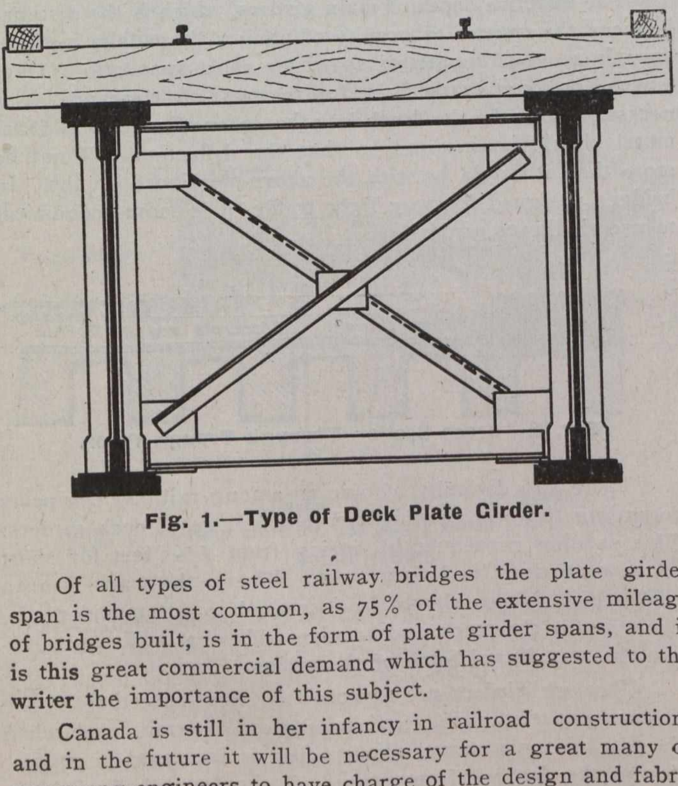


Fig. 1.—Type of Deck Plate Girder.

Of all types of steel railway bridges the plate girder span is the most common, as 75% of the extensive mileage of bridges built, is in the form of plate girder spans, and it is this great commercial demand which has suggested to the writer the importance of this subject.

Canada is still in her infancy in railroad construction, and in the future it will be necessary for a great many of our young engineers to have charge of the design and fabrication of plate girder bridges. Shop methods and erection facilities have so changed that text books do not give the young engineers all the information they require. It is not the object of this series of articles to explain the fundamental theories of plate girders, but to treat the subject from the standpoint of an engineer in actual practice, and to give an intelligible explanation of various snags which are not covered in text books, and which are either omitted in different specifications, or upon which they do not agree.

The advantages of plate girder construction over other forms of bridges are so evident that it is used wherever conditions will permit. One of these advantages is its solidity, by reason of which it is better fitted to resist injury from derailed trains, to prevent corrosion from sulphur gases, and to withstand the severe conditions of exposure which pertain to railway bridges. Another reason for the superiority of this form of bridge is its simplicity and uniformity of con-

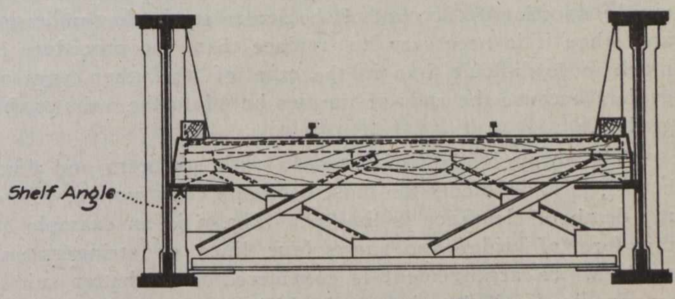


Fig. 2.—Half Deck Plate Girder.

struction, there being a minimum likelihood for error in design. Moreover, the drawing-office expense and shop costs are reduced, as it is usually possible to standardize spans. The erection is completed in a shorter time than in the case of any other form of construction. There is usually more weight of material required in plate girder bridges than in lattice or truss spans, but this objection is more than counterbalanced by its cheaper pound price, the greater speed in the completion of the work and the longer durability in actual service.

The design of a bridge may be divided into two branches; first, the determination of the type of bridge most suitable and its dimensions, and second, the calculation of stresses and sections of material. After the site of the proposed bridge has been surveyed and the engineer has determined the grade alignment of the track, the allowable depth of clearance line below the base of rail and the most suitable lengths of spans required, the design of the bridge can be attained.

Types.—The various types of plate girder bridges which are in general use at present are represented in Figs. 1, 2 and 3, the deck girder being the cheapest and simplest form and therefore used wherever conditions of clearance will permit. Where the allowable depth for clearance is reduced to the limit where a deck span would not suit, it is necessary to adopt the half deck girder, as shown in Fig. 2, or the through plate girder type, as shown in Fig. 3. The half deck girder span is very little heavier than the deck span and is frequently used where the top flange is not more than three feet above the base of rail, the main girders being spaced 13 feet between centres. There have been bridges built where the shelf angles have been lower than this, and in some structures the ties have been made to rest directly on the bottom flange. This is not good practice, as it is necessary to space the girders further apart to suit the recognized requirements of clearance, and this would demand longer and heavier ties and, moreover, the cross brace frames become so shallow that it is not possible to properly stay the top flanges of the main girders. The greatest objection to the half deck girder is that the ties resting on shelf angles must produce eccentric loading on the main girders, and this is not easily taken care of. The half deck span also requires extra heavy ties with an odd length, and these ties demand the most rigid inspection on account of the severe strain they undergo, and when it is necessary to replace them the procedure is much more difficult than in the case of the other types of girders because the ends of the ties butt into the webs of the girders.

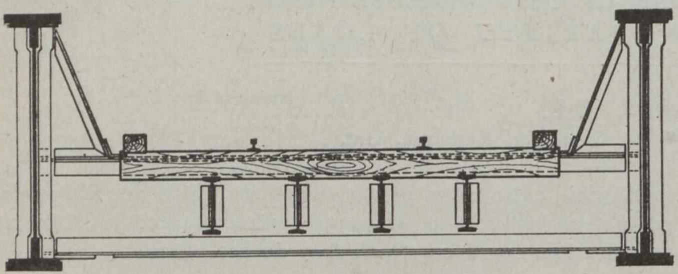


Fig. 3.—Through Plate Girder.

The through plate girder span with stringers and floor beams, is undoubtedly the most desirable construction, where the depth of clearance is limited. Fig. 3 is an example of this form of bridge and shows four lines of stringers per track, which arrangement is considered to be better suited to support derailed trains, and which requires only a very light tie. But it is a cheaper construction, and quite as satisfactory, to use two lines of stringers per track.

In the case of railway bridges passing over streets in cities, where very shallow construction is an advantage, and where protection is needed for the street traffic, a solid floor is used. This may be accomplished by I-beams with a continuous cover plate, or by trough floor construction covered with a waterproofed concrete slab and ballast. The best type of trough floor is shown in Fig. 4. It is an expensive bridge and is not in very common use in Canada, but as railroads multiply in the larger cities it will be more necessary. The trough floor can be made shallower than any other type of floor for heavy loads, and is free from the noise of passing trains, which is an objection in more open construction.

Another type of solid floor, which is illustrated in Fig. 5, is being used in Canada by several railroads, even on bridges where protection below is not needed. It consists of regular track ties in ballast supported on concrete, which covers and fills in between the cross I-beams over the main girders. This construction is being used because of the scarcity of good large bridge ties, and the expense which is frequently required to replace these ties. Any construction which decreases the demand for timber is to be recommended, and there is a probability that bridge design may be considerably changed to suit the increasing scarcity of bridge ties.

There are some tube bridges still in existence, but they are not recommended in modern construction; nor is any form of box girder desirable where the inner surface is not accessible for painting. Wherever a box girder is used, it should be properly braced with diaphragms, so that it will not change its rectangular shape.

Dimensions.—In single spans the effective length of girders is dependent on the adopted clear opening between the abutments, as the edge of the masonry bearing plate should be six inches back from the face of masonry under coping. The length of the bearing plate can then be decided by an approximate calculation of the maximum end reaction. If the final calculations should give a slightly different required area of bearing plate, the difference can usually be taken care of in its width. The effective length of girders is the distance between the centres of these end bearing plates.

In bridges consisting of a number of spans resting on masonry piers, spaced at the most economical distance, the clear space between the ends of main girders should not be less than four inches, and the effective length of the girders is dependent upon this. In steel trestles where the girders rest on towers, the ends of adjoining girders should be placed as close together as the possible expansion will permit, and the effective length will depend on the adopted detail of seat, resting on the cap of the tower posts. In this construction, where the adjoining spans are of different lengths, the different end reactions will produce eccentric loads in the posts, which should not be neglected in the design.

The effective depth of main girders, which is the distance between the centres of gravity of flanges, is usually made to vary from 1/8 of length of span, for short spans, to 1/12 of length for long spans. If, for reasons of clearance, it is necessary to make the depth less than 1/12 of span, additional metal should be inserted so that the deflection will not be more than it would be with the above-mentioned depths. In bridges designed for very light traffic, it is more economical to use shallower girders.

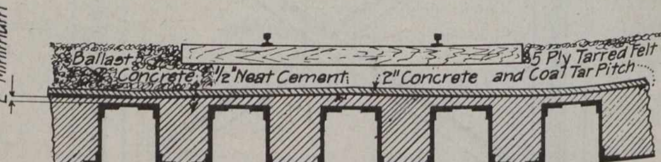


Fig. 4.—Cross Section Through Trough Floor.

There is a diversity of opinion among railroad engineers regarding the best spacing centre to centre of deck girders. This spacing consequently varies from 6½ feet for short spans to 10 feet for longer ones. Where the track is on a curve this spacing should be increased to accommodate the deviation of the track and to give additional stiffness to resist the centrifugal force of the trains.

Through girders are spaced as close together as the government clearance requirements will permit, and when the track is on a curve, this spacing is increased in proportion to the degree of curvature. A simple method of determining this required clearance is indicated in Fig. 6 and its accompanying explanatory note.

Skew in bridges should be avoided wherever possible, but it is sometimes necessary. It is less objectionable in girder spans than in trusses. Even though skew in the face of abutments is necessary, the ends of the girders should be made square to the track, as this is a better arrangement for the deck. The character of the skew is termed right-handed when it is in the direction shown in **Fig. 7.**

The depth of the deck is the distance from the base of rail to the top of the girder, and when the track is on a tangent this depth is ½-inch less than the depth of tie required to support the wheel loads. Fig. 8 illustrates the C.P.R. standard track for deck girder bridges, and it shows the methods of securing the deck to the girders, and the amount of material required. When the track is on a curve, the base of the low rail is referred to in giving the elevations. The outer rail is given a super-elevation to suit the degree of curvature. This is usually made to suit a medium speed of train, rather than a maximum, as the rails are considered to wear longer with this arrangement.

This super-elevation may be arranged by tilting the whole bridge until the webs of main girders are normal to the plane of the track. By this method the standard deck can be used, similar to the case where the alignment of the track is tangent. This arrangement gives a minimum side thrust at the top flanges where the ties rest on the girders, and also a minimum strain on the bracing, because the direction of the axis of the bridge is midway between the vertical direction of the load, when the train is moving slowly, and the direction of the resultant force of the train at high speed. The more general practice, however, is to place the girders in a vertical position and provide for the super-elevation of the track in the framing of the ties. With this arrangement the bridge has a better appearance as well. The cheapest arrangement of the deck is to use regular ties with wood shims on the outer girder to provide super-elevation, but this is dangerous practice and should not be used. The best construction is the use of bevelled ties which can be detailed in the drawing room and ordered to suit. In this arrangement the depth required for the deck depends on the minimum depth of ties, over the inside girder, that is considered necessary to properly resist the shear stresses in the ties. This depth should never be less than 6½ inches, the worst position with the track on a curve being at the centre of the

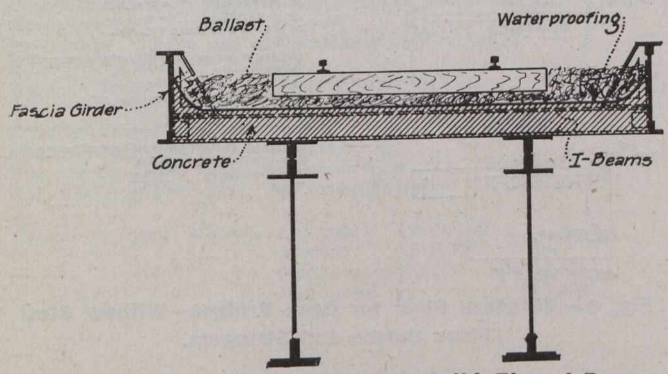


Fig. 5.—Cross Section Through Solid Floor I-Beam Construction.

span, where the camber is the greatest, the cover plates the thickest, and the lower rail farthest from the inside girder. So that if the depth of deck is decided at this point, the ties will have a greater depth towards the end of the span.

It is a common occurrence for engineers who do not correctly foresee the depths required for bridges, in the deck, in the girders themselves, and in the pedestals, to make mistakes in the construction of the masonry; and to overcome such errors it is often necessary to belly the bottom flanges of girders at the ends. This costs the contractor at least $200 a span for the steel, and is usually a total loss to him.

Camber.—This allowance is usually insisted upon for plate girder spans. The intention is to put sufficient camber in the span to more than overcome any possible deflection from loading, because a girder constructed straight might have a reverse camber when erected, which would have an unsightly appearance. A great many bridge engineers consider that this is unnecessary refinement, but if it is specified, good results can only be obtained by proper details and rigid shop inspection. Cases are known where two girders on the same span have reverse camber, although built from the same drawings and in the same shop. Another difficulty in regard to camber is in double track bridges when one track

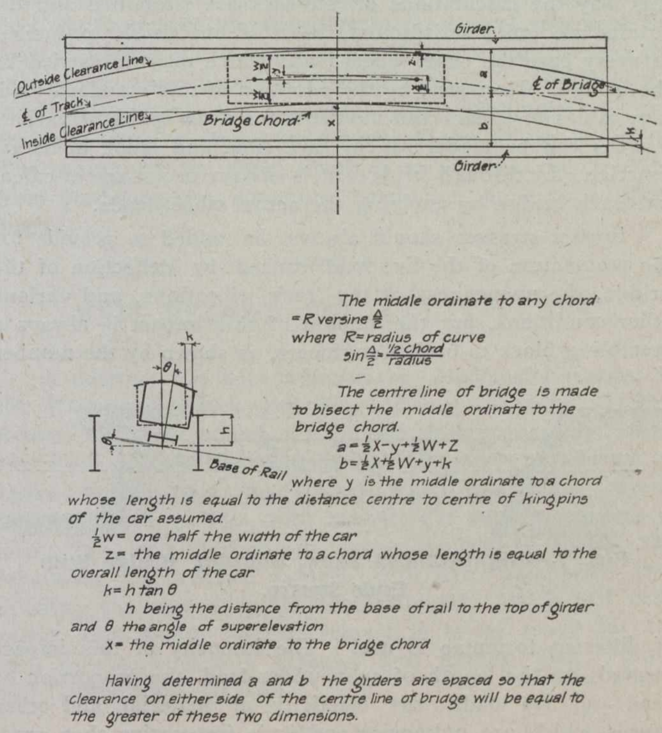


Fig. 6.—Clearance in Through Bridges on Curves.

only is loaded. Where there is one centre girder there is more deflection in the outer and lighter girder and where there are only two main girders there is more load carried by the one girder than the other, and therefore unequal deflection exists. The only arrangement to avoid this difficulty is to place two girders under each track, as if they were separate spans. This is a more expensive arrangement, but it is the best design, because the wear and tear on the bridge is lessened and each half is free to move and deflect by itself when loaded, without straining the other half which would probably be unloaded. It is often an advantage, too, in erection, as one track can be completed first, without interrupting traffic on the other track.

Calculation of Stresses.—In plate girder spans, as in all types of railway bridges, this calculation is based on the following loads: 1, dead load; 2, live load; 3, impact; 4, wind stresses; 5, centrifugal force when track is on a curve, and 6, traction. The methods, both analytical and graphical, for obtaining the dead and live load stresses, are fully covered in all text books on this subject and universally recognized in practice. As these basic methods are unaffected by evolution in construction it seems unnecessary to consider them here.

The dead load per lineal foot of track must be assumed to begin the calculations. It consists of the weight of material in the deck and the steel in the structure. In determining the deck it is usual to consider first the maximum axle load plus impact, distributed over three ties. This will determine the size of ties needed, and as the rails and guards and fastenings are standard, the weight of the deck is then known. The weight of the steel must be assumed either by approximate methods or from records of weights of other spans, and when the design is completed a check should be made to make sure that these assumptions agree with final results.

The live loads adopted by various railroads are usually standard types of consolidated engines followed by a uniform train load and an alternate heavy concentrated load, and the different classes of loading are provided for by varying the loads in the same proportion throughout the whole train. In this way the calculations of stresses are simplified and the results are quite satisfactory, as it is impossible to foresee in every case the exact wheel loads which may be carried by the bridge. Moreover, by the adoption of this standard loading, tables of shears and moments for deck spans of various lengths can be made, which save time and labor in actual practice. In through bridges it is always necessary to calculate each bridge by applying the actual wheel loads.

Impact stresses should always be added to provide for the momentum of the live load caused by deflection of the bridge, the unevenness of the track, vibrations, and various other conditions, but the amount of this impact is always a stumbling block to bridge engineers, as shown by the number

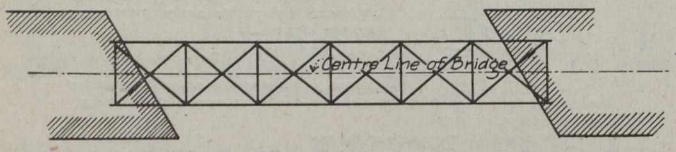


Fig. 7.—Right-Handed Skew, Showing Bridge With Ends Square.

of different formulae in use. The intensity of this impact depends on the length of span under load, the proportion of dead and live loads, the elasticity of material and other causes which are unknown, and it is imperative that practical experiments be made on all types of bridges to determine a formula for impact which will be reasonable and satisfactory. However, all formulae used at present are doubtless on the safe side.

The wind stresses in an ordinary plate girder span do not affect the sections of the main girders at all, because they are usually not considered unless they exceed 25% of the other loads combined. In plate girder bridges a moving load of 600 pounds per lineal foot of span is ample to provide for the wind on a moving train, for the oscillation of the train and for the wind on the bridge itself. This force will determine the wind stresses in the lateral system.

The centrifugal force of a train, when the bridge is on a curve, is not so important as the preceding stresses, but it cannot be neglected and should be considered, both in the laterals and in the main members. The equation $F = \frac{W V^2 D}{85700}$ gives the centrifugal force for a load W on a curvature of D degrees with a velocity of V miles per hour. It is considered to act in a horizontal direction, five feet above the base of rail and at right angles to the line of bridge. All engineers agree that the force F must be resisted by the lateral bracing in the same manner as the wind stresses, but they do not all have the same opinions of the stresses produced in the main girders. The best arrangement of a curved track on a bridge, is to place the axis of the bridge parallel to the chord of the curve, and to make the centre line of the bridge bisect the middle ordinate of the curve at the centre of the span. In other words, the deviation of the track from the centre line of the bridge is the same at the middle as at the ends of the span, and this is an advantage in the event of train derailment. Some bridge engineers are satisfied to consider that, with this position of the track, there will be practically the same load on both girders, and they only add centrifugal force stresses to the lateral system, and use the same girders for a track on a curve as for a track on a tangent.

A more general practice is to assume that there is an overturning action, and that in addition to one-half the live load, there is a load on the outer girder equal to $\frac{F h}{b}$, where F is the centrifugal force, h is the height at which F acts above the lateral system, and b is the spacing centre to centre of girders.

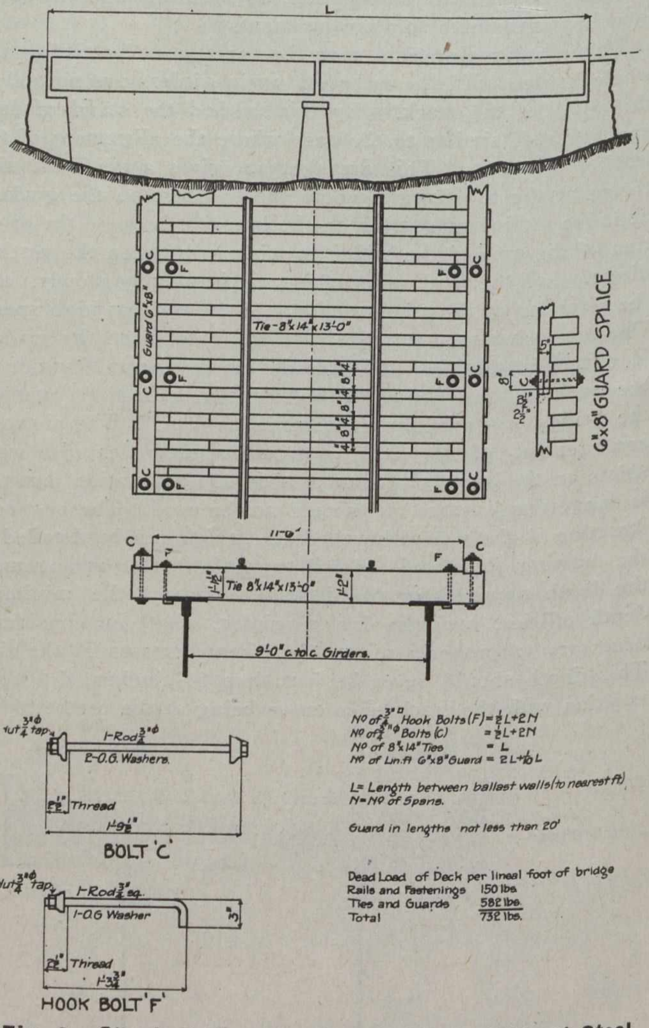
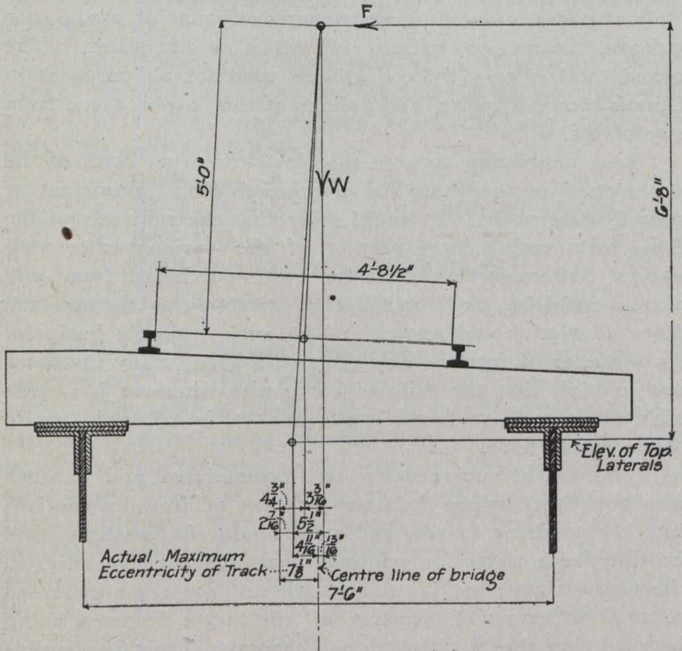


Fig. 8.—Standard Floor for Deck Bridges—Without Steel Floor Beams and Stringers.

Another practice is to consider that the eccentricity of the track at the centre of the span is constant over the entire length of the bridge. Then the proportion of the live load to be added to each girder is given by the formulae $W\left(\frac{M + b}{2 b}\right)$

Where W equals the live load, M is the centre ordinate to the curve, and b is the distance centre to centre of main girders. A thorough treatment of this subject is given in Fig. 9 and the data accompanying it. The theory applied in this example was advanced by Ward Baldwin, who is a college professor and a practical man, and perhaps the best authority on this subject in the United States. He was consulting engineer on a large viaduct in Cincinnati, which the writer designed. In this example the track is super-elevated to suit only a medium speed of train. On account of this arrangement, neither the vertical direct load of a stationary train, nor the direction of the resultant force of a train at high speed, pass through the centre line of track, and these conditions are all taken care of in the calculations. Mr. Baldwin also finds the centre of gravity of the segment, and uses it as the effective position of the centre of the track throughout the length of the span for deck girders. He then arrives at the effective eccentricity for either a fast or slow moving train. The worst condition is used in the calculations, and both girders are made the same section. The extra load which is figured to come on one of the main girders is given as a percentage of the applied load. It is used in the stresses



Length of Chord = Overall length of Girder = 62'-0"
Arc = 62·06 ft Radius 406·424 ft.
$\frac{1}{2}$ Versine = $7\frac{1}{8}$" Elevation of Outer Rail = 3"
C.G. of Arc from vertex $\frac{\cdot 06}{62\cdot 06} \times 406\cdot 424 \times 12 = 4\frac{3}{4}$"
Required Eccentricity for Equalized Stresses, train standing $3\frac{3}{16}" + 4\frac{3}{4}" = 7\frac{15}{16}"$
Velocity of Train 30 feet per second
F = ·0688 W Couple due to F = ·0688 W × 80" = 5·504 W
Eccentricity, due to F = $-5\frac{1}{2}$"
Required Eccentricity, train moving $= 7\frac{15}{16}" - 5\frac{1}{2}" = 2\frac{7}{16}"$
Actual Eccentricity = $7\frac{1}{8}$"
Effective Eccentricity, train moving $4\frac{11}{16}$"
Effective Eccentricity, train standing $\frac{13}{16}$"
Train moving, outer girder has excess $4\frac{11}{16}/90 \times W = 10\cdot 42\% \frac{W}{2}$
Train standing, inner girder has excess $\frac{13}{16}/90 \times W = 1\cdot 8\% \frac{W}{2}$

Maximum Bending Moments.	Live Load	1,950,000	3,169,000
	Impact	1,219,000	
	Eccentricity	10·42 %	330,000
	Dead Load		458,000
	Total		3,957,000

Assumed Loading L.L. Coopers E60
D.L. 1017 lbs. per lin. ft. of Girder

Fig. 9.—Distribution of Loads for Bridges on Curves.

in connection with the live load plus the impact. The above method of determining the centrifugal force stresses, combines all the assumptions made by other engineers, and suggests new ideas which merit consideration. It was the first time, so far as the writer knows, that it had ever been used and it is the more interesting on that account.

The same theory applies in the calculations of the floor system and girders of through spans, with the exception that the position of the centre line of the track at the various panels is used in the calculations, and it is not necessary to assume an effective position of the track over the length of the bridge. In through bridges, too, the stringers should be made to follow the line of track as near as practicable.

When the track is on a spiral, the degree of curvature at the centre of the span is considered constant over the whole length of the bridge in figuring the centrifugal force.

The traction stresses are caused by the momentum of trains either starting or stopping, the amount being dependent upon the coefficient of friction between the wheels and the rails, which is usually considered .20. This force is not considered in connection with the main girders at all, but it does affect the lateral bracing in through plate girder spans. The best construction, to provide for this force, is to connect the bottom of the stringers to the lateral angles at the points where they cross, and to add a diaphragm between the stringers at these points, which will take the resultant of the stresses in laterals and stringers. This diaphragm will also act as a lateral support for the top flange of the stringers. The reason for the above detail is to prevent the traction from producing any horizontal bending moment in the floor beams.

NEW RECORD FOR GREAT LAKES.

A contract has been awarded by Montreal interests to the Western Drydock and Shipbuilding Company at Port Arthur for constructing the largest freight-carrying vessel ever built on the Great Lakes. It will have a capacity of 450,000 bushels of grain. Its length will be 625 feet; width, 59 feet; depth, 32 feet, with bulk-freight pattern, engines of latest type and of sufficient power to lead in speed, and Isherwood construction system, with five bulkheads, thus dividing the ship into six compartments. Work will commence this month and the vessel is to be ready for the 1914 season, operating between Port Arthur, Fort William and Collingwood, Ontario.

VANCOUVER HARBOR PROPOSAL.

The report of inspecting engineers on the feasibility of converting the harbor of Greater Vancouver into a strategic war base has been favorably considered by the British Admiralty in conjunction with representatives of the Canadian Government, according to the Manchester Guardian. The great increase in general shipping which is expected to take place at Vancouver renders it desirable that adequate measures for its protection should be taken without undue loss of time, and it is understood that when the permanent naval policy of Canada is announced a statement will also be made on the Pacific Coast defences of the country. There is already a naval base at Esquimalt, to the south of Vancouver Island, which possesses an admirable harbor with large docks and fortifications. The Government also have under consideration the question of establishing a naval base at Port Nelson, which is to be the tide-water terminus of the Hudson Bay Railway, a project that is to open up direct communication between Liverpool and the northwest of Canada, and to effect a saving in distance of 1,800 miles over the existing routes via Montreal, St. John and New York. Owing to this great natural advantage and to the fear, lately emphasized by the Canadian Minister of Public Works, that grain passing through the warm, humid climate of Panama would be in danger of heating, it is expected that vessels trading by the Hudson Bay route will have an immense advantage over those using the Panama Canal, and that in consequence the shipping interests of Port Nelson will rapidly develop.

WATER REQUIRED BY A STEAM RAILWAY SYSTEM.

In a report to the Illinois Water Supply Association, Mr. C. R. Knowles, general foreman of the Waterworks Department of the Illinois Central Railway, places emphasis upon the importance of an adequate supply of water of good quality for the maintenance of an economic and uninterrupted train service.

Not many years ago, the load of freight trains ranged from three hundred to five hundred tons, and an engine tender with a water storage capacity of twenty-five hundred gallons was considered ample; but to-day freight trains on important trunk lines of low gradients are loaded with two thousand to four thousand tons, and engines with tender storage capacity of nine thousand gallons are quite common. The consumption of water has, therefore, greatly increased and it has become necessary to raise the standard of water supply, both in quantity and in quality in order to meet the traffic conditions.

In former years it was the practice to erect a tank and establish a water station at any point where water of any kind was most convenient, with little regard for quality or future requirements. This has necessitated many changes to meet the changing conditions and added requirements, relocating the water stations with due regard to curvature, gradients and the many previously unknown expedients of operation.

To accomplish the desired result it is often necessary to pipe water from a considerable distance, or, if an ample supply is not otherwise available, to sink wells, or construct an impounding reservoir. If the available supply is not satisfactory in quality, it is often necessary to erect treating plants for converting it into a suitable water for locomotive purposes.

All these changing conditions and increased requirements have made it necessary to maintain a waterworks department organization, whose duties are similar to that of a city waterworks department. Constant vigilance on the part of this organization is necessary to maintain an uninterrupted supply of water at all times.

The amount of water required by a railroad 6,500 miles long, over the entire system, for all purposes, is approximately 16,500,000,000 gallons per annum.

Only part of the water consumed is metered, as a large part of it is furnished on a flat rate, or pumped by facilities, owned and operated by the railroad; consequently the figures given are estimated, the estimates being based on comparative figures at points where meters show the actual amount used.

The consideration of first importance in railway water supply, both in quantity and in quality, is water for locomotives. A water which would be ideal for this purpose would be one that would not scale, would not corrode, and which would not foam or prime. Unfortunately nature does not supply such a water; consequently, where these evils do not cause too much trouble they are tolerated and where they are excessive the water is treated. In the State of Illinois, on 2,000 miles of railroad, locomotives consume annually 4,236,838,000 gallons of water; 1,751,790,000 gallons of the above amount is purchased from municipal and privately owned waterworks plants, and 138,645,000 gallons is treated by purifying plants owned by the railroad company. It is necessary to maintain 123 water stations to distribute this water to locomotives at required points.

The washing and filling of locomotive boilers at terminals require a large amount of water in addition to the above, which amounts to approximately 950,000,000 gallons per annum. This is, of course, supplied through the same facilities supplying water for locomotives, with additional facilities for maintaining the desired pressure for washing and the necessary pipe lines for distribution of the water under pressure.

There is also the consumption of water by stationary power plants, including water used for condensing engines, which is approximately 300,000,000 gallons per annum, 125,000,000 gallons of this is city water. Water is also used for sanitary purposes at shops, roundhouses, offices and stations. This requires an additional estimated amount of 250,000,000 gallons, 200,000,000 gallons of which is city water. The grand total is 5,736,838,000 gallons used for all purposes in Illinois alone, 2,476,790,000 gallons of this is purchased from city plants.

It is interesting to note that forty-three per cent. of the water used in the State is purchased from municipal or private waterworks. It would seem that the railroads of the State form such a large portion of the various water companies' patronage that rates for water purchased from city plants could be made sufficiently attractive to secure even more of what would appear to be very desirable business. As a matter of fact the city rates in a great many instances are so high that the railroad companies wherever it is possible to do so have found it cheaper to install and operate their own stations.

The use of superheaters on locomotives, and modern washout plants, where the water is blown off from locomotives into the washout system and used again for washing and heating fresh water for refilling, have affected economies in the use of water, but the consumption of water has increased to such an extent on account of the larger business being handled that the result of these economies is not perceptible in the grand total of water consumed.

A great deal more might be said on this subject, but costs, merits of various sources of supply, methods of pumping, treatment and filtration have not been considered in detail, the object being to present the water supply of a railway system only in a general way.

ROYAL COMMISSION OF GEORGIAN BAY CANAL.

A Royal Commission will be appointed to investigate the commercial advantages of the Georgian Bay Canal project. Whether the Government will proceed with a twenty-two foot waterway from Montreal through to the head of the lakes via the Ottawa River and the Georgian Bay, or whether it will proceed to deepen the St. Lawrence Canal to a depth of twenty-two or possibly thirty-five feet will depend upon the report of the Commission.

One of the two or three interior terminal elevators to be erected by the federal government in the Canadian West is to be in Calgary. Placed as this city is at the natural gateway from the grain growing area of Alberta and Saskatchewan to the Pacific coast and the Panama Canal, no other decision seemed possible. The Grain Commissioners voiced their disapproval of the city's laissez-faire attitude in not presenting a more elaborate case when the question was under consideration, but to Calgarians, the situation is so apparent that the organizations most particularly interested may be excused for thinking that everyone else ought to see it as plainly as they.

SOME THERMAL PROPERTIES OF CONCRETE.

By Charles L. Norton, Mem.Am.Soc.M.E.

A few of the results of a series of experiments carried on at the Massachusetts Institute of Technology, during the past four-and-a-half years, formed the subject of a paper read by Prof. Norton, at a meeting of the American Society of Mechanical Engineers, in Boston, on February 25th. The purpose of the research was a study of the physical properties of Portland cement concrete, which affect its value as a fire resistant material. The experiments had not been completed, but there was much of interest in what had been already ascertained.

It was proposed at the outset to make a study of the various physical properties of Portland cement concrete over as wide a range of temperatures as possible, and among the properties were the following:—

a Coefficient of linear expansion
b Diminution of mechanical strength after heating
c Specific heat.
d Coefficient of thermal conductivity

A comparison with other materials was also planned.

Coefficient of Linear Expansion—The measurements of the coefficient of linear expansion are now practically completed. The method adopted for the measurements of elongation caused by heating was the common so-called telescope method. The specimens in the shape of 6-in. or 10-in. cubes were slowly heated in a double gas muffle or an electric resistance furnace. The temperature of the furnace and of a number of points in the concrete was taken by means of platinum-rhodium couples. Near the furnace were mounted two telescopes, which could be sighted through holes in the furnace wall upon reference points on the surface of the block. At low temperatures an arc light and system of mirrors were used to furnish adequate illumination. One of the telescopes was provided with a micrometer eye-piece by means of which a movement of the reference mark of 0.0001 in. could be measured.

The values obtained at low temperatures agree very well with the commonly accepted value of 0.0000055 for the elongation per unit of length per deg. Fahr. Apparently, this value increases slightly up to 575 deg. Fahr. Above this point the coefficient becomes smaller; at 1,500 deg. Fahr. the coefficient becomes zero, and above this point, slightly negative.

Table 1 gives the average values for a large number of specimens:—

Table 1 Average Value of Specimens.

Temperature, Deg. Fahr.	in the Expression $l_t = l_o (1+\beta t)$
72 to 360	0.0000045 to 0.000060
72 to 750	0.0000050 to 0.000060
72 to 1090	0.0000045 to 0.000050
72 to 1600	0.0000035 to 0.000042

The blocks which have been heated to 1,500 deg., did not return to their original dimension on cooling, their permanent elongation being about 75 per cent. of their maximum elongation. There was no sensible permanent elongation resulting from a second heating.

All of the specimens tested for expansion were of stone concrete of the proportions 1: 2: 5. The stone was clean, the sand sharp, the cement of good quality, and every precaution was taken to secure a concrete of the first order. The specimens weighed on the average 150 lb. per cu. ft. A considerable number of tests demonstrated that the dimension which these small cubes took during a rise in temperature was dependent upon the temperature of the outside rather than the average temperature of the block.

The variation of this coefficient with the temperature is such as to make the difference between it and the coefficient for steel considerable at high temperatures. As has been well understood, the similarity of the coefficient is helpful in preserving the integrity of reinforced concrete structures at ordinary temperatures, but the divergence of the two coefficients at higher temperatures is not a serious matter in the reinforced structure when exposed to fire, since the metal reinforcement and the concrete surface are rarely at the same temperature.

There is a marked expansion increase up to about 700 deg. Fahr., followed by a slower rate, and at about 1,500 deg. Fahr. by marked shrinkage.

Comparison with Clay Brick and Silica Brick.

Temperature Range, Deg. Fahr.	Clay Brick Coefficient	Silica Brick of Expansion (β)
0 to 900	0.0000038	0.000012
0 to 1600	0.0000031	0.000008
0 to 1900	0.0000023	0.000007

Some bricks and all concrete are liable to a permanent set of about 75 per cent. of their total elongation on heating to 1,500 deg. Fahr.

Diminution of Mechanical Strength after Heating—In order to study the effect of high temperatures upon the compressive strength of concrete several scores of 6-in. and 8-in. cubes were made and allowed to set for 90 days or slightly longer. These blocks were heated at different temperatures in a gas furnace similar to that used for the expansion experiments, for different lengths of time at various periods from the 90 days up to five years.

The cubes which were not heated showed an average compressive strength of 2,700 lb. per sq. in. when 90 days old; at the end of five years the compressive strength of the blocks had risen to an average value of 4,278 lb. per sq. in. When aged for 90 days in a damp place, exposed to fire at 900 deg. Fahr. for two hours, the compressive strength fell to 2,200 lb., or a loss of 15 per cent. Blocks five years old, dry, exposed to fire at 1,700 deg. Fahr. for two hours, gave values of 1,500 to 1,900 lb. per sq. in., a loss of 50 per cent. to 65 per cent.

The loss was much more marked in the case of the 6-in. than the 8-in. cubes. It is evident that the small cubes give far too great loss in strength on heating. Some cubes allowed to stand lost much by slacking; this action has been noted by Professor Woolson in earlier tests. It should be noted also that there was a considerably greater deformation under load of the heated blocks than of those not heated.

A large number of small beams were next made, some with and some without reinforcement; most of these were either 6 in. by 6 in. by 48 in. or 8 in. by 8 in. by 48 in. The specimens which were reinforced contained four ½-in. round steel rods situated near the corners equidistant from the two faces of the beam. In some the distance from the reinforcement to the face of the beam was 1 in. and in others 1½ in. A few beams had a 2-in. protection to the reinforcement.

Three beams for example, each 6 in. by 6 in. by 48 in., in which the reinforcing rods were 1 in. from the face of the beams, were broken by center load, the first beam not having been heated at all, the second heated for one hour in a fire that fused the surface of the concrete, and the third being similarly heated for two hours. The beam which was not heated broke under a load of 5,700 lb., the second, heated for one hour, broke at 2,750 lb., while the third, heated for two hours, broke at 1,950 lb. This is a most remarkable showing under severe conditions. It should be borne in mind that these small beams were so slow in cooling down that they showed the effect of heating much longer than the time mentioned, say 24 hours. The flames, moreover, surrounded the beams on all sides. In tests at three and five year ages, the temperature was between 1,600 deg. and 1,700 deg. Fahr.; the 8 in. by 8 in. by 48 in. reinforced beams broke at 14,200 lb. when not heated, but at 4,920 lb. when heated. Smaller beams 6 in. by 6 in. by 48 in., not reinforced, broke at 1,300 lb. when not heated, at less than 100 lb. heated.

As a result of these tests upon the beams, it was evident that the failure of the specimens was in every case due to the rods pulling through the concrete. This is wholly a matter of insufficient anchorage, and these short beams are therefore not very helpful in giving information concerning the behavior of full-sized beams in buildings, and except as they give relative information concerning different mixtures, they are of very little value. The small cross-section of these beams tends to make the fire exposure abnormally high. It should be noted that all of the non-reinforced beams broke in handling, which suggests the severity of the tests as compared with the experience of actual conflagrations.

A series of similar beams was next made up of cinder concrete, the proportions of the mixture being 1 : 2 : 5. A portion of these were mixed with clean cinders, which showed upon analysis but little carbon; a second part was mixed with cinders to which 10 per cent. of fine bituminous coal had been added and the other beams were mixed with cinder, to which had been added 25 per cent. of fine coal. The 25 per cent. mixture can be disposed of in a word—when once thoroughly heated it burned until it fell to pieces. With the 10 per cent. mixture, however, no such action occurred; there was no indication that the concrete would support its own combustion even for a short time. It was apparent, however, that the 10 per cent. mixture was not so good a fire-resistive material as that which contained no added carbon. From the few specimens containing less than 10 per cent. which have been examined up to the present, it seems probable that the safe limit is close to 5 per cent. More information is now being secured on this point by the use of larger beams.

Specific Heat—The study of the specific heat of concrete was made by the ordinary calorimeter method, the "method of mixtures" of Regnault. Specimens of the concrete, usually fragments of the larger test pieces, were heated slowly in an electric resistance furnace to the desired temperature and then plunged into the calorimeter. The weight of the water and its rise in temperature give the amount of heat given off by the body in cooling. Extraordinary precautions were taken in getting the exact average temperature of the specimen in the furnace, and to insure its rapid transfer to the calorimeter. In most of the experiments a double calorimeter was used so that the specimen did not come in contact with the water of the calorimeter, so that any evolution of heat by hydration of the cement was avoided. Tables 2 and 3 give the specific heat of concrete and of other materials:—

Table 2—Specific Heat.

Temperature, Deg. Fahr.	Stone Concrete 1—2—5	Stone Concrete 1—2—4	Cinder Concrete 1—2—4
72 to 212	0.156	0.154	....
72 to 372	0.192	0.190	0.180
72 to 1172	0.201	0.210	0.206
72 to 1472	0.219	0.214	0.218

Table 3—Specific Heat of other Materials.

Material	Temperature	Specific Heat
Stone Concrete	72 to 500	0.210
Stone Concrete	72 to 800	0.204
Stone Concrete	72 to 212	0.180
Cinder Concrete	72 to 212	0.156
Red Brick	72 to 212	0.214
Red Brick	72 to 500	0.192
Red Brick	72 to 1100	0.200
Quartz	400 to 1200	0.308
		0.305
		0.279
Cement	room temperature	0.271
		0.186
Sand		0.191
Trap		0.201
	?	0.258
		0.270
Sandstone	?	0.220
Dolomites		0.222
Slag		0.169
Granite	?	0.173
		0.196
		0.200

Coefficient of Thermal Conductivity.—The measurements of thermal conductivity were made by a number of methods and have taken far more time and energy than all the others put together. The thermal conductivity is that property which determines how rapidly heat will travel through a substance and how rapidly therefore objects beyond will be heated by transmission. The conductivity becomes of prime importance in all questions of protection of the metal in reinforced concrete buildings. There is a limited amount of data to be found relative to this important property of any of the common materials of engineering and such data as are to be found are not concordant. As to the conductivity of concrete or its variation with temperature and with composition, practically nothing has been known.

The methods adopted for the measurements will be here described in outline only. The formula showing the relation of the temperature upon the two sides of a plate to the amount of heat which would flow through is as follows:—

$$Q = \frac{K\ (t_1 - t_2)\ sA}{d}$$

$$\text{or } K = \frac{Qd}{(t_1 - t_2)\ As}$$

where

- K = the coefficient of thermal conductivity dependent upon the nature of the material and its temperature.
- Q = the quantity of heat flowing through the plate in the area measured
- A = the area
- t_1 = the temperature of the hotter side of the plate
- t_2 = the temperature of the cooler side of the plate
- d = the thickness of the plate
- s = time during which Q units flow through the area A.

The formula will be seen to be merely an expression of the following relations, that the flow of heat is proportional to the area, to the temperature and to the time, and that it is inversely proportional to the thickness.

After spending many months in attempting to develop other methods, the electrical method used by the writer for the past 15 years in studying the flow of heat through steam pipe coverings was adopted. The value Q of the heat flowing was determined by supplying the heat by means of the heating of a conductor carrying a current of electricity; by measuring the electrical energy supplied the quantity of heat developed may be known with great precision. Further, if this heat is passed through the plate under test and into a calorimeter on the far side, a check upon the value of Q may be had. For the determination of the temperature difference, thermal couples, resistance thermometers, and mercury thermometers were used, but thermal junctions made of thin strips of copper and nickel, or of platinum and platinum-rhodium, were generally found most serviceable.

The apparatus used for the lower temperatures consisted of a thin, electrically-heated plate, to the two sides and edges of which concrete could be applied. Outside of the concrete there were then placed heavy copper or brass plates which could be kept at a constant temperature by an internal circulation of water. Thermal junctions were placed at several points on each surface and in the body of each concrete plate. The electrical input was measured by calibrated Weston instruments, and calibrated thermal junctions gave the value of the temperature difference to the nearest one-one hundredth of a degree. For the thickness, numerous measurements were made with a pair of flat-nosed calipers and averaged. It was necessary to keep this apparatus running for several days before it could be balanced, that is, before the rate of flow of heat outward through the plates became constant and equal to the electrical input.

Later, in order to make tests on plates as thick as some of the walls in common use, another method was adopted. Cubical boxes 36 in. in outside dimension were built with walls of several thicknesses. Inside the boxes were placed electric heaters which served to raise the inside surface to a temperature above that of the surroundings and a small fan served to keep the air in the box stirred to insure uniformity of temperature throughout. The boxes were tightly sealed. The power supplied to both heater and fan was measured as before. Mercury thermometers and thermal junctions, as well as a Callender recording resistance thermometer, were used to measure the difference in the temperatures inside and outside of the box.

Data have been secured on scores of specimens and they are practically identical with the results obtained by the plate tester. It must be borne in mind that the thermal conductivity is based upon the difference in temperature at some two points in the material itself and not the difference in the temperature of the air on the two sides of the specimen. If, for instance, a 6-in. wall of solid stone concrete separates two spaces whose temperatures are 40 deg. Fahr. apart, the surface temperatures of the concrete will be much nearer one another than 40 deg. Fahr. There is a drop in temperature in passing through the wall which is dependent upon the thermal conductivity and upon the quantity of heat passing through. There is a drop in temperature at the surface which is dependent on a rather complex set of relations between the temperature and nature of the surface and the surroundings and the adjacent air. For many materials the amount of heat lost from a surface for small differences in temperature not over 20 deg. Fahr. is between 16 and 18 B.t.u. per sq. ft. per 24 hours for 1 deg. difference between the surface and the average temperature of the surroundings. More than one-half of this is a loss by radiation in accordance with the Stephan-Boltzman law.

$$\text{Energy} = \text{Constant}\ (T^4 - T_0^4)$$

$$W = 5.7\ E \left[\left(\frac{T}{1000}\right)^4 - \left(\frac{T_0}{1000}\right)^4 \right]$$

where

W = watts
T = absolute temperature of surface
T_0 = absolute temperature of surroundings
E = about 0.6 to 0.7 (always less than 1).

For the high temperatures a modification of the entire process was found necessary. The concrete to be tested was cast in the form of a cylinder on the outer surface of and concentric with a steel bar which could be heated to a high temperature by the passage of a heavy current. Outside of the cylinder of concrete was applied a closely fitting "continuous" calorimeter. The temperatures of the bar and of the calorimeter were measured by thermal junctions, and the amount of water and its rise in temperature gave the value of Q. In order to guard against the uncertainty of the temperature at the ends of the bar, the calorimeter was made so as to enclose only about one-half the length of the bar, the rest being covered by guard rings similar to the calorimeter, but without provision for the measurement of the quantity of water.

The heating of the bars required a considerable amount of special apparatus, since it was necessary to provide a current of upwards of 2,000 amperes for the high temperatures, and to be able to vary its amount to any desired value below that point. For this purpose there were installed three 15-kw. transformers connected on the primary side with a three-phase 2,300-volt circuit. By means of divided secondaries and a rather elaborate arrangement of switches, the secondary voltage could be varied from 190 volts down to 55 volts. This secondary voltage was applied to the primary of a second step-down transformer, whose secondary was divided into 20 coils. By means of a switchboard the entire output of the transformer could be had at almost any desired low voltage. This enabled us to heat bars insulated by materials of different composition and of different thicknesses to any desired temperature up to 2,800 deg. Fahr. With this arrangement both the steel and the concrete can be easily melted.

The results obtained are given in Table 4. It is to be regretted that there is no uniformity of practice as to the units to be adopted in reporting the measure of effectiveness of insulators. While the physicist renders his report in calories per square centimeter, per centimeter thickness, per one degree centigrade per second, the steam engineer confines his observations to B.t.u. per hour, per square foot, per inch of thickness, per one degree Fahrenheit, and the refrigerating engineer reports on the basis of a 24-hour time unit. The writer has even seen a report in terms of hogsheads of water raised to the boiling point, time not stated. A brief comparison of these values with those for other materials may be interesting.

Table 4—Coefficient of Thermal Conductivity of Concrete.

Temperature of Hot Side of Plate Deg. Cent.	Deg. Fahr.	Mixture	Coefficient, Cal. per 1° C. per sq. cm. per cm. per sec.	Coefficient, B.t.u. per 1° F. per sq. ft. per in. thick per 24 hours
35	95	Stone 1—2—5	0.00216	150.
50	122	Stone 1—2—4 not tamped	0.00110 to .00160	76. to 114.
50	122	Cinder 1—2—4	0.00081	56.
200	392	Stone 1—2—4	0.0021	146.
400	752	Stone 1—2—4	0.0022	153.
500	932	Stone 1—2—4	0.0023	160.
1000	1832	Stone 1—2—4	0.0027	188.
1100	2012	Stone 1—2—4	0.0029	202.

The specific heat of concrete is slightly less than that of either red brick or fire brick, hence the amount of heat needed to raise the temperature of a pound of brick is about 10 per cent. more than for a pound of concrete. But the density of concrete is enough greater than that of brick to raise the heat capacity of a cubic foot of concrete above that of brick. The difference is not large, however,

It seems clear that for a time after the beginning of exposure to fire, the concrete and its reinforcement will expand at much the same rate, but that the further expansion of the surface will not proceed at so rapid a rate. This will tend to reduce the stresses which the expansion of the heated surface would otherwise set up in the cooler interior. It is perhaps because of the failure of the concrete to return to its original dimensions that the small amount of surface cracking found after a fire is due.

The experiments made with coal and cinder mixtures indicate the necessity of added care in the selection of cinders for this purpose.

Table 4 of thermal conductivities gives data as to the rate at which heat will travel through concrete. It is interesting to note the great difference between the tamped and the untamped concretes made from stone. The one was as porous as possible, and the other as dense. One transmits nearly twice as much heat as the other. The cinder concrete, as is commonly believed, is much better as a heat insulator than the stone concrete, being nearly three times as effective as the denser stone concrete in retarding the flow of heat. It may be interesting to call attention to the heat insulation afforded by other materials. The best of the commercial articles commonly used for this purpose is compressed cork, which is nearly 25 times as effective as stone concrete. Steel on the other hand, transmits heat from 75 to 100 times as fast as the densest of the stone concrete.

Table 5—Thermal Conductivities..

Material	B.t.u. per 24 Hours per 1 Deg. Fahr. Sq. Ft. per 1 In. Thick.
Agglomerated Cork	6.4 to 9.0
Linings or Quilts of Hair and Flax	10.0 to 18.0
Pine	13.0
Oak	26.0
Spruce	14.0 to 18.0
Magnesia	10.0
Asbestos Sponge	8.0

STEEL BRIDGE PROTECTED WITH CEMENT.

The Department of Public Works in Pittsburg has recently made use of an ingenious method to save from deterioration a footbridge on Pine Street that passes over the railroad tracks. This steel frame was becoming affected by the gases from the engines that passed beneath it. In order to save the bridge from ruin the board enclosed it in concrete, which was so attractively and effectively set in place that the bridge is now stronger and far more artistic than ever, and at the same time is protected from any further attacks by the deleterious fumes. The entire structure, including the stairways, the supports, the floor and railing, were covered with a layer of cement, and the viaduct is now a reinforced concrete structure, although such a thing was not contemplated at the time of its erection. The idea is so practical that it may be worth following elsewhere in the case of metal structures of various kinds that are subjected to disintegrating gases.

Escher Wyss & Company have moved their head Canadian office from the Canadian Express Building to the Coristine Building, Montreal.

HIGHWAY CONSTRUCTION WITH PAINT BINDER AND ITS SHEET ASPHALT SURFACE.

A type of construction not generally used in the building of interurban roads is being employed on one of the roads of the state highway system of California on the section lying between South San Francisco and Burlingame. The most unusual features of the construction are the thin asphalted binder coat, and the 1-in. sheet asphalt surface. The following description of the work on this section is abstracted from an article by Mr. A. E. Loder, division engineer, in the California Highway Bulletin, the official publication of the State Highway Commission:

The roadway is graded to a width of 40 ft., with a maximum gradient of 4 per cent. conforming with the rolling contour of the country. Long, easy, vertical curves connect all changes of grade, producing a pleasing profile. Flat curves are used at every deflection in the line.

The pavement is 24 ft. in width and has a crown of 4 ins. Earth shoulders containing gravel and old macadam extend to a width of 8 ft. along each side of the pavement with a cross slope of 1¼ ins. per foot. The pavement rests upon a thoroughly compacted sub-grade composed of old macadam and a sand-clay mixture resembling hardpan, which after rolling is in such condition that it is not damaged when the gravel and sand are hauled and dumped directly upon it without the use of planking, and it remains so compact that no dirt is picked up with the sand when loading it into the mixer.

Timber headers 2 ins. by 6 ins., nailed to stakes, line the pavement trench and are laid to a line flush with the finished surface. These protect the edges of the pavement while the shoulders are being settled by traffic, and provide a means by which the pavement may be readily brought to a true and uniform surface.

The pavement consists of a 5-in. concrete base composed of a 1:3:6 mixture, to which is bounded a standard sheet asphalt surface 1 in. in thickness.

The concrete is prepared in a portable mixer to a rather wet consistency and is delivered directly to its place in the pavement by means of a swinging spout. The surface is given a rough finish, suitable for binding bituminous materials, by sweeping across the line of pavement with a stiff house broom or warehouse broom before the concrete reaches its final set. The new concrete is watered daily, except in rainy or damp, cloudy weather, until about five days old.

The asphalt wearing surface being laid on this job is shown on the daily test sheets to be as near the standard grading and composition as is possible to obtain. Nothing unusual is noted in connection with its use, except that a greater density is obtained after rolling the one-inch sheet than is possible with a thicker city surface, and consequently better wearing qualities and more stability should be expected.

When the concrete is dry and at least one week old, it is thoroughly swept, removing the dust of traffic passing at the side of the road. The binder coat is then applied. This coat consists of 1 part by volume of melted asphaltic cement, of the consistency used in the pavement, to 2 parts by volume of engine distillate. The asphaltic cement is heated in a small portable kettle to a temperature between 200° and 325°. A measured quantity is removed to the spreading pail a safe distance from the fire and allowed to cool to about 250°. The distillate is then added and stirred for about one minute, when it is found to be thoroughly uniform and the temperature is reduced by at least 100°. The distillate can be added when the asphalt is at a temperature of 325°, but at this temperature it is accompanied by considerable boiling and is somewhat dangerous.

The binder liquor, while hot, is poured over the concrete from buckets, and uniformly swept over the surface with stiff house brooms until every particle of surface is coated with a thin film and all excess is swept from holes or depressions in the concrete. The paint binder penetrates deeper into the concrete when permitted to flow in a thin wave ahead of the first sweeping. A second sweeping after a few minutes removes excess from depressions and spreads it uniformly over the concrete. The thinnest possible application of paint should be used so that after evaporation, which is completed in from one and one-half to two hours, the surface should have a glossy black appearance. If too small a quantity is used, or if the percentage of asphaltic cement to distillate is considerable less than above, a brown surface will result, which will not make a successful bond with the asphalt surface.

Two men can easily mix and apply this asphaltic coat on 12,000 sq. ft. per day. On 69,000 sq. ft., where the proportions were being varied somewhat, it was found that 100 sq. ft. required 0.856 gal. of engine distillate and 3.5 lb. of asphaltic cement. The total cost on above area, including 15 per cent. on labor, was $0.0018 per square foot of surface.

It is found that no inconvenience is caused to the work of laying asphalt by the placing of the asphaltic coat. After one hour's time it does not stick to the wheels of motor trucks or wagons. It is not desirable to so cover the concrete farther ahead of the asphalt work than is required for the distillate to evaporate and leave the binder hard.

In one case, several days' rain which fell on paint freshly applied caused the asphaltic coat to appear loosened from the concrete in many places. After two days' dry weather, however, it seemed to bond again to the concrete so that it could not be removed. It is believed that the paint binder will tend to waterproof the asphalt surface, preventing damage to its under side from moisture which may rise through the concrete.

If the asphaltic coat is allowed to accumulate in any quantity in a depression such as a heel mark, its location is soon apparent after the placing of asphalt since excess asphaltic cement appears on the surface during rolling. With reasonable sweeping, however, no trouble of this kind has been experienced.

There is a marked difference in the behavior of hot asphaltic mixture under the roller where the paint binder has been used and where it has been omitted. Where concrete has been painted, the asphalt does not move or welt up in front of the roller to any appreciable extent, as is noted when rolling asphalt on plain concrete.

It is found that the asphaltic cement, while dissolved in the distillate, penetrates into the surface of the concrete to a distance of from 1/10 in. to 1/8 in. and in some cases even further. Samples of the surface removed show the concrete adhering uniformly to the asphaltic surface. When removing the sample the concrete is fractured and a layer of solid concrete is removed, carrying the first layer of finer gravel. When trimming a joint to begin a new day's work, the surface of the concrete base is always broken off in removing the thin edge of asphalt which has been cut from the finished work.

For experimental purposes, a few hundred feet of the surface has been placed without the use of the paint binder. As expected, no bond is secured except that of a mechanical nature, due to the roughness of the concrete. Notwithstanding this, the surface remains in first-class condition after one month of heavy traffic, and it is believed that good results will be obtained under wear without the use of a binder of any kind. However, the use of this binder at so small an additional cost will improve the pavement and prolong its life to such an extent it will more than justify its expense.

MAY FIRE LOSSES

The Canadian Engineer's estimate of Canada's fire loss during May amounted to $2,123,868, compared with April loss of $1,470,622 and $2,251,815 for the corresponding period of last year. The following is the estimate for May losses:—

Fires exceeding $10,000	$1,540,500
Small fires	306,342
Estimates for unreported fires	277,026
	$2,123,868

The following are the monthly totals of the losses by fire during 1910, 1911, 1912, and 1913:—

	1910.	1911.	1912.	1913.
January	$ 1,275,246	$ 2,250,550	$ 3,002,650	$ 3,913,385
February	750,625	941,045	1,640,153	2,037,386
March	1,076,253	852,380	2,261,414	1,710,756
April	1,717,237	1,317,900	1,355,055	1,470,622
May	2,735,536	2,564,500	2,251,815	2,123,868
June	1,500,000	1,151,150	4,229,412	....
July	6,386,674	5,384,300	1,741,371	....
August	1,667,270	920,000	1,164,760	....
September	894,125	1,123,550	883,949	....
October	2,195,781	580,750	1,416,218	....
November	1,943,708	1,506,500	1,184,010	....
December	1,444,860	2,866,950	1,769,905	....
	$23,593,315	$21,459,575	$22,900,712	$11,256,017

During May thirty-three lost their lives through fire; this is the largest number of fatalities since July, 1911.

The following are the monthly totals compared with 1909, 1910, 1911 and 1912:—

	1909.	1910.	1911.	1912.	1913.
January	16	27	27	27	14
February	8	15	12	11	21
March	16	20	18	24	22
April	18	37	20	15	11
May	21	15	28	18	33
June	16	52	13	6	..
July	4	15	110	9	..
August	17	11	22	16	..
September	10	10	13	6	..
October	26	16	17	21	..
November	34	19	20	22	..
December	33	19	17	28	..
Totals	219	256	317	203	101

The fire waste in each province for first five months of this year has been estimated by *The Canadian Engineer* as follows:—

Ontario	$2,697,806
Alberta	2,649,203
Manitoba	1,542,912
Quebec	1,109,266
Nova Scotia	943,409
New Brunswick	730,801
Saskatchewan	717,295
British Columbia	490,538
Prince Edward Island	374,787
	$11,256,017

COMPARATIVE STATEMENT OF CANADA'S MINERAL PRODUCTION

FOR YEARS 1910 AND 1911

Product.		1910			1911			Increase (+) or Decrease (−).		Increase (+) or Decrease (−).	
		Quantity.	Value (a)	Per cent of total.	Quantity	Value (a)	Per cent of total.	Quantity.	%	Value.	%
Metallic			$	%		$	%			$	
Antimony ore	*Tons	364	13,906		0	0				− 13,906	
Cobalt (i)	Lbs.		51,986							− 51,986	
Cobalt oxide and nickel oxide	"				154,174						
Cobalt material, mixed cobalt and nickel oxides	"				1,260,832	221,690	0.22			+ 221,690	
Copper (b)	"	55,692,369	7,094,094	6.64	55,648,011	6,886,998	6.67	− 44,358	0.08	− 207,096	2.92
Gold	Ozs.	493,707	10,205,835	9.55	473,159	9,781,077	9.48	− 20,548	4.16	− 424,758	4.16
Pig iron from Canadian ore (c)	Tons	104,906	1,650,849	1.54	42 186	613,404	0.59	− 62,720	59.79	−1,037,445	62.84
Iron ore sold for export (k)	"	114,449	324,186	0.30	40,137	88,570	0.09	− 74.312	64.95	− 235,616	72.68
Lead (a)	Lbs.	32,987,508	1,216,249	1.13	23,784,969	827,717	0.80	− 9,202,539	27.90	− 388,532	31.95
Nickel (e)	"	37,271,033	11,181,310	10.46	34,098,744	10,229,623	9.91	− 3,172,289	8.51	− 951,687	8.51
Silver (f)	Ozs.	32,869,264	17,580,455	16.45	32,559,044	17,355,272	16.81	− 310,220	0.94	− 225,183	1.28
Zinc ore	Tons	5,063	120,003	0.11	2,590	101,072	0.10	− 2,473	48.84	− 18,931	15.78
Total			49,438,873	46.28		46,105,423	44.67			−3,333,450	6.74
Non-Metallic.											
Actinolite	Tons	30	330		67	736		+ 37	123.00	+ 406	123.00
Arsenious oxide	"	(j) 2,049	(j) 81,044		2,097	76.237		+ 48	2.34	− 4,807	5.93
Asbestos	"	77,508	2,555,974	2.39	101,393	2,922,062	2.83	+ 23,885	30.82	+ 366,088	14.32
Asbestic	"	24,707	17,629		26,021	21,046		+ 1,314	5.32	+ 3,417	19.38
Chromite	"	299	3,734		157	2,587		− 142	47.49	− 1,147	30.72
Coal	"	12,909,152	30,909,779	28.93	11,323,388	26,467,646	25.64	− 1,585,764	12.28	−4,442,133	13.50
Corundum	"	1,870	198,680	0.18	1,472	161,873	0.15	− 398	21.28	− 36,807	18.53
Feldspar	"	15,809	47,667		17,723	51,939		+ 1,914	12.11	+ 4,272	8.96
Fluorspar	"	2	15		34	238		+ 32		+ 223	
Graphite	"	1,392	74,087		1,269	69,576		− 123	8.84	− 4,511	6.09
" artificial	"	1,221			1,086			− 135	11.06		
Grindstones	"	3,973	47,196		4,566	52,942		+ 593	14.92	+ 5,746	12.17
Gypsum	"	525,246	934,446	0.87	518,383	993,394	0.96	− 6,863	1.31	+ 58,948	6.31
Magnesite	"	323	2,160		991	5,531		+ 668	206.00	+ 3,371	156.00
Manganese	"				5½	300		+ 5½		+ 300	
Mica			190,385	0.17		128,677	0.12			− 61,708	32.41
Mineral Pigments—											
Barytes	Tons	0	0		50	400		+ 50		+ 400	
Ochres	"	4,813	33,185		3,622	28,333		− 1,191	24.75	− 4,852	14.62
Mineral Water			199,563	0.18		223,758	0.21			+ 24,195	12.12
Natural Gas g)			1,346,471	1.26		1,917,678	1.85			+ 571,207	42.42
Peat	Tons	841	2,604		1,463	3,817		+ 622	73.96	+ 1,213	46.58
Petroleum (h)	Bls.	315,895	388,550	0.36	291,092	357,073	0.34	− 24,803	7.85	− 31,477	8.10
Phosphate	Tons	1,478	12,578		621	5,206		− 857	57.98	− 7,372	58.61
Pyrites	"	53,870	187,064	0.17	82,666	365,820	0.35	+ 28,796	53.45	+ 178,756	95.56
Quartz	"	88,205	91,951		60,526	83,865		− 27,679	31.38	− 8,086	8.79
Salt	"	84,092	409,624	0.38	91,582	443,004	0.42	+ 7,490	8.91	+ 33,380	8.15
Talc	"	7,112	22,308		7,300	22,100		+ 188	2.64	− 208	0.93
Tripolite	"	22	134		20	122		− 2	9.09	− 12	8.96
Total			37,757,158	35.34		34,405,960	33.33			−3,351,198	8.88
Structural Materials and Clay Products.											
Cement, Portland	Bls.	4,753,975	6,412,215	6.00	5,692,915	7,644,537	7.41	+ 938,940	19.75	+1,232,322	19.22
Clay products—											
Brick, common	No.	627,715,319	5,105,354	4.77	645,550,517	5,420,890	5.25	+17,835,198	2.84	+ 315,536	6.18
Brick, pressed	"	67,895,034	807,294	0.75	87,350,539	1,094,582	1.06	+19,455,505	28.65	+ 287,288	35.59
Brick, paving	"	4,214,917	78,980		5,220,400	79,444		+ 1,005,483	23.86	+ 464	0.59
Brick, moulded & ornamental		703,345	16,092		605,643	11,281		− 97,702	13.89	− 4,811	29.89
Fireclay and fireclay products			50,215			89,130				+ 38,915	77.50
Fireproofing and architectural terra-cotta			176,979	0.16		409,585	0.39			+ 232,606	131.00
Pottery			250,924	0.23		102,493	0 10			− 148,431	59.15
Sewer-pipe			774,110	0.72		812,716	0.79			+ 38,606	4.99
Tile, drain	No	24,562,648	370,008	0.34		339,812	0.32			− 30,196	8.16
Lime	Bus.	5,848,146	1,137,079	1.06	7,533,525	1,517,599	1.47	+ 1,685,379	28.82	+ 380,520	33.46
Sand-lime brick	No.	44,593,541	371,857	0.34	51,535,243	442,427	0.43	+ 6,941,702	15.57	+ 70,570	18.98
Sand and Gravel (exports)	Tons	624,824	407,974	0.38	573,494	408,110	0.39	− 51,330	8.22	+ 136	0.03
Slate	Squares	3,959	18,492		1,833	8,248		− 2,126	53.70	− 10,244	55.39
Stone—											
Granite			739,516	0.69		1,119,865	1.08			+ 380,349	51.43
Limestone			2,249,576	2.10		2,594,926	2.51			+ 345,350	15.35
Marble			158,779	0.14		162,783	0.15			+ 4,004	2.52
Sandstone			502,148	0.47		451,183	0.43			− 50,965	10.15
Total			19,627,592	18.37		22,709,611	22.00			+3,082,019	13.57
Grand Total			106,823,623	100.00		103,220,994	100.00			−3,602,629	3.37

CANADA'S MINERAL PRODUCTION.

The table on the opposite page is from the current issue of *The Monetary Times*. With the following explanation of symbols used, it should be of great value to all readers of *The Canadian Engineer*:—

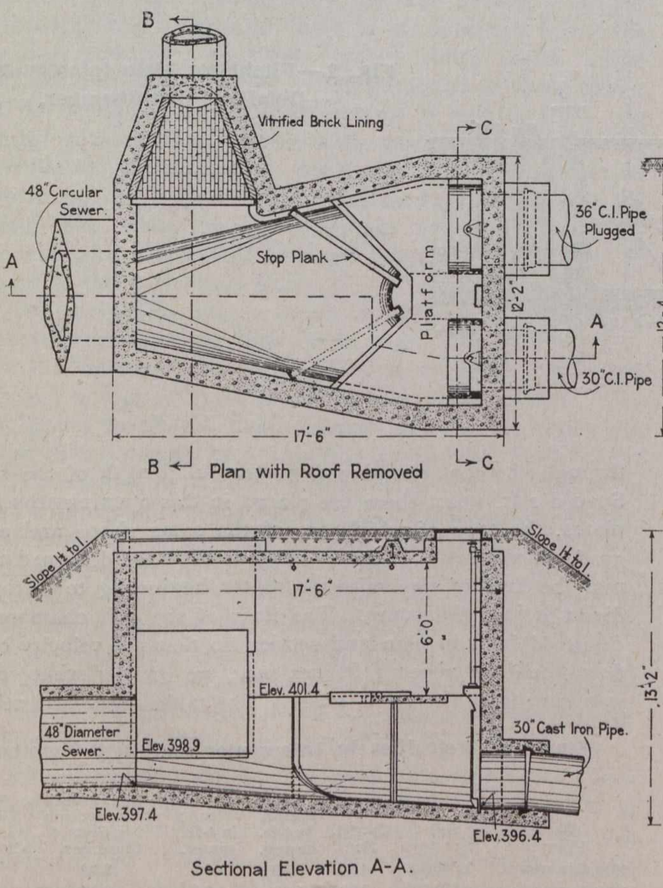
*Short tons throughout. (*a*) The metals copper, lead, nickel, and silver are for statistical and comparative purposes valued at the final average value of the refined metal. Pig iron, zinc ore, and cobalt oxides are valued at the furnace or spot, and non-metallic products at the mine or point of shipment. (*b*) Copper content of smelter products and estimated recoveries from ores exported, at 12.376 cents per pound, in 1911; and 12.738 cents per pound in 1910. (*c*) The total production of pig iron in Canada in 1911 was 917,535 tons valued at $12,307,125, of which it is estimated 875,349 tons valued at $11,693,721 should be credited to imported ores; in 1910, the total production was 800,797 tons valued at $11,245,622, of which 695,891 tons valued at $9,594,773 are credited to imported ores. (*d*) Refined lead and lead contained in base bullion exported at 3.480 cents per pound, in 1911; and 3.687 cents in 1910, the average prices in Montreal and Toronto respectively. (*e*) Nickel content of matte produced value at 30 cents in 1910 and 1911. (Increasing quantities of nickel-copper matte are now being used in making monel metal which is sold at a price much below that of refined nickel.) The value of nickel contained in matte, as returned by the operators, was about 10 cents per pound for both years. (*f*) Estimated recoverable silver at 53.304 cents per ounce in 1911, and at 53.486 cents in 1910. (*g*) Gross returns for sale of gas. (*h*) Quantity on which bounty was paid and valued at $1.22½ per barrel in 1911 and at $1.23 in 1910. (*i*) Value received in 1910 by shippers of silver cobalt ores for cobalt content. Cobalt not paid for in 1911. (*j*) In 1910 includes 547 tons arsenical ore valued at $5,716. (*k*) In 1911, figures as reported by the producers, which differ slightly from those of the Trade and Navigation reports.

FITCHBURG SEWAGE DISPOSAL PLANT.

Points in the Design of Siphon and Grit Chambers of Main Interceptor—Settling Tanks and Sprinkling Filters are Also Special Features

In the fifth semi-annual report of the Sewage Disposal Commission for the city for Fitchburg, Mass., two interesting structural features of the main interceptor belonging to the new system were described. These are respectively the siphon and grit chambers. It will be remembered from previous articles that the commission was created in 1910 with authority to construct a main trunk sewer and a system of sewage disposal that would meet with the approval of the Massachusetts State Board of Health. The commission has Mr. David A. Hartwell as chief engineer and Mr. Harrison P. Eddy as consulting engineer.

Siphon Chamber.—The first section of the main interceptor is 5,989 ft. long. Of this distance 5,070 ft. is 30-in. cast iron pipe and 919 ft. is 48-in. concrete sewer. At the junction of the 48-in. sewer with the 30-in. cast iron pipe there has been constructed a siphon chamber, so arranged that when the flow in the sewer exceeds the capacity of the 30-in. siphon the excess will spill to the river through a 24-in.



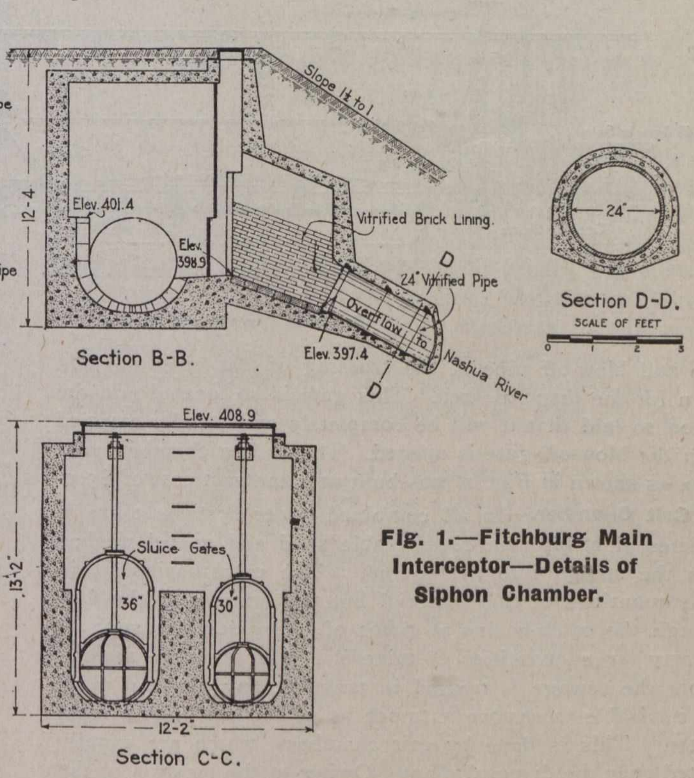


Fig. 1.—Fitchburg Main Interceptor—Details of Siphon Chamber.

pipe line. The capacity of the 30-in. siphon is about 11,000,000 gals. per day, and as the present flow of sewage is only about one-half this amount it is only at times of considerable rain that anything from the sewer will flow through this overflow pipe to the river. The siphon is also constructed with a 36-in. connection for an additional siphon pipe to be laid when the normal flow of sewage about equals the capacity of the 30-in. pipe. This overflow can be regulated by stop planks so that when the 36-in. pipe line is also laid no flow will be diverted to the river unless the amount flowing in the 48-in. sewer should exceed the capacity of both pipe lines. This siphon has a hydraulic grade of 1 ft. in 350 ft. When this 30-in. pipe is carrying the present amount of sewage the velocity of flow will be about 1½ ft. per sec., which would probably prevent the pipe from clogging if there were no gravel or sand carried with the sewage. To avoid possible clogging at time of storm a grit chamber has been constructed about 1,400 ft. above the siphon chamber, and between which and the siphon chamber there are no lateral connections. This grit chamber will be described in detail later. In case this siphon should become partially clogged provision has been made for blowing out the line by placing a 30-in. gate and blow-off pipe at the crossing of the river on land taken for the disposal area. This gate is so located and the siphon so laid that it will be completely and rapidly emptied when the blow-off gate is opened. The siphon chamber complete, as shown in Fig. 1, was built at a contract cost of $500.

Grit Chamber.—In all combined sewer systems there is at times of heavy rain considerable sand and gravel washed from the streets into the sewers. The catch-basins retain large quantities of this material but the rapidity of the flow through the catch-basins at times of heavy rains is such as to carry large quantities of mineral matter into the sewers. Before the sewage is treated in tanks at any disposal plant it is advisable to remove as much as possible of this mineral matter. This is done by grit chambers which are usually located near the disposal plant. Owing to the location of the long inverted siphon in the Fitchburg intercepting sewer with the lower end at the disposal plant it seemed desirable to construct the grit chamber above this siphon. Theoretically, the best location would be directly above the siphon chamber, but it seemed undesirable to build such a structure on private land if any other satisfactory location could be found. The location determined upon for this structure was in the sewer department yard about 1,400 ft. from the siphon chamber. While this grit chamber is located some distance from the siphon chamber still there will be no lateral connections with the sewer between the two. The general details of this grit chamber are shown in Fig. 2. The total length is 53 ft. 9 ins. and the maximum inside width is 18 ft. The sump or grit catcher situated below the sewer invert is 31 ft. 6 ins. long, 8 ft. wide and about 7 ft. deep. At the lower end of the sump is a pump well with a 4-in. centrifugal pump vertically connected with an electric motor with which to remove the water from the sump when it is desired to remove the sand and gravel settled from the sewage. The material collected in the sump will be removed in buckets through manholes provided in the floor and roof of the chamber. There is a 6-in. opening in the line of the sewer invert through the grit chamber floor the full length of the sump. Spaced 2 ft. apart there are placed in this opening iron baffle plates, the tops of which are of the same shape and at the grade of the sewer invert. These baffles are designed to arrest the flow of any mineral matter beginning to settle and divert it into the sump. The floor of the grit chamber was designed both in plan and section so that the velocity of the flow would be about 1 ft. per sec., no matter what volume was flowing in the 48-in. sewer. The table gives data relative

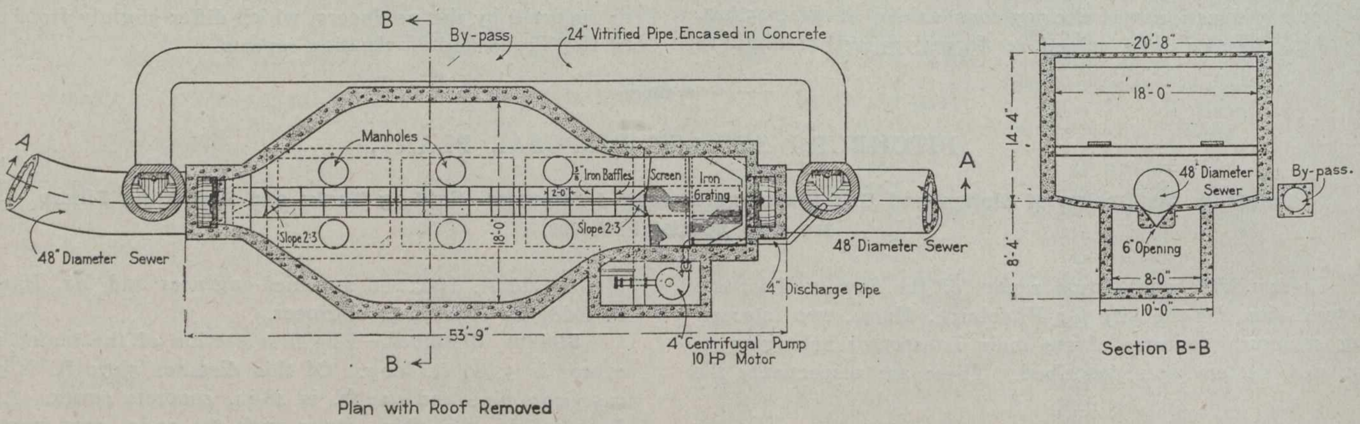
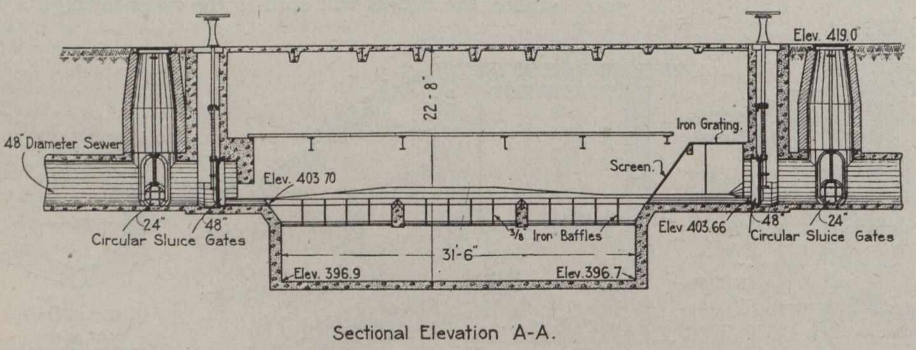


Fig. 2.—Fitchburg Main Interceptor —Details of Grit Chamber.



Flow and Velocities in Interceptor and Grit Chamber.

Flow	Gals. per day	Cu. Ft. Sec.	Depth in 4-ft. sewer.	Velocity in 4-ft. sewer.	Area of maximum water section in Grit Chamber.	Velocity in Grit Chamber.
1910 Minimum,	3,000,000	4.65	.92	2.06	3.99	1.17
1910 Average,	4,000,000	6.20	1.08	2.24	6.27	.99
1910 Maximum,	6,000,000	9.30	1.32	2.53	9.97	.93
1910 Storm	10,000,000	15.50	1.70	2.91	16.68	.93
1940 Average,	6,875,000	10.65	1.40	2.64	11.32	.94

Capacity of 4-ft. sewer with grade of .001 = 39.38 c. f. s.
Velocity of 4-ft. sewer with grade of .001 = 3.13 f.t per sec.
All above computations with n = .015 in Kutter's formula.

to velocities in the main sewer and grit chamber for the probable flow under conditions immediately following the completion of the present construction and also for the average flow of domestic sewage in 1940.

At the lower end of the grit chamber there is placed a screen so that any large matters in the sewage will be removed. This screen is made of 2-in. by ⅜-in. flat bars spaced 2 ins. apart on centres, making an opening between bars of 1⅝ ins. A 48-in. sluice gate is placed at each end of the grit chamber and a 24-in. by-pass constructed so that at times of removing grit from the sump the sewage will be carried around the chamber. This diverting of the sewage around the chamber will be only at such times as there is no storm water with the sewage. The grit chamber is roofed over at the surface of the ground with a concrete slab reinforced with I-beams and wire mesh. A small brick building for housing the electric motor and other equipment will be erected the coming season. This grit chamber was constructed by the International Construction Company, of Boston, at a total cost to the city of about $8,000.

The plans for the disposal plant have reached completion and bids were opened recently for the construction of settling tanks with separate sludge digestion chamber trickling filters, secondary settling tanks, etc.

Settling Tanks.—Sewage delivered to the works by the 30-in. cast iron siphon is first passed through a 30 x 15-in. recording Venturi meter and is then conducted to the battery of five Imhoff settling tanks. These tanks are built side by side and each is 90 ft. long, 30 ft. wide and has a maximum depth of 26 ft. As regards the inlet and effluent connections, both ends of each tank are identical in design, so that the direction of flow of sewage may be reversed periodically to equalize the sludge deposition on the tank bottom. The inlet to each tank consists of three 12-in. openings below the flow line, controlled by hand-operated sluice gates. The tanks are designed to afford a storage period of three hours, and the sludge-digesting compartment is sufficient for six months' accumulation. Under each gas vent is a sump for the collection of the sludge. Air pumps are to be used in its removal and the deposit will then be conveyed directly to the drying beds, while the settled sewage will leave the tanks over weir plates protected by scum boards, and will flow by gravity to the sprinkling filter.

The sprinkling filter, 2 acres in area, is in the form of a rectangle 410 ft. long and 228 ft. wide. The filtering material will consist of a 10-ft. depth of stone, crushed to a size of from 1 to 2 in. At one end of the bed is a main 36-in. cast-iron header to which 16-in. lateral distributing pipes are connected at intervals of a little less than 13 ft. Each lateral line is controlled by a valve, so that the area of the bed to be dosed with sewage can be varied to suit operating conditions. These lateral lines are reduced from 16 to 12 in. in diameter about half way down the length of the bed. The lateral distributors are supported directly upon the filter stones, in which they are buried to a depth which will bring the top of the pipe about on a level with the surface of the filter beds. This design of the distribution system, therefore, eliminates the use of vertical risers, which are required when the distributors are laid along the floor of the filter beds.

After the joints in the cast-iron pipe distributors have been made with jute packing and lead the pipes are to be tapped with a 2½-in. hole and threaded to receive the distributor nozzles. The specifications lay stress upon the care which must be taken to drill and tap these holes so that the nozzles when inserted shall have their vertical axes exactly plumb. The nozzles will be spaced on 15-ft. centres along the distributor pipes and will throw a circular spray. The type of nozzle to be used has not yet been selected.

Secondary Settling Tanks.—The sprinkling filter effluent will be delivered by a 30-in. concrete conduit into four secondary settling tanks, designed to intercept any solid matter which may be washed out of the sprinkling filters. These secondary tanks are circular in plan, 30 ft. in diameter, 24 ft. deep, with hopper-shaped bottoms. The inlet to each tank is in the form of a cylindrical shell of ¼-in. boiler plate, to which is connected a 15-in. spiral riveted pipe. This inlet cylinder is open at both ends and serves to collect any floating matter which may be carried down to the tank. The effluent will pass over weirs into circular channels around the tops of the tanks and will flow down stepped inclines to an open concrete-lined channel leading to the north branch of the Nashua River. The sludge from these tanks will be removed by a motor-driven centrifugal pump and discharged into the sewage entering the Imhoff tanks, in which it will settle and be further digested with the suspended matters of the sewage. By this procedure it is hoped that the offensive and slowly drying secondary tank sludge can be successfully dried.

Sludge from the Imhoff tanks and from the secondary settling tanks will be dried upon a bed of sand composed of grains having an effective size of at least 0.15 mm. and a uniformity coefficient not exceeding 10. The porous character of the underlying material made it unnecessary to install any system of underdrainage. The bed will be separated into long strips, 15 ft. wide, by concrete posts and planks, and along the centre of each strip will be laid a narrow-gauge railway track to carry cars, into which the dried sludge will be shovelled and carried away.

The works are designed for a capacity of sewage equivalent to 100 gals. per capita per day, which is approximately the amount of water consumed, the tanks providing for an estimated population of 55,000 in 1925. It is expected that the entire plant will be ready for the treatment of sewage early in 1914.

PRINCIPLES OF SHOP DESIGN.*

The laying out of machine shops must depend on the area, the shape of the ground available, and the nature of the product manufactured by a firm. The aim should always be to avoid handling materials and products more than is absolutely essential. To this end certain relations of shops to each other, and to railway sidings or canals, will have to be observed, in addition to the internal designs of the shops, the placing of heavy and light machines therein, and the systems of industrial railways and dispositions of hoisting machinery; so that the main problem includes much detail that varies with the requirements of different classes of manufacture.

With respect to the relative positions of shops as affecting the handling of work, two general cases arise. One is that of concentration in a few buildings, the other their isolation in separate buildings. In a large degree the choice between these depends on the size of a concern. The larger it is, the more desirable does the isolation of shops and of departments in shops become, partly because the necessities of supervision, partly of those of higher specialization. A small firm can carry on its machining and assembling work all under one roof, in charge of one foreman. A very large works must not only separate these departments, but must also create sub-departments in each, for light and for heavy work at least; and very often further sections must be ar-

*Condensed from The Times (London) Engineering Supplement.

ranged according to the class of machine used, as planers, drills, gear cutters, grinders, and so on. Then the question arises whether all these shall be included in one large shop covered by one roof, or be housed in separate buildings or on distinct floors, which can be decided only for each individual firm. Speaking broadly, the present tendency is towards isolation where the work done is of a sufficiently standardized and repetitive character to justify it.

But whatever arrangements are adopted, the cardinal element of economical haulage and handling must not be lost sight of. Raw materials—bars, castings, and forgings—should be taken in, and should, with the articles manufactured from them, not return on their tracks, but should progress from shop to shop, or department to department, in orderly sequence; and this idea must be uppermost when locating the positions of those departments in which preparatory work has to be done, as the casting, forging and plating departments, and the stores for iron and steel. Raw material should, as a rule, be utilized first nearest the point of debarkation. The heavy machine shops into which castings and forgings have to be taken should be located nearer to the foundry, forge shop, or boiler shop than the department in which light work has to be done.

It is well as a rule, when work is for the most part heavy, to conduct operations so far as possible on the ground level. There is, however, always a proportion, greater or less, of light work, and this can well be conducted on upper floors, or in galleries running round a shop, the latter usually having preference. In shops in which most of the work is light, as in the manufacture of small motors, brass fittings, and articles of similar bulk, floors and elevators can properly be utilized. But lack of light renders fine work difficult on dark days and runs up the bill for gas or electricity.

Instead of building in the heart of a crowded city, most new factories are now erected in the suburbs of cities, or out in the country where ground is cheap and room for extension is ample, and where healthful cottage homes can be built for the workmen.

The arrangement of shops on a ground floor only is the modern ideal in factory design, and it is one which is admirably suited for engineering works. The work being mostly of a heavy character, its manipulation is awkward on upper floors, but if it can all be dealt with on a ground floor it can be run in and out, handled with hoists and cranes, while all the trouble of lifting and lowering from upper floors is avoided. Supervision, again, is easier on one floor than on several. A manager or foreman can have more men under more effectual observation, whereas different floors require either extra foremen or divided attention. Hoisting machinery can be more efficiently installed on a ground-floor shop than in a building of several stories.

With regard to the buildings themselves, it is better and cheaper to build one-story shops than those with several floors. The walls, having no floors to carry, need not be so thick, and there is no expense for heavy joists, floor planking or concrete. More light can be admitted from the roof than from windows in walls, and a north light can be obtained with a saw-tooth roof, which avoids the direct glare of sunshine. With regard to the walls, in most engineering works they are made to fulfil other functions besides that of sustaining the roof. Details which have to be considered are the support of travellers and jib cranes, of main lines of shafting and countershafts, and sometimes of machines, such as wall planers, drills, etc., in whole or in part. Brick walls alone are not nearly so suitable for the fulfilment of these functions as are metal columns. This is one cogent reason why columns are generally preferred to brickwork, and it is all in favor of the ground-floor shop in which columns take the place of brick walls as supports, the wall often being a mere filling in of a brick course, or even sometimes of sheet iron, between the columns.

Further, the modern shop ideal is to have an unbroken width across two, three, or half a dozen bays. Each bay has its own roof, but the bays are separated only by columns, which leave clear wide spaces across the entire width that is enclosed by the outer walls. The columns, of cast iron or structural steel, are made to suit exactly the requirements of the shop, with flanges and brackets to receive the gantries of overhead cranes, the pivots of swinging cranes, bearings for shafting or countershafts, and attachments for wall machines. In the event of future shop extensions these bays can be carried out lengthwise by making more identical columns, preserving the uniformity in width and height of the shop. In a well-lighted shop built on this model there is no objection to the erection of galleries of moderate width, provided they do not interfere with the employment of suitable hoisting tackle. They would sometimes block the way of an overhead traveller, but the latter is not required in light departments. Moreover, galleries need not occupy all the length, and they may be raised higher than the crane gantries. Where space is limited the galleried shops often offer the best solution of a difficulty.

Hoisting machinery is a costly item, and one in the laying down of which the best judgment is required. There are so many systems of hoisting adopted now that it is difficult to give statements of general application. But the following considerations should have weight. In the shops themselves the choice lies between overhead tracks with hoists, overhead travellers, and walking or single-post cranes. The choice of the first two should be favored because they leave an absolutely clear way beneath. But many firms employ the walking cranes, especially in machine shops. Wall cranes will often be needed both for light loads and the local service of heavy machines. Floor trolley tracks are often used. In the yards there should be travelling steam or electric cranes to go wherever required for unloading or loading, for hauling or pushing, in the absence of a yard locomotive.

The hoisting mechanisms for light service which run along the overhead tracks may be divided into two great groups; those which are trolleys only, having eyes from which the actual hoisting machines are suspended, and those that combine the travelling and hoisting tackle in one. The first-named are mostly of the direct lift types, worked by hand, pneumatic, or hydraulic power; the second are electrical. In the hand hoists pulley blocks are suspended from trolleys pulled along by hand. In the pneumatic and hydraulic types the movement of a piston or ram in a cylinder is equal to that of the lift. In electrical hoists toothed gears, drum and wire rope are employed, driven by the motor located on the trolley. The movements of the latter may be controlled from a distance, but more commonly dependent rods with handles are employed, so that the men standing by their loads can operate the hoist from the floor. So extensive are these developments that several firms in England and America make a specialty of the fitting of overhead tracks and light hoists for them. For heavy duty overhead travelling cranes are practically universal. They are made in many styles and powers to suit all conditions, operated from above and from the floor, and as a rule now each motion is provided with its own separate motor.

Alternative to the overhead tracks are the walking or single-rail cranes, which have for a long time been favorites in the machine shops of the Manchester district and north country shops. They occupy only the room in which they happen to be engaged for the time being, and the single line of floor and overhead rails does not block the shop much. As they are slewing jib cranes, they cover an area corresponding with the entire sweep of the jib.

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CONTENTS OF THIS ISSUE.

THE ENGINEER AND THE COMMUNITY.

Dr. George Fillmore Swain, in his presidential address to the American Society of Civil Engineers at Ottawa, last week, on the part for the engineer to play in the solution of some of the problems of the present day, unconsciously expresses himself as an engineer, among his fellowmen, with an astonishingly broad conception of the relationship of men of this profession to society in general. Frequently, in late years, writers have discussed the subject, and from both sides. Taking the definition of an engineer as one who, possessing a knowledge of the laws and properties of matter, designs and constructs, and, realizing the superior facilities of communication, transportation, food preservation, water purification, etc., as the works of the engineer, the question of what he owes to society is lost in that concerning how much society owes to him. On the other hand, the reason why the engineer does not receive the praise and credit which is his due, has often been attributed to the aloofness with which he holds himself from the discussion of public improvements and the administration of governmental departments and affairs.

Rear Admiral Geo. W. Melville, retired from the United States Navy, in discussing the engineer as a citizen, stated a few years ago:—

"In view of the enormously important part which the engineer plays in the life of to-day, it is incumbent upon him, more than upon most other men, to take a vital interest in the work of government, and to lend his trained ability and judgment to its perfection. I do not mean, of course, that the engineer should do routine professional work for the governments without compensation, but that in the discussion of public improvements and the administration of governmental departments he should take an active public stand to influence and guide the non-expert part of the population.

"It is notorious that enormous amounts of money have been squandered on great public works because they were undertaken in a way which every engineer knew must be inefficient and uneconomical. If all of us as engineers had a keen sense of our duty in this respect, and would properly utilize our experience and ability through the daily press, the magazines, and the reviews, by public discussion and in the daily intercourse of life, as well as by impressing the truth upon our representatives in municipal and national affairs, I believe we should accomplish an immense amount of good."

Prof. Swain's address is one from a viewpoint not frequently found in the writings of engineers, and his masterly treatment of the undesirable phenomena to be found on the increase among men to-day should receive every reader's attention.

ENGINEERING CONVENTIONS.

These are convention days among engineers. This week has such an array of professional gatherings that doubtless the old saying that engineers are content to work, leaving the talking and the management to the lawyer and the politician, will be criticized by the wayfarers in other walks of life, who find them gathered together in hall, hotel, or railway carriage.

Of world-wide interest is the Third International Roads Congress, opened on Monday in London, Eng., and continuing throughout the week. The period of continued activity in road reform that has prevailed since the second Congress, three years ago in Brussels, has seen many methods, and not a few materials, introduce themselves, and pass from the experimental to the practical stage. Further improvements in methods of road construction and maintenance will be disclosed, to the thirty-six countries of the world represented there, and the newest information now available will be dispensed from these various sources, with regard to climatic influences, heavy trafficking, dust prevention, longevity of surfacings, frequency of renewals, etc. As it stands, technical knowledge of road-building is far in advance of road administration to govern it, and it is to be hoped that the Congress in London will bear fruit in much-needed data concerning road costs.

In Toronto the Canadian Electrical Association is in convention on the 25th, 26th and 27th, and not in Fort William as had previously been announced. Arrangements for convening in the latter city were not satisfactorily arrived at, and Toronto was chosen as the place of meeting. Technical papers are being presented at the Wednesday and Thursday sessions, and the balance of the assembly is being given over to excursions and entertainment.

The American Waterworks Association, in session at Minneapolis throughout the week, is fortunate in the choice of city. No doubt the immense filtration plant, representing the latest word in water purification, will receive its share of visitors. Authoritative papers are being read on such subjects as water purification, fire protection, ground water, rate-making, franchises and watersheds.

The American Society for the Promotion of Engineering Education holds its annual meeting this week also, and has likewise chosen Minneapolis as its city. The care and attention which this society is devoting to engineering training merits the approval of all associations in general and of individual engineers.

The American Institute of Electrical Engineers are meeting in Cooperstown, N.Y. It is their thirtieth annual convention. Some twenty papers are being presented, and many Canadian members of the Institute are in attendance.

The American Society for Testing Materials is in convention, June 24th to 28th, at Atlantic City, while the American Institute of Chemical Engineers hold their semi-annual meeting at Boston, Mass., June 25th to 28th.

PUBLICITY IN CALLING FOR TENDERS.

Unless the proposed extension is for the most part a duplication of a previous installation, manufacturers of engineers' and contractors' supplies usually expect reasonably wide publicity in the matter of requirements, being constantly on the lookout for the solicitation for tenders. In the case of a town or city, it is the general rule to purchase supplies by tender, the transaction being of such great interest to ratepayers, and not to a limited few. In some corporations the rule is rigid. Much valuable information is to be gained in dealing with the proposal submitted by tenderers, whatever the requirement may be. It is of value not only to the purchaser, but to other municipalities, and it is strange that the rule is not followed without exception.

Instances frequently come to light, however. where discrimination is practised to excess, and where forms are sent to a very small and promiscuously chosen percentage of those well prepared to submit competitive quotations on reliable supplies. Recently *The Canadian Engineer* was asked by a pipe manufacturer why a certain call for pipe and valve tenders had not appeared in its columns. Upon investigation it was found that the want, although of a city, was not advertised in any paper. Apparently it has long been the custom of the city authorities to send notice of the material required to several manufacturers only, although the city engineer is strongly in favor of widespread publicity for the benefit of other supply houses. In this case the award was made to a local firm before knowledge of the existence of the proposed extension requirements was made known to others.

Presumably it is not the desire of municipal engineers to entertain methods so unproductive and so risky. The value to them of a thorough knowledge of what firms can do in the matter of quality and prices is significant, and civic officials are not up-to-date who do not recognize the value of the competitive tendering that is ensured by advertising their calls for tenders in the technical press.

EDITORIAL COMMENT.

July 15th, 16th and 17th are the dates of the annual Convention of the Union of Canadian Municipalities in Saskatoon, Saskatchewan. Questions bearing upon public utilities, town planning, garbage incineration, water purification and the like will be discussed.

* * * *

The Fourth Annual Convention of the Pacific Highway Association will be held in Vancouver, August 11th, 12th and 13th. This association has set itself about to secure the construction of a first-class trunk road along the Pacific slope, and, with the co-operation of the Governments of both countries, and the communities along the slope, an international roadway of great service should result. Previous annual conventions have been: 1910, Seattle; 1911, Portland; 1912, San Francisco.

* * * *

One of the first duties of the new city engineer of Ottawa, which position was assumed on the 20th inst. by Mr. Arch. Currie, C.E., is an investigation into the city water supply. It is well known that it is a difficult problem, and that the office of city engineer is, therefore, not devoid of troubles of its own. The waterworks staff has applied on two recent occasions for separation from the board of works staff. The Board of Control reported unfavorably concerning the division, and it is understood that the question is now awaiting solution by the new city engineer.

* * * *

The beautification of cities is receiving splendid attention in Ontario this season. *The Canadian Engineer* in last issue announced the proposed expenditure of $7,000,000 in a forty-two mile system of boulevards to surround the city of Toronto, the work being in charge of the Parks and Exhibition Committee, and being an entirely separate enterprise from the Harbor Commission's waterfront development work. It has just been announced that Section A of the system, extending from the lake to Bloor Street along the eastern bank of the Humber River will be gone ahead with this summer, $25,000 having been appropriated for this purpose. The Government has just announced a similar scheme to embrace Ottawa and Hull. A commission is to be appointed to prepare plans for the systematic development and beautification of the two cities with regard to parks, boulevards, public buildings, etc. The traffic and transportation problems will doubtless be included in this work, and the co-operation of the transportation companies is to be expected. The mayors of the two cities are to be members of the commission. Half the cost of the scheme of planning is to be borne by the government and the other half by the two cities.

TORONTO WATERWORKS EXTENSIONS

COMMISSIONER HARRIS EXPECTED TO MAKE THOROUGH REPORT NEXT MONTH — TWO MECHANICAL FILTRATION PLANTS — SCARBORO HEIGHTS SCHEME ABANDONED

COMMISSIONER of Works R. C. Harris, of Toronto, is now gathering the final data for his report to the city's Board of Control regarding the proposed extensions to Toronto's waterworks system. The Commissioner's report will likely be presented to the Board next month, and tenders will be called for, very soon thereafter, for a new filtration plant.

The citizens of Toronto voted $6,000,000 on January 1st, 1913, for waterworks extensions. Although six months have passed since then, practically none of this money has been spent, and no official announcement has been made at any time as to why the Works Department of the city was not going ahead with the extensions. At a cost of about $26,000, a detailed report had been obtained by the city in 1912 from a board of four engineers, who were appointed, prior to the present administration of the Works Department, to advise the city of the best plan of making the necessary extensions to the available pure water supply. The board, consisting of J. G. Sing, chairman; Willis Chipman, secretary; T. Aird Murray, and Isham Randolph, reported in favor of a gravity supply system from Scarboro Heights, the water to be pumped from the bottom of the lake off Scarboro to the Heights, from which place it was to flow through from nine to twelve miles of pipe to the city, after being filtered at Scarboro.

This report was generally accepted, and when the citizens voted on the $6,000,000 by-law, it was popularly understood that the money was to be used in carrying out the board's report. Just about that time *The Canadian Engineer* pointed out a number of serious defects in the report which made the Scarboro Heights scheme seem entirely impracticable. *The Canadian Engineer* called attention to the greatly underestimated cost of the Scarboro Heights undertaking; to the possibility of getting the same result at a much cheaper cost by putting the plant at the Island, and using direct pumping instead of the gravity system; to the lack of flexibility of the gravity system; to the great waste of power in pumping water up to Scarboro Heights, only to expend the acquired head in friction when the water ran through miles of pipe to reach the city; and several other details that caused much comment in the public press at the time. The comments of *The Canadian Engineer* were actively replied to by three of the Commissioners, Mr. Murray, however, admitting the errors of the report in letters to the Mayor.

The other three members of the Commission met the City Council and endeavored to explain away the defects in the report that had been pointed out from time to time. The Commissioner of Works, however, laid the report of the experts to one side and decided to prepare a report of his own for the Board of Control, basing his report upon the experience and research work of the city's own engineering staff.

Consequently, the extension of the waterworks system was held up until the Commissioner's staff had secured such information that they were prepared to report with confidence to the Board of Control, advocating a scheme of extension far more practical than the Scarboro Heights scheme.

It is understood that after six months' careful survey of the situation, the Department of Works will in all probability advise the City Council to install a rapid sand filtration plant at the Island and to distribute the water to the city by direct pumping.

The report to be made by the Commissioner of Works early next month will be extremely thorough. The Commissioner has investigated every phase of the problem, and his report will undoubtedly overlook nothing that has any bearing upon the situation. The history of Toronto's existing slow sand filtration plant will be related, the difficulties that have been experienced with it will be explained, and the reasons clearly given as to why Toronto is now turning to rapid sand filtration.

A report will be given of the various types of filtration plants visited by the Commissioner of Works and other officials of the city during the past year, and recommendations will probably be made that the Board of Control call immediately for tenders for a rapid sand filtration plant of sixty million Imperial gallons capacity. Each tenderer will be required to file plans and specifications of his plant, together with his tender. Each tenderer will be required to guarantee the efficiency of his plant; the daily capacity, and the maximum cost of operation, chemicals, etc. The award will then be made to the plant which will cost the city the least money compared with the efficiency guaranteed. In computing this, the "cost" will include not only the first cost of the plant, but the capitalized cost of operation, chemicals, etc.

The water from this new plant will be brought across Toronto Bay through the existing tunnel, which has a daily capacity of from one hundred and ten to one hundred and twenty million gallons. As the existing slow sand plant has a capacity of only forty million gallons a day when not over-loaded, the tunnel will readily handle the one hundred million gallons per day total output of the two plants.

The city's electrical pumping capacity at the present time is fifty-four million gallons daily. The steam pumping capacity is fifty million gallons. A sixteen million gallon pumping unit is now being built for the city by the De Laval Steam Turbine Company, of New Jersey, and in all probability another steam unit will be installed at a later date. The steam pumping capacity will likely in time be brought up to the one hundred million gallons per day that the filtration plants will handle.

Under this scheme, however, Toronto would still obtain all of its water supply through the tunnel under the Bay. Should any accident occur to this tunnel, the situation would be serious; and, with this in view, the Commissioner will likely recommend in the near future that a filtration plant, of probably about sixty million gallons daily capacity, be located in East Toronto. It will not be located at Scarboro Heights, however. The water from the plant will likely be delivered to the East End by direct pumping. This plant will pump directly from the lake and will provide Toronto with a water supply independent of the tunnel.

Although Mr. Allen Hazen and his partners are still urging the city to stick to slow sand filtration, it is not likely, for a number of reasons, that the Commissioner of Works will consider any tenders for plants that are based on slow sand filtration, but will consider only the gravity and pressure systems of mechanical filtration, and the drifting sand type of filter.

There are numerous plants on this continent of the first two types mentioned, but only one plant of the last type, and that is an experimental plant which is now in operation at West Toronto. It is a half million per day plant, and is filtering to waste. It was built entirely at the expense of the company that controls the patents on this type of filter, and was built to convince the Commissioner of Works that when calling for tenders he would be justified in giving consideration to a tender on this type of filter. The experimental plant has been in operation for a little over a month, and the results have been carefully watched by officials from the City Hall, and a tender on the drifting sand type of filtration will likely receive consideration by the officials, along with the tenders on the other two older and more widely recognized types.

As the western part of the city increases in population, another filtration plant similar to the one proposed for East Toronto will likely be installed at West Toronto, so as to make the city entirely independent of any one source of supply.

THE ENGINEER AND THE SOCIAL PROBLEMS

THE PROFESSION AS A PART OF THE SOCIAL ORGANISM — PRESENT DAY CONDITIONS AND TENDENCIES — PRESIDENTIAL ADDRESS, AMERICAN SOCIETY OF CIVIL ENGINEERS' CONVENTION, OTTAWA, ONTARIO, JUNE 17th TO 20th

By DR. GEORGE FILLMORE SWAIN, Pres. Am. Soc. C.E.

[NOTE.—This article, a continuation of which will appear in next week's issue, is abstracted from Dr. Swain's address. Readers desiring copies of his paper, complete with references, footnotes, etc., may procure the same by applying to *The Canadian Engineer* for them. The paper isbeing prepared in pamphlet form and copies will be sent upon request as long as the supply lasts.—ED.]

IN asking your attention this afternoon to the remarks which I shall offer for your consideration, I cannot forbear expressing to you, once again, my appreciation of the honor which you have done me in electing me to the position in which I find myself. It is a distinction which I shall always value above any other, and it involves a responsibility to the profession of which I am deeply sensible. This feeling, together with my conviction of the importance of our profession as a part of the social organism, has guided my choice of a subject for this address.

As we gather here, interested in widely divergent branches of engineering science, it has seemed to me that I could most profitably occupy the time by asking your attention to some matters in which we all should be equally interested. I have, therefore, chosen for my subject a consideration of some Tendencies and Problems of the Present Day, and the part which the engineer should play in their solution.

We are living in a most remarkable age, an age different from any that has preceded it in the history of the world, and and one in which changes are taking place with marvelous rapidity. As a profession, we are largely responsible for the present conditions, and as such we should do our part in solving such problems as exist, and in helping to direct aright the tendencies of the day. We have a duty to ourselves, to our profession, to society, and to our successors, and we must perform it.

We have been often reminded of the fact that in one sense engineering is the oldest of the professions, since engineering constructions of some form are necessary even in the rudest communities. But in another, and perhaps a truer sense, it is the youngest of the professions. The priesthood is doubtless the oldest distinct profession recognized as such, for the most uncivilized tribes had priests to mediate between themselves and their crude deities. The priests were also law-givers, practiced the healing art (such as it was), and, as civilization progressed, were also the builders. Bridges and temples were built by them, and the most stately buildings were those devoted to ecclesiastical uses. In course of time, the lawgiver, the physician, the architect, became distinct, and then for a time the engineer was either an architect or a priest. It is fair to say that engineering is the last profession to be differentiated into a class by itself, and that its beginning dates from about the 17th century, and later received its great impetus from the series of inventions which were made toward the end of the 18th century; the spinning jenny, the loom, the puddling process, the steam engine, and the steam locomotive. Since that time, the profession has grown by leaps and bounds, has become separated into a dozen branches, and has probably become, directly or indirectly, the chief occupation of mankind. If this age may be designated as predominantly that of any profession, it is certainly the age of the engineer, or applied scientist. He furnishes us with thousands of comforts, necessities, and luxuries, of which previous generations never dreamed, and which they would have laughed at as impossible. By supplying the fundamental material elements of modern civilization—transportation, the transmission and dissemination of intelligence (by telegraph, telephone, and printing press) machinery, prime movers and the working of metals—the applied scientist becomes the minister to the other and older professions, furnishing tools for the surgeon and dentist, and chemical products for the physician; while engineering projects and problems probably supply as large a field as any for the employment of lawyers. The priest—originally lawgiver, physician and builder—now stands alone, concerned only with the moral law and its application, and with our relation to the Infinite.

Civilization, as we know it to-day, then, seems to me to be due mainly to the engineer, or applied scientist, using the term in its widest sense. Of course, a great ethical advance has also been made, of which any student of history must be fully conscious. But when we consider that moral principles were known and recognized by the ancients, in as perfect a form as that in which they can be stated to-day, without producing much of any widespread ethical progress or any advance in civilization for many centuries, we must, I think, conclude that it is the dissemination of intelligence, the facilities for transportation, the development of machinery, which have made the whole world kin, and thus have been the chief elements in promoting the universal brotherhood of man and the practical recognition of human rights, and so have been the main agents in the progress of civilization. This, somewhat differently expressed, is, as I understand it, the position taken by Buckle, often misunderstood by those who assume him to assert that no ethical progress has been made. However this may be, few will deny that the work of the engineer, if not the cause, has been a necessary condition of progress.

This progress, both material and ethical, has been widespread and astonishing in degree. In material things, not only necessities, but comforts and luxuries of which our forefathers would never have dreamed, are now within the reach of every man who is sober and industrious. Wages have risen, not only in absolute amount, but in purchasing power. The poor can now receive medical advice, medicines, and many other things free, where our predecessors could not have obtained the same things at all. Simple foods in great variety, and clothing of good quality, can be obtained at reasonable prices, and in every respect the poor man to-day is better provided for than his predecessors were. Ethically, too, he is far better off. The best books are available, if he wants them, at ridiculously low prices, free public schools are provided for his children, and all sorts of free industrial and vocational instruction is available for him in his leisure hours if he desires to use them. His hours of labor have been shortened, his civil rights have been generally recognized, he is treated as the equal of any man before the law, and his right to a fair chance in life—to opportunities commensurate with his ability to make use of them—is generally admitted in theory if not yet entirely in fact. With free public and trade schools, with conditions which allow a common laborer in a steel mill at 15 years of age to become the head of the greatest industrial organization in the world at 50, certainly it cannot be said that men do not have opportunity in this country.

But, continued progress and the interest of the social organism as a whole, require that individual initiative and ability shall be encouraged to the utmost and allowed to enjoy the reasonable fruits of its exercises; that property shall be protected; that taxation shall be equitable and uniform; that leaders shall be chosen from those most enlightened, capable, honest and judicious; that those who are only fitted for manual labor shall not acquire a distaste for it or look down upon it as inferior in dignity to other occupations; and that waste and extravagance shall be reduced to a minimum. There should be a recognition of the facts that wealth must be unequally divided, since men are unequal in ability and in character; that the prosperity of one depends upon the prosperity of all; that each man must feel secure in the enjoyment of all that he can legitimately win; that wealth, position, and luxury, do not in themselves bring happiness; and that the selfish desires of the individual must be subordinated to the interests of society as a whole if progress and not retrogression is to ensue. A state of equality of condition, as has been well remarked, would mean equality, not of wealth, but of wretchedness.

The political and social evolution in the past has, up to a comparatively recent period, not involved any diminution of the incentive to individual effort, nor to any great extent the attempt to deprive the individual of the fruits of his industry and ability. Of late years, however, with growing political power in the hands of the less intelligent classes, symptoms of a change have shown themselves. The spectacle of isolated instances of great wealth acquired unfairly or too rapidly, and of rewards out of proportion to service, instead of being looked upon as necessary phenomena, seeing that men are human, and that no human affairs can ever be perfect, has lead to a widespread spirit of envy and discontent, and sometimes to a desire to deprive men of the results of their honest toil.

It is to some unfavorable phenomena incident to this movement that I wish to call your attention, believing that if they continue, disaster may result, in which case, as always, the suffering will mainly come upon those least able to bear it.

Equality Among Men.—What I conceive to be the true democratic ideal is this: that all men are equal before the law—so that neither differences in wealth, race, social position nor talent shall confer any advantage or impose any disadvantage in the impartial administration of justice; that while ability may be admired, every man who is honest, industrious, sober, and faithful, and who does his work in the world as well as he can and with due regard to the rights of others, is deserving of equal respect and regard, whether he occupy the humblest or the most exalted position; that success depends upon the spirit with which one's natural endowments are utilized and the degree to which they are developed, and not upon those endowments themselves, so that the humblest laborer on the street may be making as great a success of his life as the most gifted; that there should be kindliness and a spirit of brotherhood between all men and neither envy of those more capable, who receive greater rewards, nor contempt of those less gifted, who do the menial work of the world; and that neither race, poverty, nor inferior social position should prevent the possibility that a man, by hard work, integrity, and conscientiousness should be able to reach, by some available ladder, a position commensurate with his abilities. A man should be judged by what he is, not by what he has, whether he is black or white, or who his grandmother was. He should have the opportunity to get such education as best fits his natural qualifications. Rich and poor should be judged by the same standard—inherent worth. But though respect should be equal, rewards should not be, but should be in proportion to the value of the service, and governed by the law of supply and demand; nor are great rewards necessary for happiness.

Unfortunately, a democratic government, especially with universal suffrage, instead of tending to the realization of this ideal, tends in some respects directly away from it, and leads not seldom to the grossest perversions of it. The equality of man, which the framers of the Declaration of Independence held to be self-evident, instead of being interpreted as above, is held to mean that men are inherently equal in all respects.

It is self-evident that instead of being equal, men are very unequal. There is perhaps more difference between the most intelligent and the least intelligent voter than there is between the latter and an intelligent animal. It is held that all, being equal, should have equal opportunity. But why should there be equality of opportunity for unequal individuals? Inequality of opportunity for unequal men is a nearer approach to true equality than equal opportunity for unequal men. Why, for instance, should all men have opportunity for a college education, when only a few can profit by it, and the great majority should work with their hands, not with their heads? Not every man who is able to pass successfully through a college course is able to use it when he has finished, and many a good mechanic has by its means been spoiled to make a poor and discontented clerk or lawyer.

One of the conditions of individual progress is the willingness to recognize and admire superiority, and without envy to rejoice in its success. The idea of the equality of man limits this recognition, and so hampers individual progress, and therefore collective progress. In college, there is little in class associations to stimulate a man to excel. If he does, he is termed a "grind" and is looked down upon. If all men are equal, he has no right to exhibit any superiority to his fellows. The same is true among the so-called laboring classes. No man must do any more work, or do it any better than another. Individual excellence and initiative are discouraged. Indeed, individual freedom is not seldom infringed upon, and a man is not allowed, at times, to work at wages satisfactory to himself, when he desires to do so—a strange result of freedom, and in reality as great an outrage as any that can be quoted from the medieval annals of despotism. With growing discontent, many minds turn to socialism, that impracticable Utopia which, as President Butler has well said, "would wreck the world's efficiency for the purpose of redistributing the world's discontent."

The idea of the equality of man, instead of allowing the best men to govern and fitting the man to the proper vocation, leads to the placing of unfit men in power, the control of large masses of men by demagogues, the judging of men by the number of votes they control; and thus it leads to the withdrawal of many of the best men from active participation in public affairs, because they see how little influence they can exert, and that the only reward of one who unselfishly serves the public is likely to be criticism and contumely. It also discourages loyal and faithful service, and makes difficult the maintenance of proper relations between employer and employees.

What the ultimate result will be, cannot be foretold. The political doctrine of the equality of man is still a trial. Yet, as regards the United States, where that doctrine has its present expression, Lincoln long ago observed that if it fails, it will not be on account of interference from without, but it will be by suicide. It behoves us, therefore, if we can, to see to it that our institutions shall not fail by suicide.

Nevertheless, it is a somewhat striking fact, that several of the most philosophical and learned historians have distrusted the ultimate success of our institutions. Froude, Macaulay and Lecky all express the gravest doubt of the permanence of our form of government.

These predictions will, we hope, prove erroneous. We must make them so if we can. Nevertheless, the more we reflect, the more I think we shall realize that out of the false theory of the equality of man, have sprung many real dangers. A spirit of unhealthy discontent has been aroused, and the people, who are sovereign, endeavor by various kinds of legislation, to realize in fact the untruth of equality. They make the common mistake of assuming that legislation is a sovereign remedy for all ills. Not knowing how to proceed, they become the prey of every selfish demagogue who, while stirring them up to exaggerate their troubles, and professing his ability to remedy them, is simply seeking his own ends. These men know that a large part of the voters to whom they must appeal are ignorant, easily swayed by claptrap and deceived by hypocrisy, "incapable of disentangling a difficult question, judging distant and obscure consequences, realizing conditions of thought and life widely different from their own, estimating political measures according to their true proportionate value, and weighing nicely balanced arguments in a judicial spirit." The demagogue therefore appeals to class interests and class animosities, and does his utmost to foment a spirit of discontent, even though every condition justifies the opposite, gaining his reward by newspaper headlines, notoriety, public office, or not seldom, wealth secured at the expense of the public that he deceives. The spirit of servility and sycophancy which in former times led men to grovel in the dust at the feet of kings and princes, is still with us, unchanged in form. Only its object is different, and its adulation is now directed to the sovereign voter—the more ignorant, the more easy to flatter and deceive. Knowing human nature, may we not doubt the man who claims to act for the good of the people; and trust him rather who frankly admits that his actions are governed by his selfish interests, but who has learned that these can only be served by promoting the best interests of all.

Some of the remedies for these dangers, it seems to me, are obvious. In the first place, we should realize that the statement that all men are created equal, properly interpreted, simply means that they are equal before the law, that all men should be treated with justice, should have fair opportunities, and that each should be secured in his right to the products of his own labor, and to his own liberty, so far as his acts do not injure others. Aside from this, instead of considering men equal, we should recognize and encourage inequality, for it is easily to be seen that the progress of society depends upon it. Equality of condition means pauperism or savagery; the inequality of man means the division of labor, progress, civilization.

In the second place, we should encourage the recognition and admiration of superiority.

In the third place, we should preach the gospel of content instead of discontent. There are two kinds of discontent; one praiseworthy; one ignoble. The former springs from a laudable ambition and a desire to perfect one's self, so far as natural endowment will permit. The other springs from envy and the desire to reap the rewards of the industry of others. The former kind of discontent is to be encouraged; every man should be given an opportunity to develop himself and to be confirmed in the possession of the prizes which he may gain. But the discontent which springs from envy, which leads men to depend upon government help, instead of self help, which sanctions forms of unjust taxation which may be nothing less than legalized robbery, should in every possible way be repressed. The attention of men, instead of being concentrated on what they want, should be more directed to a realization of what they have. In contrast with the conditions which existed one or two centuries ago, even the conditions of the poorest classes at the present time are immensely improved. Yet, with all the reduction of working hours that has taken place in the last 50 years, and the other improvements in condition, I doubt if there is any more real happiness and content among the poorer classes. Nor have I any doubt that the excessive talk about bettering the condition of the working classes, blinds them to the opportunities for their own thrift and industry.

Unfortunately, it is a vain hope that there will ever be an absence, or even a dearth, of demagogues to stir up this spirit of unworthy discontent, but we should do all in our power to counteract it. Unfortunately, also, much of it is due to the unwise use of wealth by those who possess it, who think that money can buy everything, and is the end and aim of existence, and who, instead of being governed by a feeling of the brotherhood of man, and the spirit of respect for true worth even in the humblest occupations, assume an attitude of superiority, or even of insolence, towards those less fortunate than themselves.

It is vain to hope that we can ever reach a point where there will be no poverty. This would realize what Dr. Johnson termed the triumph of hope over experience. It would mean a radical change in human nature. As long as there are masses of men who are shiftless, lazy, incompetent, and vicious, whom nobody would willingly employ, poverty will exist. Still, every effort should be made to relieve it where it is undeserved. It will be well, however, to bear in mind that suffering is a remedy, and that unwise philanthrophy may do harm instead of good. If men will learn in no other way the lessons of life, they must learn them by suffering, which is Nature's cure. Of course, it is often hard to distinguish deserved from undeserved suffering. The latter may be wisely relieved; the former generally not. Surely an all wise Creator would not have filled the world so full of it except for some good purpose, and that purpose cannot be to afford to others the opportunity for relieving it, for much of it cannot be relieved.

The Tendency to Disregard Authority.—Out of the tendency to look upon all men as equal, spring some other tendencies to which I will refer. One of them is to disregard authority, and to consider that one man's opinion is as good as that of any other. We see this tendency about us every day; it leads to intellectual arrogance, dognatism and lawlessness.

Every man has presented to him, almost daily, questions which he is not competent to decide for himself, either because he has not had the necessary time, training or experience, or because he is incapable of judging.

In these days when literature is so superabundant, it is most important to choose our advisors wisely, to know whom to trust, to discern wisdom, to select the proper books to read, to choose the best authorities to whom we shall listen, and, when we have so chosen, to consider attentively the message they bring, and to distinguish advice that springs from self-interest from that which is disinterested. There is a great temptation to form hasty or immature judgments on slight authority, and the habit, once formed, may be difficult to eradicate.

The disregard of authority is peculiarly observable in the younger generation. It is not confined to the uneducated, but is even more observable in many whose self-esteem has been increased by a course in college. Finding that men disagree on almost every subject, and that even those in positions of authority do not hold the same opinion, it is easy to conclude that one man's opinion is as good as another's. Let us examine this matter further.

The subjects of study may be broadly divided into three classes: 1st, the relations of abstract ideas, that is, mathematics and logic; 2nd, natural science; 3rd, the so-called humanities.

With regard to subjects in the first class, no observation or experience is necessary, and there will be no differences of opinion. They are not, properly speaking, matters of opinion at all. There can be no discussion as to whether two and two make four, or as to whether the three angles of a triangle amount together to two right angles.

With regard to natural science, conclusions depend to some extent upon observation, experiment, and experience Hypotheses may be formulated, experiments made, conclusions deduced therefrom, and differing conclusions may be arrived at by different persons. In this class then, there may reasonably be divergencies of opinion. These subjects are, therefore, less definite, more hypothetical, more uncertain. than those in the first class.

Under the third class are comprised what are called mental and moral philosophy, politics, government, history, language, etc. This class of subjects is even more uncertain and less definite than the second. Experiments are less applicable and less likely to lead to definite results, the data are more shifting and variable, experience is of great value, and extreme differences of opinion will often occur.

The thoughtful man will recognize these differences between the various subjects of investigation. He will form his conclusions upon subjects in the first class with definiteness and certainty, and will be justified in feeling confident of their correctness. He will recognize the greater indefiniteness of subjects in the second class, and if he forms definite opinions, he will hold them in a sort of tentative manner, realizing that the next experiment or discovery, or greater experience, may show them to be incorrect. He will realize the still greater indefiniteness of subjects in the third class, and while he may well form definite opinions regarding these also, he will hold them with still greater modesty, realizing that in almost every question of this character there is much to be said on the other side, and that he may be entirely wrong. Only the man who has studied the subjects in all three of these classes will realize fully the different degrees of certainty attaching to each. Such a man will be much more modest and safe in his conclusions than a man who has studied only one class of subjects. It may further be remarked that a man who has studied only the third class of subjects, will be likely to be more dogmatic and less safe than a man who has studied the first or the second, or both, because not being familiar with subjects in which a great degree of certainty, or even absolute certainty, is attainable, he may assume that such degree of certainty is attainable in the subjects of the third class; whereas, a man who has studied mathematics or science, and is accustomed to definiteness, will, when he is confronted with problems of politics, government, or ethics, be at once struck with the great difference in reliability of the data, the impossibility in many cases of making crucial experiments, and the fluctuating conditions involved. For this reason, it is not uncommon that scientists, mathematicians, or engineers hold and express opinions regarding politics, economics or ethics, with much less dogmatism than less well-informed men who have devoted their attention more strictly to these last-named subjects.

(To be continued.)

TRADE DISPUTES DURING MAY.

The record of trade disputes maintained by the Department of Labor shows that, as is usual at this season, the majority of the disputes occurred pending the adjustment of new wage schedules. These were nearly all of short duration. The mining industry on Vancouver Island was seriously interfered with, more than 3,000 men being out during the whole month through the continuance of the dispute at Ladysmith and Cumberland mines, and the closing down of the mines in the Nanaimo District. A great number of the disputes of the month occurred among workers in the metal trades. The disputes of May affected upwards of 11,500 employees and accounted for the loss of more than 150,000 working days. Disputes affecting various classes of municipal employees in Vancouver and affecting also the boot and shoe workers in a number of the factories in Quebec were satisfactorily adjusted during the month through the instrumentality of boards under the Industrial Disputes Investigation Act. The Department of Labor also assisted in the adjustment of disputes affecting the employees of the Hydro-Electric Commission in Toronto, and affecting also the longshoremen in Montreal and St. John, N.B. In the latter case a board has been established under the Industrial Disputes Investigation Act.

During April, 1913, the exports of Canada to the United States amounted in value to $8,763,013, which is $497,334 less than those of April, 1912. Her imports from the United States for the month were $37,416,217, exceeding corresponding figures of last year by $6,416,998.

CONVENTION OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS AT OTTAWA.

The American Society of Civil Engineers held its 45th annual convention in Ottawa at the Chateau Laurier, June 17 to 20th. The convention was held under the auspices of the Ottawa members of the American and Canadian Societies of Civil Engineers. A detailed programme of the occasion was given in May 29th issue of *The Canadian Engineer*, and it is timely to state here that the proceedings of the convention were carried out in a most exemplary manner. The meeting was largely of a social nature, which necessitated more than ordinary care and attention, and the resulting comments pertaining to the proceedings point decidedly to most admirable management.

It is 32 years since the American Society of Civil Engineers held its previous convention on Canadian soil. During the years which have elapsed since, the engineering profession in both the United States and Canada has undergone a very marked development, and while we cannot give our readers much information concerning the convention of 1881, which was held in the city of Montreal, we feel quite sure that the convention held last week in Ottawa eclipsed all conventions which the society has held up to date.

The number of delegates registered totalled something like 385, including the ladies. The convention opened on the afternoon of the 17th with a reception to the visitors, the reception duties, in the absence from the city of the Premier, falling upon the Hon. Martin Burrell, Minister of Agriculture. This event took place in the Chateau Laurier. In the afternoon of the same day, the president and officers of the American Society of Civil Engineers held an informal reception in the ballroom of the Chateau, followed by a dance.

Wednesday morning at 10 o'clock the convention was called to order at a business session and the president's address, which was undoubtedly the outstanding feature of the convention, was delivered. Prof. Swain presented an address that for thought, logical sequence, reasoning power and rhetoric, will stand unique for a long time to come. It was a classic, and during the days of the convention following the presentation of the address, it was a constant topic of conversation everywhere among the delegates. A part of this address is published in another portion of this issue.

Following the business meeting a luncheon was tendered to the visiting members by the Ottawa branch of the Canadian Society of Civil Engineers in the main dining-room of the Chateau Laurier, Mr. R. F. Uniacke, of Ottawa, occupying the chair. At his right sat Prof. Swain and on his left Sir Wilfrid Laurier. There were but two toasts, one to the King and another to the President of United States. The toast to the King was responded to by Sir Wilfrid Laurier and that to the President of United States was responded to jointly by Prof. Swain, president of the American Society of Civil Engineers, and Consul-General Foster, of Ottawa.

A Few of Those in Attendance at the Ottawa Convention.

The members and ladies then proceeded to the home of Thomas C. Keefer, C.M.G., who is a past president of the American Society of Civil Engineers, at the Manor House, Rockcliffe Park. This was a most delightful occasion. The day was perfect and it permitted the engineers of Canada and the United States to mingle in a most congenial manner.

The evening of that day was given over to three or four short illustrated talks in the ballroom of the Chateau Laurier. Mr. David A. Molitor, C.E., consulting engineer of the Toronto Harbor Commission, gave a very clear and lucid description of the Toronto Harbor Commission's work, and showed by means of a large-sized chart what that commission had set out to accomplish toward the improvement of the Toronto harbor. Mr. C. R. Coutlee, of Ottawa, gave a very interesting talk on the railway situation, while Mr. J. B. Challies, superintendent, Water Power Branch, Department of the Interior, and Mr. R. F. Uniacke, chief engineer of the Transcontinental Railway, also delivered addresses, both illustrated by lantern slides.

Thursday was spent in visiting points of local interest. In the afternoon the delegates and the lady guests were treated to a three-hours' tour around the city, terminating at the residence of Mr. Collingwood Schreiber, C.M.G., consulting engineer to the Canadian Government, where the members and their ladies were entertained at afternoon tea.

On Thursday evening a reception was tendered by the Ottawa members of the Canadian Society of Civil Engineers to the members of the American Society of Civil Engineers and ladies attending the convention.

Special reference should be made to the work done by the combined committees of the Ottawa members of the American Society and the Canadian Society of Civil Engineers in arranging the details for the entertainment of the visitors while in Ottawa. It was no easy task which these men undertook and that they did their work to a nicety was evidenced by the expressions of appreciation on the part of the visitors. This committee did its work with a thoroughness that was noticeable to all present, and we are glad to pay tribute to them in this way. The committee consisted of the following: Lieut.-Col. W. P. Anderson, C.M.G.; A. W. Campbell, A.M. Can. Soc. C.E.; W. A. Bowden, B.A.Sc., M. Can. Soc. C.E.; C. R. Coutlee, M. Am. Soc. C.E., M. Can. Soc. C.E.; S. J. Chapleau, M. Am. Soc. C.E., M. Can. Soc. C.E.; J. B. Challies, A. M. Can. Soc. C.E.; K. M. Cameron, A. M. Am. Soc. C.E., A. M. Can. Soc. C.E.; A. R. Dufresne, M. Am. Soc. C.E., M. Can. Soc. C.E.; A. A. Dion, M. Can. Soc. C.E.; Sir Sanford Fleming, M. Am. Soc. C.E., M. Can. Soc. C.E.; Gordon Grant, M. Can. Soc. C.E.; Thos. C. Keefer, C.M.G., Past President Am. Soc. C.E., Past President Can. Soc. C.E.; C. H. Keefer, M. Am. Soc. C.E., M. Can. Soc. C.E.; T. C. Keefer, Jr., A. M. Can. Soc. C.E.; Major R. W. Leonard, M. Can. Soc. C.E.; A. St. Laurent, M. Can. Soc. C.E.; E. D. Lafleur, M. Can. Soc. C.E.; A. Langlois, A. M. Am. Soc. C.E., M. Can. Soc. C.E.; A. B. Lambe, A. M. Can. Soc. C.E.; Lieut.-Col. G. S. Maunsell, A. M. Can. Soc. C.E.; G. A. Mountain, M. Can. Soc. C.E.; D. W. McLachlan, A. M. Am. Soc. C.E., A. M. Can. Soc. C.E.; J. Murphy, A. M. Can. Soc. C.E.; J. B. McRae, M. Am. Soc. C.E., M. Can. Soc. C.E.; E. H. Pense, A. M. Am. Soc. C.E., A. M. Can. Soc. C.E.; Collingwood Schreiber, C.M.G., M. Can. Soc. C.E.; W. J. Stewart, M. Can. Soc. C.E.S; J. M. Somerville, J. Taylor, A. M. Am. Soc. C.E., A. M. Can. Soc. C.E.; R. F. Uniacke, M. Can. Soc. C.E.; G. W. Volckman, M. Am. Soc. C.E., M. Can. Soc. C.E.; James White, M. Can. Soc. C.E.

The following members of the Canadian Society of Civil Engineers were among those who registered: Peter Charton, Montreal; T. C. Keefer, Ottawa; Chas. H. Keefer, Ottawa; A. W. Robinson, Montreal; Wm. McNab, Montreal; G. H. Duggan, Montreal; D. W. McLachlan, Ottawa; J. A. Jamieson, Montreal; David Molitor, Toronto; A. B. Lambe, Ottawa; F. X. T. Berlinguet, Three Rivers; Phelps Johnson, Montreal; A. M. Bouillon, Quebec; H. R. Safford, Montreal; J. H. O'Brien, Montreal; Henry Holgate, Montreal; E. Jodoin, Montreal; A. Coussineau, Ottawa; Paul A. Bique, Montreal; G. W. Volckman, Ottawa; J. A. V. Beaudry, Montreal; Col. W. P. Anderson, C.M.G., Ottawa; C. N. Monsarrat, Montreal; W. H. Breithaupt, Montreal; G. H. Bryson, Brockville; J. W. Doty, Montreal; E. H. Pense, Ottawa; F. R. Redpath, Montreal; W. O. Houston, St. Thomas; S. Bray, Ottawa; G. R. Heckle, Montreal; R. F. Uniacke, Ottawa; H. M. Davy, Ottawa; A. S. Going, Montreal; A. T. Tomlinson, Montreal; Gordon Grant, Ottawa; A. J. McCool, Ottawa; J. A. Robert, Ottawa; E. O. Sullivan, Montreal; A. W. Sullivan, Valleyfield, Que.; E. J. Walsh, Montreal; C. H. Mitchell, Toronto; A. M. Beale, Ottawa; B. E. Norrish, Ottawa; L. M. Edwards, Toronto; A. E. Brooke, Toronto; John Kennedy, Montreal; J. J. Salmond, Toronto; Prof. C. H. McLeod, Montreal; J. K. Scammell, St. John, N.B.; E. C. Keefer, Toronto; Alexander McDougall, Ottawa; A. A. Dion, Ottawa; H. A. Burson, St. Catharines; Wm. Storrie, Ottawa; C. O. Wood, Ottawa; F. H. Byrne, Ottawa; C. A. Bigger, Ottawa; J. B. Challies, Ottawa; R. Steckel, Ottawa; F. H. H. Williamson, Ottawa; R. F. Davy, North Temiskaming; A. G. Genest, Ottawa; Sidney B. Johnston, Ottawa; C. V. Johnston, Ottawa; E. V. Johnston, Ottawa; O. Higman, Ottawa; J. B. Hunt, Ottawa; W. S. Lawson, Ottawa; A. C. St. Laurent, Ottawa; V. Valiquet, Ottawa; Alexander Bailey, Ottawa; J. P. Laforest, Hull; G. G. Gale, A. E. Smaill, Ottawa; N. Cauchon, Ottawa; J. T. Farmer, Montreal; H. A. Woods, Montreal; C. D. Sargent, Cornwall; J. H. Garbden, Montreal; J. T. Johnston, Ottawa; M. C. Hendrie, Ottawa; W. F. M. Bryce, Ottawa; C. H. Attwood, Ottawa; G. H. Ferguson, Ottawa; G. P. Hawley, Cedars, Que.; W. D. Bergman, Montreal; K. M. Cameron, Ottawa; M. F. Cochrane, Ottawa; E. S. Mills, Ottawa; J. H. Brace, Cedars, Que.

INSURANCE ENGINEERING.

Considerable interest has been awakened in engineering and manufacturing circles in Canada by the formation at Montreal of a firm that might be called insurance consulting engineers. Just as other consulting engineering firms specialize in various branches, such as waterworks, or bridges, or factory construction, etc., this firm specializes in expert insurance engineering knowledge.

The firm name is E. M. Sellon & Company, Limited, with offices at 136 St. James Street, Montreal, and the personnel of the board of directors is sufficient recommendation for a wide-spread knowledge of the firm in regard to the business they are undertaking. The directors are E. M. Sellon, M.I.E.E.; J. J. Creelman, Professor of Railway Economics at McGill University; and Mr. Lawford Grant, president of the Canadian British Insulated Company, and honorable secretary for Canada for the Institute of Electrical Engineers of Great Britain.

This firm considers that insurance is a science, and requires expert treatment. A skilled force of engineers and inspectors is maintained to advise in regard to the insurance of industrial undertakings. They inspect industrial risks at their own expense, and thus secure at first hand the full information which is necessary to obtain rating at the minimum tariff. Such inspection frequently enables the firm to make suggestions on fire protection which add security and more than pay for themselves. In these cases the client places the insurance through the firm in the same manner as it would be placed through any firm of insurance brokers.

When new construction is proposed, however, the firm places its knowledge of fire protection and of the many matters which govern insurance rating at the disposal of the engineers and architects who have charge of the construction, the insurance then also being placed with the firm in the usual manner. There is undoubtedly considerable opportunity for decided success for a firm in Canada specializing in this work, as the minimizing of the fire hazard, and the increasing of what might be called "fire-proofness," is a subject of vital interest to every manufacturer.

New Westminster ratepayers have approved by-laws aggregating nearly $600,000, as follows: street, $200,000; light, $40,000; waterworks, $45,000; schools, $55,000; sewers, $150,000; firehalls, $25,000; civic stables, $15,000; exhibition, $25,000.

ENGINEERS' LIBRARY

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

Book Reviews:

BOOK REVIEWS.

Manual of Public Utilities (first annual number). Published by Poor's Railroad Manual Company, 535 Pearl Street, New York; 1,924 pp. Price, $7.50, postpaid.

This manual is devoted entirely to statements of public service corporations, such as street railway, gas and electric light, water, power, telephone and telegraph companies. It is a record of about 8,500 corporations, or practically every public utility in Canada and the United States.

The general index contains the names of merged companies, with references to the companies into which they have passed. The balance sheets and income accounts of the more important companies are presented in comparison with those of other years, so as to show the rate and extent of growth and development, supplying thereby the necessary data upon which to form an opinion of the value of their securities.

The manual contains reference to a larger number of public service corporations and their standing than does any previously published work.

Emery and the Emery Industry. By A. Haenig. Translated from the German by Charles Salter. 104 pp.; 5 ins. x 7 ins.; 45 illustrations; tables; bound in imitation leather. Publishers, Scott, Greenwood & Son. London, England. Price, $1.50 net.

This little work in three chapters deals with the growth of industry of abrasives and grinding machines attendant upon the development of the machinery industry. A neat historical introduction is followed by a chapter on natural and artificial abrasives, together with considerable space devoted to carborundum—its properties, methods of manufacture, output, etc. Chapter II. enters upon the preparation and complete treatment of emery wheels and discs, taking into consideration hardness and grain of material, binding medium and allowable peripheral velocity, stability and capacity of grinders, and points in their mounting, use and experimental tests. The next chapter is based upon the various types of grinding machines and their special uses.

The book closes with a valuable list of references, for the most part from the German, and a very complete index. The volume is well printed and handsomely bound, and the subject matter has been treated in a clear and most interesting manner. It will be of value to all laymen, tradesmen and engineers in mechanical circles.

Steam Engineering. By W. R. King, U.S.N., Principal Baltimore Polytechnic Institute. Publishers, John Wiley & Sons. 450 pp.; 6 ins. x 9 ins.; cloth. Price, $4.00 net.

The number of books along this line is increasing with such rapidity that very much originality can scarcely be expected in any of them. The author of this book, however, does not claim originality for his work, but feels that the systematic arrangement and simplicity attempted are worthy of merit.

Considerable space has been devoted to each of the parts of a power plant, such as the boiler, the engine, the condenser, etc., and as the engine is a very vital and probably the most intricate part, the method of designing and testing it has been gone into with some detail. The action of the simple slide valve is explained, and an entire chapter is devoted to the use and construction of the Leuner valve diagram.

The design of simple and compound engines is discussed, together with the general advantages of compounding and the method of combining the diagrams of these engines. There is only one chapter devoted to the turbine, and one-half of this is devoted to the de Laval make.

A five-page chapter on Entropy does not seem to be of much assistance to the general policy of the book, owing to its brevity, and one feels that it should have been longer, or else entirely omitted.

The whole order adopted in the book is very unusual, but the matter contained should be helpful to those without a close technical knowledge of the science of steam engineering, and, on the whole, the work is sufficiently simple as to be very easily understood.

A Text Book of Thermodynamics. By James R. Partington, M.Sc. Publishers, Constable & Company. 542 pp.; 5½ ins. x 8½ ins.; cloth. Price, $4.20 net.

This book has been written with special reference to chemistry, and is a mathematical treatment of the science of thermodynamics, the illustrations and applications applying almost entirely to chemistry.

The first chapter on thermometry and calorimetry, which deals with such matters as thermometers and the specific heats of substances, is followed by two chapters discussing in some detail the first and second laws of thermodynamics, on which the rest of the book is naturally based. These laws are then taken up in their general applications to fluids, and following this two chapters deal with their special reference to the perfect and permanent gases and vapours.

The remaining half of the book gives the special applications of the science to chemistry, containing chapters on thermochemistry, gas mixtures, the general theory of mixtures and solutions, capillarity and absorption, the kinetic theories and other kindred subjects.

The work is very nicely gotten up, but, as the calculus has been freely used, the book would be of little value to anyone not having sufficient mathematical training. To the advanced student, however, it should prove of considerable value.

Iron and Steel Constructional Work. By Karl Schindler. Translated from the German and adapted to English practice by Charles Salter. Publishers, Scott, Greenwood & Company, London, England. 140 pp.; 5 ins. x 7 ins.; 115 illustrations; cloth. Price, $1.00 net.

The book is divided into five sections, the first of which is devoted to cast iron and mild steel columns, with reference to calculation for compression, eccentric loading, etc. Tables of inertia of various shapes are given for each. Section II. deals with girders and beams and the methods of loading, girder connections, rivetted girders, and contains an additional chapter on floor construction. The next section comprises four chapters on roof construction, dealing with loads, roof principals and trusses, together with their calculations and details. The construction of iron staircases is dealt with carefully by precept and example. The last section of the book is devoted to skylights of various types, floor lights and glazed roofing. At the end are five-place logarithmic tables, antilogarithms, trigonometrical functions, tables of squares, cubes, etc., and of metric equivalents.

The book is carefully written, and forms a compact little structural handbook, with examples suitable for practical application. The illustrations are clear and appropriate, and the notation used throughout conforms well with that in general use.

Resuscitation.—By Dr. Chas. A. Lauffer, Medical Director, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. Publishers, John Wiley & Sons, New York. 47 pp.; 4 in. x 7 in.; cloth bound. Price, 50 cents net.

This book includes a reprint of a paper on this subject delivered by the author before the Philadelphia section of the National Electric Light Association. The author, after explaining a number of successful results which have been obtained from employing resuscitation methods on men who were supposedly dead, gives a clear description of the mechanism of respiration, illustrating same by a number of views of the various parts of the anatomy.

The Prone Pressure, or Schafer, method of resuscitation which has been adopted by the National Electric Light Association, and a number of other engineering societies, is described in detail.

This book brings out in a clear, concise manner the necessity of people in general being versed in the principles of resuscitation, and clearly shows how they can become sufficiently learned to prove of valuable assistance in the ordinary walks of life.

Solution of Railroad Problems by the Slide Rule. By E. R. Cary, C.E., Professor of Railroad Engineering and Geodesy, Rensselaer Polytechnic Institute. Publishers, D. VanNostrand Company, New York. 136 pp.; 4 ins. x 6 ins.; cloth. Price, $1.00 net.

This work is a compilation for the use of the civil engineer of the many ways in which his slide rule can be of extraordinary benefit. Numerous illustrations, examples and formula display methods whereby the instrument may be used with comparative accuracy, and a great saving of time, in the laying out of simple, compound, vertical or easement curves, and turnouts. A chapter is also devoted to its application in computing earthwork.

The first chapter deals with the slide rule alone, its description and method of operating in the solution of problems in general. Throughout the remainder of the text and under headings stated above are forty problems accompanied by forty-three illustrations and numerous tables. The book closes with tables of contents and a series of 114 formulas bearing upon railway track work.

In the working of the decimal point the author departs slightly from the practice recommended by slide rule booklets of keeping track of it in each operation. He recommends a mental calculation to ascertain the position of the decimal point in the result. This is the practice of many slide rule users, its only disadvantage being liability to err owing to mental occupation upon other parts of the calculation. Again, the manufacturers' instructions are the quicker, and, on the whole, are to be recommended.

An engineer will find the book of great use to him in railway work.

A Text-Book on Trade Waste Waters—Their Nature and Disposal. By H. M. Wilson and H. T. Calvert. Publishers, Messrs. Charles Griffin & Co., Limited, London, W.C. 450 pp.; 74 illustrations; 6 in. by 9 in.; cloth. Price, $4.50 net.

The book is written primarily from the standpoint of the sanitarian, and aims to show the means by which the waste liquids of industry can be disposed of so as to prevent pollution of streams or other sources of public water supply. However, with the characteristic thoroughness of English text-books the authors pay due attention to the commercial value of by-products, and fully discuss the various means that are adopted in order to recover materials of value from factory waste.

The book is technical, yet, owing to the many and various industries dealt with, peculiarly interesting. The plan throughout has been to describe the processes of manufacture which give rise to the waste water under discussion and to then describe the liquid and the treatment necessary. By this means the book becomes intelligible alike to layman and engineer.

"Trade Waste Waters" should prove valuable to all those who have the care of public water supplies, to the engineer who must advise them, and to the manufacturers, to whom it may mean not only the avoidance of a public nuisance but often a considerable economy of production. It brings into one volume the related matters of an extended literature, to which by copious bibliographies the reader is referred. The only exception that might be taken by a Canadian reader would be that the book relates almost wholly to English conditions and practice. English law in regard to stream pollution is the burden of practically two chapters. But even if in this regard it will not serve as a text-book of Canadian practice, that fact does not seriously detract from the value of the book.

Percentage Compass. For navigators, surveyors and travellers. By John C. Fergusson, M. Inst. C.E. Longmans, Green & Co., London, Eng. Unmounted, 75 cents; mounted, $1.10.

This comes in the form of a chart which is calculated to simplify the use of the compass and to effect a great saving in all angular computations. By means of this chart the surveyor and the traveller or the navigator can find as he goes along: First, the difference of latitude and departure; second, the closure angle of a compound traverse; third, the length of the closure line; fourth, by the use of the circular scale C it is possible to solve any problem in plain trigonometry by simple arithmetic. The percentage compass is a practical application of Fergusson's percentage unit of angular measurement of the magnetic compass dial, which converts it into a simple and accurate range finder.

PUBLICATIONS RECEIVED.

Annual Report of the City Engineer of Halifax.—Issued by the city of Halifax, N.S.

American Peat Society.—Ninety-eight page journal issued by the Society, Toledo, Ohio.

Works Administration.—28-page pamphlet issued by the Gunn, Richards & Company, New York.

Canadian Forestry Journal.—Pamphlet issued by the Canadian Forestry Association, Ottawa, Canada.

Some Mistaken Popular Notions Concerning Public Service Corporations.—By Frederick Strauss. Issued by the J. G. White Companies, New York.

Permissible Explosives.—Technical paper No. 52, by Clarence Hall. Issued by he Bureau of Mines, Department of the Interior, Washington, D.C.

Patents.—Official journal of patents of Great Britain, for June, 1913. Issued by the Patent Office, Southampton Building, Chancery Lane, London, W.C. Price, 6d.

Ohio State Board of Health.—April bulletin issued by the Board of Health, and contains interesting papers read before the Board by well-known medical men.

Properties of Saturated and Superheated Ammonia Vapor.—96-page bulletin by G. A. Goodenough and Wm. E. Mosher. Issued by the University of Illinois, Urbana, Ill.

Apparatus for Gas-Analysis Laboratories at Coal Mines.—Illustrated technical paper by G. A. Burrell and F. M. Seibert. Issued by the Bureau of Mines, Washington, D.C.

Magnetic Iron Sands.—Report by George C. MacKenzie, B.Sc., dealing with the investigation of the Natashkwan magnetic iron sands. Issued by the Department of Mines, Ottawa.

The Flash Point of Oils.—Technical paper dealing with methods and apparatus for its determination, by T. C. Allen and A. S. Crossfield. Issued by the Department of the Interior, Washington, D.C.

Mineral Production of Canada.—Annual report by John McLeish, B.A., containing revised statistical information descriptive of the mining and metallurgical production in Canada during the calendar year 1911. Issued by the Department of Mines, Ottawa.

American Wood Preservers' Association.—480-page booklet containing the proceedings of the ninth annual meeting of the American Wood Preservers' Association, held at Chicago, Ill. Issued by the society. F. J. Angier, secretary-treasurer, Baltimore, Maryland.

Report on the Livingstone Channel.—Contains the recommendations in reply to questions submitted by the Governments of the United States and Canada in regards the Channel. Issued by the International Joint Commission, Washington, D.C., and Ottawa, Ont.

Repair and Maintenance of Highways.—72-page illustrated bulletin by L. T. Hewes, Ph.D., dealing with the repair and maintenance of macadam roads of all kinds, gravel, sand-clay, and earth roads. Issued by the Department of Agriculture, Washington, D.C.

Minority Opinions, Kettle.—Bulletin dealing with dissenting opinions in regard to application of the Rainy River Improvement Company for approvement of plans for a dam at Kettle Falls. Issued by the International Joint Commission, Washington, D.C., and Ottawa, Ont.

Testimony in the Livingstone Channel.—225-page bulletin containing the references of the Governments of the United States and Canada under Article IX. of the treaty of May 5th, 1910. Issued by the International Joint Commission, Washington, D.C., and Ottawa, Ont.

Hearings and Arguments re Kettle Falls Dam.—128-page bulletin containing the hearings and arguments in the matter of the application of the Rainy River Improvement Company for approval of plans for a dam at Kettle Falls. Issued by the International Joint Commission, Washington, D.C., and Ottawa, Ont.

Highway Improvement.—Annual report of W. A. MacLean, chief engineer of highways, relating to highway improvement in the Province of Ontario, and containing the latest information on road construction, road metal, highway bridges and culverts, with illustrations. Issued by the Department of Public Works, Toronto, Ont.

The Year Book, 1912.—Containing the sixth annual report of the Council and transaction for 1912; also trade reports. Swedish traffic questions, with maps inserted of the city of London, railway and canal of Sweden, Blyth harbor, Port of Sutherland, River Tyne, Hartlepool docks, Hull docks, Immingham new dock and Port of Great Grimsby. Issued by the Swedish Chamber of Commerce in London, England.

Report of Water Commissioners, London, Ont.—Thirty-fourth annual report of the officials of the waterworks and electrical departments for the year ending November 30th, 1912, and the parks department for the year ending December 31st, 1912. It includes the general manager's reports and secretary's detailed statement of receipts and disbursements. Issued by the Waterworks, Electrical and Parks Department, London, Ont.

Cheap Steam and Machine-Firing.—A 27-page illustrated pamphlet dealing principally with the application of independent buckets, elevators and shoots to feed the stokers; construction and operation of the Gold Medal machine stoker; shows arrangement of machines for gas-firing as an alternative to coal-firing, and report of actual tests. Steam users will find drawings of the leading types of boilers especially interesting. Issued gratis to steam users by G. H. Tod, Manning Chambers, Queen Street West, Toronto.

CATALOGUES RECEIVED.

The Valve World.—Nicely illustrated catalogue. Issued by the Crane Company, Chicago, Ill.

Tobin Bronze.—Illustrated catalogue issued by American Brass Company, Ansinia Brass and Copper Branch, Ansinia, Conn.

Electric Service Magazine.—15-page illustrated catalogue. Issued by the Toronto Electric Light Company, Limited, Toronto.

Electric Arc Welding Apparatus.—Illustrated catalogue. Issued by the C. and C. Electric and Manufacturing Company, Garwood, New Jersey.

Labor Saver.—Illustrated catalogue on the efficiency and economy of production. Issued by the Stephens-Adamson Manufacturing Company, Aurora, Ill.

Sockets and Receptacles.—Third edition of supply catalogue, illustrated, contains 64 pages. Issued by the Canadian General Electric Company, Toronto.

Fuel Costs.—Eight-page pamphlet dealing with comparison of oil, gas and coal as a fuel. Issued gratis by the Tate-Jones & Company, Inc., Pittsburg, Pa.

J.-M. Packings and Specialties.—132-page, nicely illustrated catalogue, dealing with J.-M. asbestos products. Issued by the Canadian H. W. Johns-Manville Co., Limited.

Weber Chimneys.—48-page illustrated catalogue dealing with Weber coniform chimneys and methods of construction.

May be obtained on application from Weber Chimney Company, Chicago, Ill.

Robb Engine Boilers.—Illustrated catalogue in unique and original style. Issued by the International Engineering Works, Limited, formerly the Robb Engineering Company, Amherstburg, N.S.

Pneumatic Drills, Reamers, Wood Borers, Flue Rolling and Tapping Machines and Grinders. Illustrated catalogue. Issued by the Chicago Pneumatic Tool Company, Fisher Building, Chicago, Ill.

A Test by Technologists.—Contains the expert reports on the six years' weather tests of paint for steel on the Pennsylvania Railway Bridge at Havre de Grace, Md. Issued by the Lowe Bros. Company, Dayton, O.

The Road Models of the Office of Public Roads.—Descriptive catalogue illustrating the standard types of model road construction which represents the modern ideas of highway engineers. Issued by the United States Department of Agriculture, Office of Public Roads, Washington, D.C.

Chicago Pneumatic Tool Company have issued bulletin Nos. 128, 132 and 133 dealing with miscellaneous equipment of pneumatic drills, pneumatic motors and geared hoists and cylinder air-hoist and jacks, respectively. These may be obtained from the company, Fisher Building, Chicago, and 50 Church Street, New York.

The Purification of Water Supplies.—70-page illustrated catalogue containing a concise resumé of the nature of impurities usually found in natural water supplies and the modern methods adopted for effecting their removal. Deals with the physical characteristics of water, its impurities and quality in regards industrial purposes, methods of purification by storage, advantages and disadvantages of slow sand filtration, the advantages of the rapid system of filtration in general and the Paterson rapid system of filtration, gravity filter for industrial purposes, and the Paterson system of softening, sterilization and removal of iron in particular. Issued by the Paterson Engineering Company, Limited, 12 Norfolk Street, Strand, London, W.C.

NEW BOILER REGULATIONS FOR ONTARIO.

Following an act passed by the Ontario Legislature two sessions ago, regulations affecting the construction of boilers are to be brought into force on July 1st. Mr. D. M. Medcalf, who is public inspector of boilers for the province, has drafted regulations under the act which will henceforth compel manufacturers of boilers to submit plans and specifications to this branch of the Department of Public Works to insure a standard in both material and method of construction.

The regulations provide that all new boilers to be constructed in the province shall conform to a proper standard; second-hand boilers to which extensive repairs have been made will also be inspected. Until the present time practically any class of construction would go in the province, and boilers have been sold indiscriminately that have raised the danger risk to such an extent that human life has been impaired.

Twenty-four hundred miles of telephone wire will be strung by the employees of the Alberta department of telephones on rural lines this year, in addition to a large amount of long-distance line in construction and new exchange work in the growing towns and cities of the province. Over two million dollars will be expended by the government in extending the telephone system of Alberta during the year. At the beginning of the year there were in wire miles 9,671 miles of rural lines and 6,689 miles of long-distance telephone lines in **Alberta.**

COAST TO COAST.

Edmonton, Alta.—After examination into the possibilities of Rabbit Hills as the future source of a gravity supply of water for the people of the city of Edmonton, the commissioners have reported to the city council that they are not at all favorably impressed with it, but have faith in the present system proposition. First of all the Montreal experts, whose services in connection with their report on the city's water system cost $15,000, suggested that the plant at the present site be improved and extended to take care of Edmonton's requirements, now and for the future. That recommendation was turned down by the council owing to the fear that at some time heavy floods might submerge the flats and render the pumping and power station situated thereon useless, thereby depriving the citizens of light, power and water at one fell swoop. It was then decided to accept the second suggestion of the experts, namely, to look to Rabbit Hills as the source of supply, and the commissioners were instructed to prepare surveys and plans of this system. This they have apparently done, with the result that they have advised council not to proceed with its intention to obtain the city's water supply from that source, but rather to transfer their choice to the Beaver Hills proposition. When this report was read at a recent meeting of the council the members of that body seemed at first too taken aback to say very much, though some scathing criticisms of the commissioners were forthcoming later. Finally, on the motion of Ald. Tipton, it was agreed to instruct the commission board to proceed with their work of preparing plans and surveys of the Rabbit Hills scheme as set forth in the report of the Montreal experts, and as endorsed by resolution of the city council.

Saskatoon, Sask.—Although Saskatoon has cheaper steam-generated electric power than any other city in the prairie provinces, the city commissioners are taking steps to secure electricity at an even cheaper rate. The necessity for this is greatly emphasized by the government's announcement of the location of an interior storage elevator at Saskatoon. As the structure now to be erected, a five-million-bushel elevator, is but the first unit of what will eventually be an institution with a capacity of upwards of twenty-five million bushels, and as its establishment must of necessity tend to the development of the milling industry, and as a vigorous campaign for the securing of manufactories for Saskatoon is now in progress, the benefit which will accrue from any saving in the cost of power may readily be imagined. Commissioner Yorath, who has specialized in power problems, states that he has very definite prospects for cheaper power, these including three distinct propositions; one of these involves the generation of power at a point some 125 miles from Saskatoon and its transmission to the city; another includes possibly a more pretentious scheme which is being taken up with certain interests in London, Eng., and a third proposal, details of which are being considered.

Quebec, Que.—Honorable J. F. Caron, Minister of Agriculture, is very pleased with the results obtained so far through the policy of the good roads. There are fifty-eight gangs working at various points of the province, and all are going fast with the improved machinery supplied to them. The number of municipalities asking for money grants is ever on the increase and a sum of $5,000,000 has been paid by the government to the towns, villages and municipalities desirous to improve. This sum is exactly half the credit effected last year to these improvements. This sum, of course, does not include what the government is spending on large national roads. The Edward VII road will be the first completed, and the road between Montreal and Quebec is under way, the contractors having begun work from the western end of the road at Charlemagne. The road between Montreal and Ottawa will probably be built on the south bank of the Ottawa if the Province of Quebec can make arrangements with Ontario to build from St. Eugene to Ottawa.

Halifax, N.S.—Halifax has reason to be proud of and satisfied with the purity of its water. A sample was sent last month to Dr. J. T. Donald, Ottawa, official analyst to the Dominion Government. He was asked to make an analysis of the water as regards its suitability as a boiler feed water. Dr. Donald's reply was highly complimentary as to the value of the water for drinking purposes, with a report also regarding its use in boilers: "This is a remarkable water, containing as it does less than two grains of mineral matter per Imperial gallon. It is thus a very pure water. It is just possible it may be too pure for satisfactory use in boilers. We have had cases where a water with so little mineral matter had caused pitting and corrosion of tubes. This tendency was overcome by adding a small amount of lime to the water. If you will give us further particulars if you have any trouble in using this water we shall be glad to discuss the matter with you."

The analysis from a sample containing 10.5.13 was as below:—

	Grains per gallon.
Total solids	1.82
Sodium chloride	0.82
Carbonate of lime	0.25
Carbonate of magnesia	0.08
Iron oxide and alumina	0.11
Organic matter, etc.	0.56

Toronto, Ont.—The great host of Ontario people who yearly flock to the summer resorts of the north and the watering places about the fresh water system will this season enjoy a more adequate protection from unsanitary conditions than ever before. The efforts of the provincial board of health, which have been bent for several years towards the enforcement of efficient and cleanly methods of sewage disposal and water supply, are beginning to bear fruit. Dr. J. W. S. McCullough, chief health officer of Ontario, states that one great source of contamination has been removed in the adoption of high-class sewage systems on board the tourist steamers in the inland lakes. Five of these boats which ply constantly from point to point in the Muskoka region have installed septic tanks, and the intention of the department is that by next year every tourist line will be asked to submit to similar arrangements. Apart from the ordinary reaction of chemicals, which is set at work in all such plants, the additional precaution of turning live steam into the compartments for disinfection purposes will be followed. In this way no possible complaint as to the contamination of the water in the narrower channels or bays can occur in future. The general inspection of the cottages and hotels in the different parts of the province is being carried on at the present time. Owing to the activity of the department last year in forcing negligent proprietors into line, more satisfactory conditions are being experienced by the officials this year. District Officer Clinton, of Belleville, has completed an investigation of the Kawartha Lake region and with few exceptions has approved the methods. The Grimsby and Burlington Beaches at the present time are undergoing the investigation of Dr. McLenahan, of Hamilton, the board representative in that district. Because of the popularity of these places with a large class of people who cannot journey far from city life, the conditions are more congested. In consequence more difficulty is found in maintaining proper sanitary conveniences. A willingness to comply with the new regulations is now being met by the department, however. The installation of the new tanks on board ship was largely at the instigation of the shipowners, and hotel proprietors are gradually assuming the same attitude of co-operation.

Ottawa, Ont.—A party of surveyors is being sent out by the Public Works Department to prepare contract plans for the improvement to the French River in connection with which a vote of $500,000 was made at the last session. The river connects Georgian Bay and Lake Nipissing and would be one of the main sections of the Georgian Bay Canal if that great work were undertaken. Even if it were not, the improvements contemplated would facilitate navigation to the North Bay terminals from the Great Lakes. The principal improvements necessary are a system of controlling dams to regulate the level of the lake and two or three locks. The vote made last session is sufficient for carrying out the preliminary details and commencing construction. With regard to the Georgian Bay Canal project, it is intended, as announced by Hon. Mr. Rogers, to appoint a commission to enquire into the commercial feasibility of the project. From an engineering point of view, the feasibility of the undertaking has been fully established, but there is a singular lack of information as to the extent to which the canal, when built, would be utilized and become one of the great transportation routes of the country, as it is destined to be. It is not certain as yet as to when the commission will be appointed, but when it is, different parts of the country will be visited and evidence taken. Upon the report which is made will depend very largely whether or not the proposition will be gone ahead with by the government.

St. Boniface, Man.—In reference to the notice received from the Canadian Federation of Boards of Trade, the St. Boniface board have voted to support the Georgian Bay Canal scheme in opposition to the scheme of the United States to divert the great waterway to the United States waters, the Canadian plan calling for an expenditure of $75,000,000, as against the United States scheme of $51,000,000. The St. Boniface board is pledged to use its influence in favor of the Georgian Bay Canal, and to urge its members of parliament at Ottawa to support the project in the House.

Ottawa, Ont.—A peculiar case of unsatisfactory tenders is now before the Government, and after some weeks' consideration is still undecided. It is a contract for a building costing a million and a half dollars. Tenders were invited and received, but the lowest one was $200,000 below the estimate and $500,000 below the other bids. It came from a new and inexperienced firm, though accompanied by a heavy deposit cheque. New tenders were called, and instead of dropping out, the contractor has practically repeated the offer. The next lowest tender is from a firm whose work is very unsatisfactory. The situation is a delicate one because the work is being held back, and if the usual custom of accepting the lowest tender or the next one above is not followed there will be criticism. All of the big and reputable firms are away above the others. Meanwhile nothing is being done, and what solution will be arrived at is uncertain.

Victoria, B.C.—Four Cabinet Ministers will visit Victoria this summer, namely: Hon. Robert Rogers, Hon. J. D. Hazen, Hon. H. P. Pelletier and Hon. W. T. White. Mr. Rogers' visit is, of course, the most important, as under his department comes the work of construction of the Victoria harbor works and the Esquimalt drydock. The plans for the breakwater and piers for Victoria are being prepared by the Engineering Department of the Public Works at the present time, and the call for tenders will be issued within a few weeks. As for the Esquimalt drydock, which will be included in part of the permanent naval policy of the Government, nothing can be done until a complete survey is made of the harbor. It is understood that a party will leave at once to undertake this work; and Mr. Rogers states that construction will be rushed with all possible speed.

Saskatoon, Sask.—According to civic authorities, cheap power is the chief requirement of Saskatoon to make it a milling centre. If a low rate of power is obtainable, it is only a matter of a short time until large mills will be under construction. It is understood that Hydro-Electric developments are shortly to receive consideration. It is the opinion of several engineers around the city that to make the power scheme profitable two dams will have to be built in the river. The Saskatchewan River probably carries more sand down with it than any other river in the Dominion. The idea now is to build a dam far up the river in the neighborhood of Pike Lake, which would act as a breakwater and hold all the silt which would otherwise drift down the river and form against the real dam, which is to supply the head water, which will make the wheels go round. If this is not done all the sand silt will form a drift up against the real dam, and thus spoil the head of water to a material degree. It is now seven years since Saskatoon first investigated the potentialities of the South Saskatchewan River with a view of producing power. At that time Saskatoon paid Engineer Mitchell, of the Ontario Hydro-Electric power scheme, $800.00 to report on the conditions of the river in the Saskatoon district with a view to securing the best of the different power sites in the vicinity of Saskatoon. There is a chance, on the other hand, that the visit to Prince Albert may mean the re-opening with that city of negotiations to take a block of power from their power-house at LaColle Falls. This opportunity was given to Saskatoon some time ago, but the city fathers did not embrace the scheme very heartily. If this is done, a right-of-way will have to be purchased between her and the site of the falls, a distance of something over a hundred miles.

Fort William, Ont.—Good progress is being made by the 200 men, who, with about 40 teams, are clearing and grading roads in the district for the Ontario Government. At present some 80 men and 30 teams are engaged on the Oliver Road, about two miles from Port Arthur. The men in charge of the work report that no unlooked for obstacles have been met with. Another large crew of laborers are working on the Pigeon River Road, which is ultimately to connect Fort William and Port Arthur and Duluth. It is intended to have the Pigeon River Road cleared and graded as far as the Minnesota boundary line this fall. Work on the continuation of the highway has been commenced in Cook County, Minn.

Vancouver, B.C.—"Switzerland annually receives millions in revenue from her mountain scenery and I see no reason why we should not do so within the next few years," said Col. R. E. Thomson, provincial engineer of Strathcona Park at the Progress Club recently. There was, he added, everything in the island area that would appeal to the mountain climber. There were peaks of great height, crevasses, glaciers and "chimneys," a rather narrow opening in the rock in which mountain climbers delight. Strathcona Park, he said, would be made a place to which tourists the world over would be attracted. Camping places along the sides of the many lakes would be improved and put into proper condition. The large number of small lakes just west of the Beaufort range of mountains would be surrounded with camping settlements. Here children would be able to play close to nature, while all kinds of outdoor sports could be indulged in. The land would be piped, thus assuring the campers of an adequate water supply and of a pure quality. The beaches about these lakes would furnish admirable places for bathing and swimming, while boating, canoeing and other aquatic sports would be fostered by the tranquil stretches of water which reflect the mountains close by. It is the purpose of the government, said Col. Thomson, to preserve all the curiosities of nature that would be found. Beaver dams and the work of the animals would be kept intact, so that people might see the real work of these creatures. The big trees which are in some cases over thirteen feet in diameter, would be left standing and proper supervision exercised to see that they were protected. Employees of the Strathcona Park, are now experimenting with flowers from the Himalaya Mountains to see if the same shrubs and roots can be grown in this province. The flora in the park would, he thought, equal that about Mount Rainier to the south. Nowhere could the wishes of the alpine climber be better satisfied than in Strathcona Park.

PERSONAL.

MR. T. F. SUTHERLAND, assistant inspector of mines, now resident in Cobalt, comes to Toronto on July 1st to assume his duties as chief inspector of mines for Ontario.

MR. A. P. HAZEN, who has been in the employ of the Dominion Government at Ottawa, on the design of the Port Nelson terminal of the Hudson Bay Railway, has just resigned.

PROF. V. I. SMART, of McGill University, department of railway engineering, is leaving to assume the position of general manager for the General Railway Signal Company, of Canada.

MR. D. W. McLAUGHLIN, of the engineering staff of the Hudson Bay Railway, has just left for Port Nelson to conduct survey work in connection with the establishment of the railway's terminals at that point.

MR. E. T. CORKILL, who has been chief inspector of mines in Ontario for some years, has just accepted a position with the Canadian Copper Company, at Copper Cliff. The office is that of safety engineer, and is the first of its kind in Ontario.

MR. GEORGE IRVING has been appointed Canadian manager for the National Meter Company, of New York, and not Mr. George Irvine, as stated in a recent issue of *The Canadian Engineer*. Mr. Irving will make his headquarters at 229 Spence Street, Winnipeg.

MR. R. E. HORE, Mem. Am. Inst. M.E., and for some years instructor in Geology and Petrography, Michigan College of Mines, succeeds Mr. J. C. Murray, resigned, as editor of the "Canadian Mining Journal," Toronto. He graduated from the University of Toronto in 1905.

MR. J. G. SEYFRIED, structural engineer and assistant to the chief engineer, Grand Trunk Railway, at Montreal, has resigned to accept an appointment as engineer, Bridge Department, Canada Foundry Company, Limited, Toronto. Mr. Seyfried will have charge of the designing and estimating, and will become assistant to the manager of the Bridge Department, Mr. J. L. Brower, M.C.S.C.E.

HON. LOUIS CODERRE, secretary of state, who is now also minister of mines, that branch having been recently transferred to his portfolio, has decided this summer to make an extensive western trip, going as far as Dawson City. Mr. Coderre will travel west with the delegates of the International Geological Congress, which meets in Toronto in

August. He will visit all the important western mining centres and in that way will be able to make a personal study of the needs of the department, and to become intimately acquainted with the mining resources of the country.

MR. ARTHUR S. HERBERT has resigned his position as general manager of the Siemens Company of Canada, Limited, and has been appointed general manager of the branch offices of the Siemens Company in Australia. Mr. Herbert is now in England, but will return to Canada for a few weeks early next month, sailing for Australia from Vancouver about the end of August. He will be succeeded in Canada by MR. C. A. ABLETT, whose name has been closely associated with the electrification of the rolling mills in Europe during the past few years, and who recently made a brief investigation of the position of the large steel works of Canada with regard to electric drive. Mr. Ablett will take up his duties in Canada at the beginning of next month, but the appointment dates from the 1st inst.

COMING MEETINGS.

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 INTERNATIONAL GEOLOGICAL CONGRESS.—The Twelfth Annual Meeting to be held in Canada during July and August. Opening day of the Toronto Session, Thursday, August 7th. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Annual Meeting in Regina September 16, 17 and 18. General Secretary, Major Drum, Ottawa; Local Secretary, Dr. Murray, Regina.

THE INTERNATIONAL ENGINEERING CONGRESS.—Convention will be held in San Francisco in connection with the International Exposition, 1915.

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.

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