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The Canadian Engineer

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General Specifications for Steel Highway Bridges, Ontario, 1917

An Analysis of the 1917 Specifications Shows Many Changes and Improvements—Recommended Length of Beam Spans Has Been Extended From 35 to 40 Feet

By E. H. DARLING, A.M.Can.Soc.C.E., M.E.

DRESSED in the convential garb of an official blue-book, the 1917 General Specifications for Steel Highway Bridges for Ontario, issued as an appendix to the annual report of the Department of Public Highways, does not present, at first glance, any striking difference from its predecessor of 1911. A closer inspection, however, discloses many marked changes and improvements.

The class of bridge over which the Department has supervision, and which this specification covers, is the town and county highway bridge pure and simple. Bridges carrying electric railways operating under provincial charters come under the Ontario Railway and Municipal Board's specification of 1916. This latter specification has a section devoted to movable bridges but as such bridges are almost invariably over navigable waters they, as well as all bridges over railways with Dominion charters, would have to comply with the 1908 specification of the Department of Railways and Canals. We thus have, it is to be regretted, three entirely different official specifications for highway bridges in Ontario. The one under review is limited strictly to the floors and superstructure of steel bridges carrying highway traffic only. A separate specification has been prepared for concrete bridges.

While the same general arrangement of the former specification has been adhered to it has been greatly improved by the re-grouping of clauses under their appropriate heads. Many ambiguous clauses have been rewritten altogether and other out-of-date ones have been cut down, revised, or omitted. Taken in detail, these

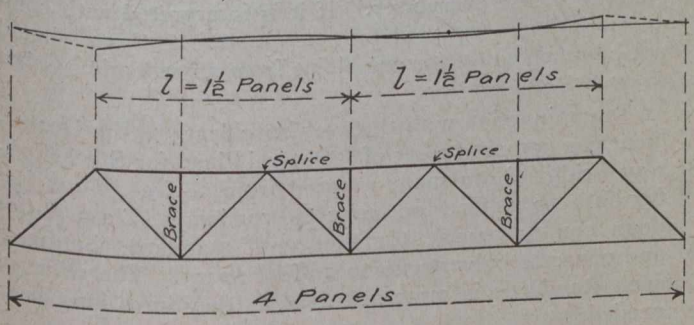


Fig. 1

little changes indicate the upward trend of practice in highway bridge construction which has been slowly going on for many years.

The recommended length of beam spans has been extended from 35 feet to 40 feet. Truss spans under 40 feet have been built in the past and, in fact, in the standards issued by the Department stress sheets are given for spans as short as 34 feet, but for such short trusses an extravagant amount of material is required to obtain satisfactory results. The introduction of deep Bethlehem beams has made possible a 50-foot beam span, transportation facilities being the controlling factor.

Under the head "General Dimensions" the only change is in the minimum clear width of sidewalk, which is increased from 4 to 6 feet. The 4-foot walk was only

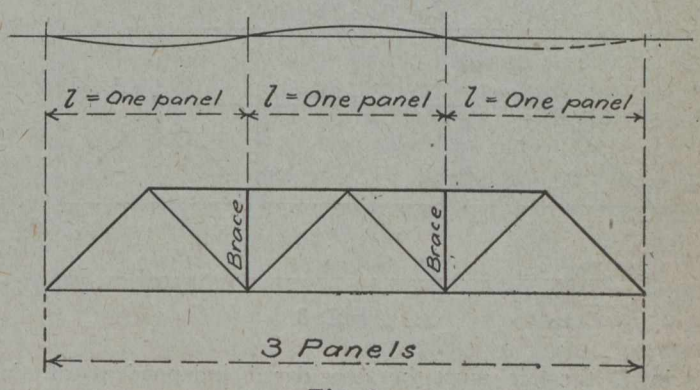


Fig. 2

an aggravation but, on the other hand, a 5-foot walk would be perfectly satisfactory in many localities. The extra foot on the side of a bridge costs considerably more in proportion than the increase in floor area, and it should not be added unless necessary.

The classification and loading of bridges is left unchanged but a little diagram has been added showing distribution for concentrated loads. The assumptions regarding wind loads have been revised and simplified. The whole load is now to be considered as a moving load and to be 300 pounds per foot on the loaded chord and half this amount on the unloaded chord.

Allowable unit stresses for steel and masonry are also left unchanged, but stresses for timber in bending have been added. These stresses are about what are commonly used for indoor construction and do not give much margin for the severe usage to which timber is subjected in a highway bridge. It would have been well to have given also allowable unit stresses in cross and longitudinal shear, as these are sometimes the controlling factors in the design of joist. The omission of unit compression stresses and column formulæ for timber may be justifiable in a steel bridge specification.

One of the most important innovations in the whole specification is the change in the clause relating to impact. This clause, as far as it relates to main members, reads:

"Impact shall be added to the maximum live load stresses. For stringers, floor beams, and hangers the impact shall be 30 per cent. of the maximum computed live load stress and for all other members . . . the impact to be added shall be 10 per cent. of the maximum computed live load stresses."

This clause is not only a great deal simpler than the cumbersome formulæ which it replaces, but the results are more logical and in accord with experience. The intention probably is that all stresses as figured for the concentrated live load be increased 30 per cent. and those for the uniform live load, 10 per cent. This, however, is not perfectly clear in the wording of the above clause. True, the concentrated live load usually produces the maximum stresses in the stringers, floor beams and hangers, but it may also, under special conditions, produce maximum stresses in diagonal members, counters, bearings on abutments, and sometimes in very short spans, in main chord members. On the other hand, sidewalk stringers carry only uniform live load, for which 10 per cent. impact would be sufficient, and there is room for argument as to whether a cantilever sidewalk bracket is a floor beam or not within the meaning of the above clause. If it is admitted that "impact" is a property or factor of the live

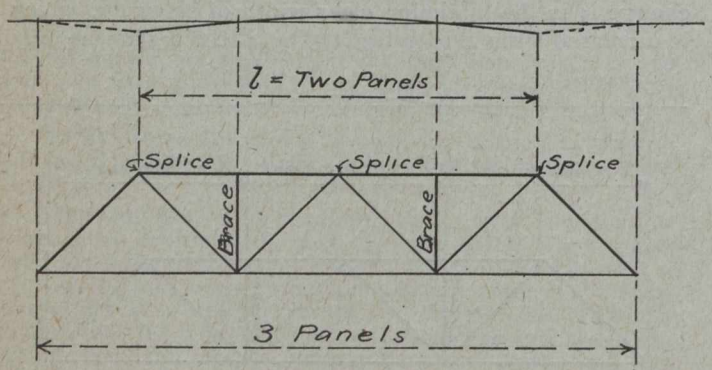


Fig. 3

load, then it must be considered independent of the member of a structure which it may affect. The above clause would be greatly improved if it were rewritten so as to clearly state that the percentage for impact must be added to the estimated stresses produced by the various loads, and then there would be no doubt that maximum stresses in whatever member or connection they occur would be provided for.

Under the clauses which deal with "Construction," "Details" and "Workmanship" there are to be noted many minor revisions, all tending toward those higher standards of practice which have long been in use in railway bridge work. Sub-punching and reaming of rivet holes, while left optional to the engineer in charge, is for the first time mentioned in these specifications. There is one little item that might be questioned on the grounds of economy and that is the requiring all pipe railing to be galvanized. Admitting all the considerations in favor of the galvanized pipe, yet there are many places where the painted pipe would be just as serviceable and as durable as the painted truss it is attached to or the painted lattice railing alongside of it. For this reason the galvanizing might well be left optional.

Important changes have been made in the paint specifications in which is now included a specification for red lead. The amount of this pigment in the shop coat of paint has been increased from 12 to 20 pounds per gallon, which makes a pretty heavy paint for a shop coat. It is suggested that steel hand-railings be painted white. This is, of course, to make them show up better in the distance and at night, just as canal bridges are sometimes painted white for the same reason. Might this not, however, be made the first step toward a more decorative treatment of steel bridges? Certainly white bridges stand out more prominently in the landscape and look less like a machine. The pleasing effect of many concrete bridges depends a great deal on their whiteness. White paint would also show up the rust spots and the need of repainting would sooner become evident to even the most careless observer.

The specification for steel has been considerably revised and now closely follows the 1909 Standard Specifications for Structural Steel for Bridges of the American Society for Testing Materials. In fact it requires careful comparison to detect the differences and it would have been more satisfactory to have adopted these standard specifications without change.

Commendable additions and ones which will add to its usefulness are sections on timber floors, creosoted wood blocks and preservation of timber. This last-mentioned subject is every year becoming more important and deserves a place in the highway bridge specification.

The final section, "General Conditions," has been somewhat amplified and strengthened in the interests of municipality by stating more fully and clearly the powers of the engineer in charge.

The specification is provided with a very complete index. The care taken in the cross-indexing is indicated by the fact that while there are only two hundred and thirty clauses to be indexed there are probably over six hundred references in the index. Some key words, however, are not the ones which one would naturally look for. For example, these are some of them: "*Carelessness* of contractor," "*Disorderly* employees," "*Interference* with travel," "*Reliable* work to be done," "*Workmen*, painting to be done by skilled," etc.

This specification is the product of a growth or evolution. The practice adopted by the department of frequently revising their specifications, cutting out dead material, revising ambiguous clauses, adding new matter and yet retaining (and thus standardizing) what has been found by experience to be practicable and satisfactory, has resulted in an unusually consistent and workable specification, which is placing, if it has not already placed, steel highway bridge building in Ontario on a solid basis. But in saying all this it is not necessarily implied that the specification is perfect or that it will be universally approved. It is probably not such a one as a committee of engineers and contractors would draw up but, on the other hand, it has a definiteness and character which is usually lacking in a specification in which an attempt is made to please everybody. If it is interpreted with common sense and in a not too narrow spirit there should not be much cause for complaint from anyone who wishes to do first-class work.

In conjunction with the 1917 specifications the Department has prepared a set of "General Plans for Steel Highway Bridges" for spans ranging from 28 feet to 120 feet for both 16 and 18-foot concrete roadways, Class A (for main county roads), together with standard abutments and concrete culverts up to 20-foot spans. The value of such standards is quite apparent as they have long been needed.

Each plan gives a complete stress diagram for a bridge and a small scale "show plan," such as up-to-date bridge companies have been accustomed to prepare with their tenders. These show plans indicate details of construction with fair clearness, but it is probable that they are intended to be taken only as suggestions and not to be followed absolutely. Whether it is due to their small scale or not, they are inclined to be clumsy, poorly proportioned, and in some cases inconsistent and wasteful of material and rivets. Every bridge shop has its own particular methods of operation, and work which one shop

is equipped to do economically might be very expensive in another. It is only fair, then, that considerable latitude be given in such matters as long as the results are satisfactory. A good detailer requires more than a knowledge of stresses, materials and shop methods. He must be endowed with considerable inventive genius and what the artist calls "technique." In the production of neat, compact and simple details, of not the least importance is a habit of rigid economy such as can only be acquired by breathing for a time the atmosphere of a contractor's office. To attain the best results often requires the co-operation of several minds, even in such a simple structure as a highway bridge.

The issuing of these standard plans will probably establish the use of the box section for top chords for Warren trusses and abolish the "T" chord, at least for spans over 50 feet. By way of funeral oration the writer feels like saying a last good word for the old "T" chord. It is a fact that many "T" chord trusses have failed in the past and there are many more which, although they have not actually failed, are yet very unsatisfactory. On the other hand, there are literally scores of bridges in this province with "T" chords and for spans up to 100 feet which are giving perfect satisfaction. The "T" section is used so extensively in engineering for compression members and is the base of so many designs, such as roof trusses and other framing, the flanges of columns, beams and girders, that some explanation is necessary as to what has given it a bad name in highway bridges.

An investigation of the instances of weakness and failure will invariably show faulty design. In fact, the peculiar properties of the pony Warren truss are disregarded by most designers and because the box chord has a factor of safety large enough to cover these errors—errors which would wreck a "T" chord—the latter is condemned. Some interesting examples of this common oversight are illustrated in these standard designs. For instance, it is usual, in proportioning the top chord section of a truss to consider the unsupported length, in a horizontal plane, to be one panel length. On this principle the sinuous or elastic curve for the top chord of a three-panel truss is assumed to be as shown in Fig. 1. The correct assumption is, however, more like Fig. 2, in which the unsupported length is two panels. For trusses of more than three panels the unsupported length will be one and a half panels. (See Fig. 3.) It will also be noted that splices in the chords always come near the centre of the column where the bending moment is likely to be a maximum.

Referring to the standard plans (Plate No. 2) for 40, 42 and 44-foot spans, 16-foot roadway, we find that this is the only standard with a "T" chord, whereas of all others these three-panel trusses should have box chords. The l/r, instead of being 78, as stated, is really 156, and the value of the chord in compression is only 31,000 pounds, whereas the estimated stress is 58,800 pounds.

Now, it so happens that in most cases the box chord has the necessary stiffness to take care of such errors as these and the splices are better able to resist bending than the usual "T" chord splice. The end posts and diagonal members also impart more or less stiffness to the chord. Hence the preference for this type of construction. The box chord truss, however, costs from 25 to 50 per cent. more than the "T" chord truss. As for cost of maintenance and for durability, the box chord has on an average 75 per cent. more surface to rust and probably costs twice as much to paint. If a carefully designed "T" chord truss can be made perfectly safe and satisfactory, is an engineer justified in recommending the public to pay the additional cost for a box chord bridge?

As for the three-panel truss, the writer has sometimes used the old queen-post design in which the uncertainties are eliminated and the results are quite satisfactory.

DRAINAGE IN THE RED RIVER VALLEY IN MANITOBA*

By G. B. McColl, D.T.S., M.L.S.

THE basic industry of Manitoba is agriculture and the greatest economic service we can render the Empire is to increase the production of foodstuffs. The extent of arable land in this province is limited so that the opportunity for improvement lies largely in increasing the production of those areas already taken up for cultivation. Next to the soil itself, the most essential requirement for successful farming is the proper control of surface water. In thorough and systematic drainage lies the only hope of insuring good crops from year to year. Even climatic conditions and the length of the growing season are dependent in a measure on drainage. The prevention of the spread of noxious weeds is also impossible where drainage conditions are unfavorable.

The province of Manitoba contains within its boundaries the outlet system of a vast watershed, stretching from the Rocky Mountains to Hudson Bay. Lake Winnipeg—713 feet above sea level—acts as a collecting basin for the run-off from the great agricultural areas of this watershed (including all the arable land in Manitoba) and so we may regard this lake as the ultimate outlet for agricultural drainage in the province. A ridge crosses the province running northwest and southeast. West of this ridge the land continues at a higher elevation through to the Rocky Mountains. From the foot of the ridge eastward the elevation falls off from about 1,000 feet above sea level down to the level of Lake Winnipeg. The Assiniboine River cuts a wide valley through this ridge and with several other smaller streams divides it into four parts, known respectively as Pembina, Riding, Duck and Porcupine Mountains. The Red River, like Lake Winnipeg, lies in a trough, the land sloping toward it from both east and west, and the river through its tributaries forms the natural outlet of the major portion of Manitoba's arable land. The Assiniboine, running rapidly down the hillside, has cut out a valley for itself and in its lower stretches frequent overflowing has built up a bank on either side extending a mile or two from the river and several feet higher than the land farther back. Consequently, in flood season, the Assiniboine in its lower course may be higher than adjacent lands and cannot be used for draining such lands without risk of serious flooding.

The precipitation (rain and snowfall) in Manitoba is not great, ranging from 15 to 20 inches a year, and there is barely sufficient for the needs of the crops. We are safe in assuming that land here is never seriously damaged by water that falls on it, but entirely by that which flows over or accumulates on it from adjoining lands. The principle of drainage is not to deprive the land of useful water but to so control the flow of surface water as to prevent damage and conserve moisture for the crops. In the Winnipeg district, on an average of the total annual

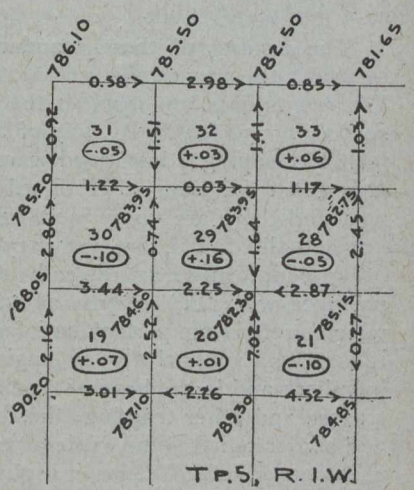
*Abstract of paper read before the Manitoba Branch, Canadian Society of Civil Engineers, October, 1917.

rainfall, about 9 inches falls during the growing season, 5 inches after harvest, which forms a reserve supply for the next season, and 7 inches during the months when the ground is frozen. This last must largely run off the surface or evaporate as it cannot sink in to any extent. Evaporation beyond what is essential to growing crops is undesirable. As it takes heat to boil a kettle, it likewise takes a large amount of heat to boil off an inch of water from an acre. Consequently, land where there is heavy evaporation is more subject to frost than land in good tilth.

With this general introduction we will pass on to a more detailed consideration of the drainage area stretching west from the Red River to the Pembina Mountains, and extending north from the international boundary to within a mile or two of the Assiniboine River. (As previously noted, the watershed of the Assiniboine in this region is very narrow.) There are numerous coulees entering the Red River between its junction with the Assiniboine and the international boundary but they are generally short and of local consequence. Two tributary streams, the Sale and Morris Rivers, form the main outlets for drainage. The watershed comprises slightly over two million acres and of this the Morris River has to take care of some 900,000 acres and the Sale River of some 600,000 acres. The balance is distributed among the various smaller coulees. Several streams which rise in the Pembina Mountains lose themselves on reaching the more level land and previous to the construction of artificial outlets, spread out over the country to form large marshy tracts, one of which, the Boyne Marsh, extended across several townships. In addition to the spring freshets from the slopes of the Pembina Mountains, occasional floods from the Assiniboine inundated large areas, the water following a southwesterly course overland to the Red River. As there are three distinct sources of flooding, (1) local water accumulating on the lower levels from surrounding land, (2) flood water from overflow of streams or drains within the watershed, and (3) flood water from outside the watershed (Assiniboine River) it is to be expected that there might be a diversity of opinion as to cause and remedy. Each phase must be dealt with separately. Both the Morris and Sale Rivers are subject to backwater from the Red River, the former to a much greater extent than the latter.

Bench Monument, Cast Iron Protected by Concrete Ring. Lower View Shows Monument in Place

Drainage is of necessity a local problem. Certain general principles apply everywhere but these are so modified by conditions of climate and soil, by the industries affected and by the nature of the relief required that a study of the question right on the ground itself is imperative. In Manitoba the spring floods occur at a season which is a critical one for the farmer. A little delay in spring seeding may make the difference between a good crop and a failure. Drainage, to be effective, must relieve the land quickly of its surplus water. Even in a dry season it does not pay to have water lie on the surface. It is noticeable in a field of grain that where spots have remained wet until the water sinks in or evaporates, the grain does not germinate readily and weeds get the upper hand, resulting in a poor yield.



Specimen Diagram Showing Closures in Each Square Mile (Eliminated by Adjustment)

Among the general principles which apply to all drainage we may mention the following:—

(1) The capacity of a drain or drainage system should increase and not decrease toward the outlet. In figuring the capacity, actual service conditions must be taken into account. Where the grade is decreased, the width must be correspondingly increased. It is often the practice to widen a shallow portion of a drain and then revert to a narrow cut through a succeeding ridge, forgetting the principle that water will find its level and overflow in the shallow portion before reaching a level of corresponding capacity in the ridge.

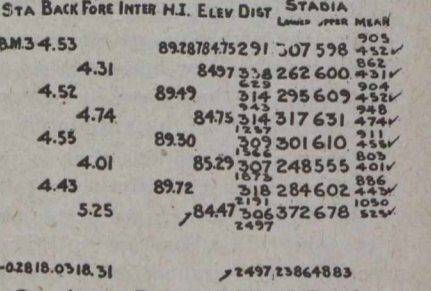
(2) A suitable grade, as uniform as possible, should be chosen to prevent erosion and sedimentation.

(3) A comprehensive survey should be made of the whole area draining or likely to be drained through any part of the proposed system, so that account may be taken of future extensions. The system should be so located as to serve every part of the area to be drained by it, but on no account should water from another watershed be diverted into a system not designed to receive it.

Among the special conditions which affect the district under consideration, two are outstanding:—

(1) The drains at the time they are required to give the most service are full of packed snow and ice, which retards the flow and exaggerates any inequalities in capacity.

(2) The district depends almost entirely on surface water for domestic and farm purposes, the underground supply being saline and unsuitable even for stock. Consequently, all watercourses, both natural and artificial, are dammed at intervals to hold the water. This not only checks the flow but through sedimentation permanently decreases the capacity. The most satisfactory solution of



Specimen Page of Field Book, Showing Checks

this problem would be to excavate suitable reservoirs, the subsoil being an impervious clay which readily holds the water. This could be done economically on a large scale with proper machinery and would be a great boon to the district.

The drainage difficulties now existing in these areas may be divided into four classes:—

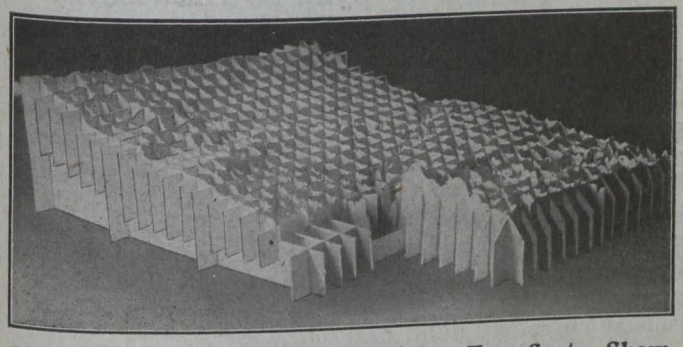
(1) Natural conditions which have not been remedied.

(2) Natural conditions which have been partly remedied.

(3) Damage due to faulty location and construction of drains.

(4) Lack of proper provision for maintenance.

It is easy to see how here again much confusion may arise. Engineering defects may be blamed on natural conditions and trouble arising through lack of main-



Cardboard Model, Interlocked Like an Egg Crate, Showing Over Eight Hundred Miles of Levels, Morris Municipality. Scale: Hor., 1″ = 1 Mile; Vert., 1″ = 10′

tenance may be charged to faulty construction. Beyond question, all the land in this watershed now lying idle or being farmed to little or no profit, can be easily brought into a high state of production. There is considerable work yet to be done and some of what has been done in the past must be remedied; the question of maintenance has to be faced squarely and provision made that will insure it against neglect. (In this connection we would strongly recommend some provision for municipal drainage inspectors with powers similar to those of the noxious weed inspectors.)

Preliminary to remedying the conditions on the ground, there should be a revision of the drainage laws of the province to make them more in keeping with the principles of equity and justice and at the same time more suitable to the present needs of development. Co-operation is essential. Arbitrary divisions of land, whether between private holdings or municipalities, complicate matters. Legislation to be effective must work to the general good without discrimination, its purpose being to overcome selfish obstruction without working injustice. All drainage operations tend to change the natural flow and the fact that a drain is constructed to empty into a natural watercourse does not relieve the parties responsible from liability for the effect of such change on the watercourse throughout its length.

The following is a brief outline of the methods used in making our comprehensive level survey:—

(1) Bench monuments (cast iron protected by concrete ring) were placed every two miles each way throughout the area covered.

(2) Connecting lines were run and checked to the two nearest benchmarks of the Geodetic Survey in order that all elevations might be referred to sea-level datum and be consistent with any future work done in the province.

(3) The outlines of each township were check-levelled and the resulting net adjusted to eliminate small closing errors.

(4) The interior section lines were levelled over once and the network of levels in each township adjusted to the township outlines.

The degree of accuracy set was a closure of 0.10 ft. times the square root of the distance in miles, and this error was rarely exceeded. Where the adjustment indicated a gross error and the line was check-levelled, the result in each case confirmed the adjusted value.

Our aim was not to obtain precise results, but rather to have all elevations consistent and sufficiently accurate for all ordinary engineering requirements. The distance between stations was determined by stadia readings which served as a check on the level readings. Plans were made of each township on a scale of 1,000 ft. to the inch, and all elevations recorded on same as determined. The total cost of this work was less than two cents per acre.

OTTAWA BRANCH, CANADIAN SOCIETY OF CIVIL ENGINEERS

On Friday, November 2nd, the members of the Ottawa Branch of the Canadian Society of Civil Engineers met at the Regent Theatre, when films were shown of the water powers of Canada tributary to Vancouver, Calgary, Winnipeg and Montreal.

The films shown were recently completed for the Dominion government by the engineers of the Department of the Interior in co-operation with the Department of Trade and Commerce. In addition to showing the developed and undeveloped water powers tributary to the cities mentioned the scenarios include many interesting scenic effects and are, from that point of view alone, well worth viewing. They are now being screened before financial, professional and technical organizations in the United States. Sets of the films have also been furnished the Canadian Trade Commissioners abroad to be screened before interested parties in Australia, South Africa and eventually South America and European countries. By special request of a member of the Inventions Board of the Admiralty, a set has recently been forwarded to London to be shown before high officers of the Admiralty and officials of the Imperial government.

It is understood that the North-Western Railway of India is to use oil fuel in future, a decision arrived at after some lengthy experiments. Large oil tanks have been installed at Kiamari connected to a pipe line from Karachi.

The chairman of the executive committee of the Chicago Rock Island and Pacific Railroad has submitted a proposal to the United States Government that provision should be made in the Liberty bond issue for a sum of from three hundred to five hundred million dollars, to be used as loans to the railways for extensions and improvements. It is claimed that the interest now being paid on loans is 8 per cent., but that under the proposition the interest need not be more than 4 per cent.

United States and Canadian engineers recently met at the Hume, in British Columbia, to discuss the Kootenay Valley reclamation scheme and what data should be collected before any practical steps are taken toward carrying out the proposed drainage plan. S. H. McCrory, of Washington, represented the United States Federal Government. Other engineers present were: William Young, British Columbia controller of water rights; J. P. Forde, federal district engineer; J. G. Swan, head of the federal hydrometric service in British Columbia; W. J. E. Biker, provincial hydrographic engineer. Opinion expressed at the conference was favorable to the project.

RAINY RIVER WATER POWER PLANTS*

THE plant of the Minnesota & Ontario Power Company and associated companies at International Falls and Fort Frances consists of a power house and paper mill on each side of Rainy River connected by a V-shaped dam pointing upstream. Wasteway capacity for the discharge of the flood waters from Rainy Lake is provided by ten sluices in the Canadian wing of the dam and by six sluices at the head of the old Canadian canal. Each sluice has a width of 10 feet, a sill elevation of 477.5 Public Works, Canada, datum and an arch crown elevation of 490.0. The discharge through these sluices is controlled by two-phase wooden sluice gates, which are raised by means of a motor-driven hoist. In addition to these wasteways there is a 12-foot log sluice with a sill elevation of 487.0.

The dam is of masonry construction, rubble-faced and capped with concrete. The spillway section of the dam is about 450 feet long, with crest at elevation 497, and is provided with flashboard supports and decked to allow passage from one side to the other.

In the American power house, the power developed is used only for the purpose of grinding wood pulp. The installation consists of six units of four 39-inch wheels, each unit direct connected to a battery of four wood-pulp grinders. The wheels are of the "Smith" type, built by the S. Morgan Smith Co., of York, Pennsylvania. At a head of 28 feet, for which the turbines were selected, the manufacturer's rating for each unit of four wheels is 2,011 horse-power, 226 r.p.m. and 782 c.f.s. discharge. The centre of shaft is at elevation 483.0 and the elevation of the bottom of the draft tubes is 461.0. The values of power and discharge given here are 5 per cent. less than those listed on the manufacturer's catalogue, on account of the larger shaft required when four wheels are attached to a single shaft. In operation these wheels generally run at full gate with constant efficiency at all heads, the speed varying with the different heads as given by the manufacturers' catalogue, and the power and discharge being decreased 5 per cent. from the rated values for single turbines. The pressure pumps of each grinder act as governors, since the increasing of the turbine speed increases the pump speed and the pressure against the grinder, with the result of more power being used in grinding the wood. It has been stated that the speed of grinders should not exceed 260 r.p.m. on account of the possibility of the bursting of the grindstones.

On the Canadian side, power is used both for the purpose of grinding wood pulp and for generating electric power. The pulp-grinding installation here consists of five units of four 36-inch wheels, each unit direct connected to a battery of three grinders. The wheels are of the "Smith" type, built by the S. Morgan Smith Co. At a head of 28 feet, the manufacturers' rating for each unit of four wheels is 1,716 horse-power, 244 r.p.m. and 667 c.f.s. discharge. The centre of shaft is at elevation 483.0 and the bottom of draft tube at elevation 460.0. The same conditions of operation as described for the grinders in the American plant are applicable to this installation. The first of the Canadian grinders were operated in June, 1914, the entire present installation being in use by August, 1914.

The hydro-electric portion of the Canadian power house generates electric power principally for the driving of the paper-making machinery and the lighting of the plant, a small block of power being used in lighting the two adjacent towns. This installation consists of four units of four 36-inch wheels, each unit direct connected to a 1,250-k.v.a., 3-phase, 60-cycle, 6,600-volt generator, regulated by improved Lombard governors. The wheels are of the Holyoke type "C", manufactured by the Holyoke Machine Co., of Holyoke, Massachusetts. The manufacturer's rating for each unit of four wheels at a 28-foot head is 1,700 horse-power and 212 r.p.m. The centre of shaft is at elevation 484.0 and the bottom of draft tube at elevation 460.0. The hydro-electric portion of the Canadian power house, together with the American grinders, has been operated since September, 1910.

*From report of Consulting Engineers White and Meyer to International Joint Commission.

WINNIPEG RIVER WATER POWER PLANTS*

The Winnipeg Electric Railway Company's Plant.—The hydro-electric plant of the Winnipeg Electric Railway Company is located on the Pinawa Channel of the Winnipeg River. A very complete account of both the historical and physical features of this plant has been presented in Water Resources Paper No. 3 by Mr. J. T. Johnston, of the Dominion Water Power Branch. This plant was completed in 1906 and during that year furnished the first hydro-electric power used in Winnipeg. The electric power from this plant is used for the purposes of street railway operation, light, heat and power.

The installation at the Winnipeg Electric Railway plant consists of nine main units, each unit consisting of four horizontal inward flow runners mounted in pairs and placed longitudinally in the penstocks. Four of the nine units, each have a manufacturer's rating, at a 39-foot head, of 2,595 horse-power and 200 r.p.m., each unit being direct connected to a 1,000-kw. revolving field, 60-cycle, 3-phase, 2,300-volt generator. The remaining five units each have a manufacturer's rating at a 39-foot head of 4,788 horse-power and 180 r.p.m., each unit being direct connected to a 2,000-kw. revolving field, 60-cycle, 3-phase, 2,300-volt generator. The turbines are equipped with Lombard governors. The generators are guaranteed to operate at full load at 95.5 per cent. efficiency. Excitation is provided by two 100-kw., 125-volt, direct-current machines coupled to two 200-horse-power McCormick turbines, and operating at 600 r.p.m.; and by two 175-kw., 125-volt exciters coupled to 3-phase, 2,300-volt induction motors, operating at 514 r.p.m.

The head available for power purposes at this site varies with the season and the flow, the average head being 39 feet. During the winter, ice conditions have at times caused considerable trouble, resulting in a decrease in available head. A flow of about 8,000 c.f.s. is required to operate this plant under normal head at the full capacity of the present installation.

The power is transmitted to Winnipeg at 60,000 volts, over a 65-mile duplicate transmission line. In Winnipeg this company has an auxiliary plant and storage battery capable of producing 22,000 horse-power, bringing the total power available for distribution in the city up to approximately 45,000 horse-power. During the winter season of peak load, all of the stream and storage battery plant, in addition to the hydro-electric plant, are operated to capacity.

The Winnipeg Municipal Plant.—The hydro-electric plant of the City of Winnipeg is located at the Point du

*From report of Consulting Engineers White and Meyer to International Joint Commission.

Bois Falls of the Winnipeg River, 75 miles in a direct line from Winnipeg. The plans for this plant were begun in the latter part of 1906, but on account of the delay caused by the financial stringency of 1907 the plant was not completed and the initial installation operated until October, 1911.

The original installation, completed in April, 1913, consisted of five main units, each composed of a horizontal, double-runner turbine of 5,200 horse-power which, at a 45-foot head, has a discharge of 1,250 c.f.s., a speed of 164 r.p.m., and a guaranteed efficiency of 84 per cent. at full load. Each turbine unit is direct connected to a 3,000 kw., revolving field, 60-cycle, 3-phase, 6,600-volt generator. The turbines were supplied by Jens, Orten-Boving & Company, London, and the generators by Vickers, Limited, of River Don works, Sheffield. This original installation is completed by two exciter units, each of 250 kw. capacity, driven by water turbines running at 500 r.p.m.

In 1914, three additional main units of different design from the original were installed. These units are also of the double-runner, horizontal shaft type, but of larger capacity than the initial units. Official tests gave an output of 7,220 brake horse-power at 80 per cent. gate opening and 46-foot head, or about 7,000 horse-power for a 45-foot head. The new units are each direct connected to a 5,000 k.v.a. revolving field, 60-cycle, 3-phase, 6,600-volt Westinghouse generator. The installation in 1916 consists of five units of 5,200 horse-power each and three units of 7,000 horse-power each, or a total of 47,000 turbine horse-power. The normal head at the plant is 45 feet. No ice troubles have been experienced thus far during the period of operation.

Assuming that the eight bays in the uncompleted portion of the power house are equipped with units of similar size to those last installed, the station will have a total capacity of 103,000 turbine horse-power. The power is transmitted to Winnipeg at 66,000 volts over a 77-mile transmission line.

Winnipeg River Power Company.—The Winnipeg River Power Company, which is controlled by the same interests as the Winnipeg Electric Railway Company, has under way at the present time (1916) the development of the Du Bonnet site of the Winnipeg River. This site is at a distance of about 80 miles from Winnipeg. As stated in Water Resources Paper No. 3:—

"The station as now designed provides for the ultimate utilization of the entire regulated river flow and will install eight 21,000 horse-power turbines, each running at a speed of 163.3 revolutions per minute, and requiring 4,100 cubic feet of water per second, when operating under a head of 56 feet. These turbines will be of the four-runner horizontal shaft type, and will be placed in pits formed in the concrete substructure."

In October, 1914, a railway 13 miles in length was completed by these interests from the Canadian Pacific line at Lac du Bonnet down to the power site. At the time of the final public hearings before the International Joint Commission at Winnipeg in February, 1916, the plans had been prepared for the beginning of construction whenever conditions for financing the enterprise should become sufficiently favorable.

The largest suction gas plant is in South Africa. It is of 575 brake horse-power capacity and with bituminous South Rand coal of 10,912 B.Th.U's per lb., and containing 60.7 per cent. fixed carbon. the consumption comes out at 1.146 lb. per brake horse-power hour with a low load factor.

CANADIAN RAILWAY ASSOCIATION FOR NATIONAL DEFENCE

An association has been formed along lines corresponding to the American Railway Association's special committee on national defence, better known as the United States Railroads War Board. The new board will be known as the Canadian Railway Association for National Defence, and will have general authority to formulate in detail a policy of operation for all or any of the railways for the co-ordinating of industrial activities toward the prosecution of the war and for rendering the most efficient possible service to the national cause.

The first meeting to consider the formation of the association was held in September last and in response to a request from Sir Henry Drayton that a closer co-operation between the various railways and the common use of rolling stock during the war was most desirable.

Following this meeting, which was attended by representative railroad men, Messrs. Beatty, Gillen, Price and Vaughan went to New York, where they saw the Railroads War Board's secretary, and obtained a large amount of information as to the board's operations. Messrs. Gillen, Price and Vaughan afterwards went on to Washington, where they saw the Commission on Car Service, which works under the Railroads War Board's directions, and obtained information as to its work.

A second meeting was held in Ottawa, October 11th, there being present Hon. J. D. Reid, who had in the meantime succeeded Mr. Cochrane as Minister of Railways, Sir Henry Drayton, Sir George Bury, E. W. Beatty, D. B. Hanna, and U. E. Gillen, the matter being further discussed and a decision arrived at to hold a more general meeting in Montreal.

Another meeting of the association was held in Montreal October 23rd, on which occasion Mr. D. B. Hanna, of the Canadian Northern Railway, presided. At this meeting the following resolution was adopted unanimously:—

That the railways of Canada, realizing the national need of co-ordinating all industrial activities toward the prosecution of the war, and desiring by further co-operation with each other to render the most efficient possible service to the national cause, do hereby agree to establish, for the period of the war, an organization which shall have authority to formulate in detail, and from time to time, a policy of operation of all or any of the railways, which policy, when it is announced by such organization, shall be accepted and made effective by the several managements of the individual railway companies. To that end the following committees shall be established: (1) A committee of four, to be chosen from the chief executive officers of the several railways, to be called "The Special Committee on War and National Defence," which shall have general direction of the said scheme. (2) A committee to be chosen from the vice-presidents and chief operating officers of the railways, composed of seven members, to be called "The Administrative Committee," whose duties shall be to carry out the policies laid down and arrangements made by the Special Committee on War and National Defence. That the Administrative Committee shall have power to appoint sub-committees, who shall have supervision over the following: (i) Passenger transportation; (ii) Freight transportation; (iii) Tariffs and statistics; (iv) Materials and supplies. That a general secretary to both committees shall be appointed, with such duties as shall be assigned to him, together with such staffs as he may require, to be selected by him from the

employees of the several railways. That the expenses incurred in carrying out the arrangements of the above shall be assessed against all railways operating in Canada, on a basis of half the cost in proportion to the mileage operated, and the other half in proportion to gross earnings. This applies to mileage and gross earnings in Canada.

The committees were constituted as follows:—

Special Committee on War and National Defence—Lord Shaughnessy, president, Canadian Pacific; Sir William Mackenzie, president, Canadian Northern; H. G. Kelley, president, Grand Trunk; A. H. Smith, president, New York Central.

Administrative Committee—U. E. Gillen, vice-president, Grand Trunk, chairman; Sir George Bury, vice-president, Canadian Pacific; D. B. Hanna, third vice-president, Canadian Northern; C. A. Hayes, general manager, Eastern Lines, Canadian Government Railways; F. F. Backus, general manager, Toronto, Hamilton & Buffalo; J. H. Walsh, general manager, Quebec Central; E. D. Bronner, vice-president and general manager, Michigan Central.

Car Service Committee—A. Hatton, general superintendent, car service, Canadian Pacific; J. E. Duval, general superintendent, transportation, Grand Trunk; W. A. Kingsland, general superintendent, Quebec Lines, Canadian Northern; W. N. Ripley, superintendent, car service, Canadian Government Railways; A. E. Locke, superintendent, car service, Toronto, Hamilton & Buffalo; W. A. Griffin, superintendent of traffic, Timiskaming & Northern Ontario Railway.

Sub-committees will be established in each province to report to the administrative committee.

W. M. Neale, acting superintendent of car service, Canadian Pacific, Montreal, was appointed secretary of the association and of all its committees.

On Friday, October 19th, before the Toronto Section of the American Institute of Electrical Engineers, Mr. Frank T. Wyman read a paper on "Transformer Design." Sixty members were present and quite an active discussion followed the reading of the paper.

Work on a new underground telephone cable from Washington to New York is now well under way. This cable will contain 80,000 miles of wire, and will be a valuable addition to the existing underground system which provides the national capital with all underground communication with Baltimore, Wilmington, Philadelphia, Trenton, Newark, New York, Bridgeport, New Haven, Hartford, Providence and Boston.

Inquiries have been sent from France to the United States for 96-in. and 74-in. seared plate mills and a 42-in. universal plate mill, to be electrically driven. The specifications include three main mill motors, 100 small motors, shears, roll tables, and from 9 to 15 heating furnaces. Lifting equipment, including 12 electric cranes, having capacities ranging from 10 tons to 50 tons, will probably be bought in Europe. The name of the prospective purchaser, now engaged in the manufacture of ship plates and munitions, has been withheld.

The first Norwegian iron and concrete boat was launched at the Porsgrund Cement Works, Christiania, recently, in the presence of Prime Minister Knudsen. The boat is built entirely on a new system, with the bottom up, from which extraordinary position the launching took place. The underlying sledges glided out with the ship. When the water was reached the hull was detached from the sledges. It gradually sank to a certain point and slowly righted itself. This ship of 200 tons was built in three weeks, but the next will only require about half that time. The frame can be used with each subsequent ship of the same size. It is intended to start wholesale building of iron and concrete boats of from 200 to 500 to 1,000 tons.

SASKATCHEWAN BRANCH OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS PRESENTS PETITION TO PROVINCIAL GOVERNMENT

The Saskatchewan Branch of the Canadian Society of Civil Engineers presented the following resolution to Premier Martin, of Saskatchewan, on October 29th:—

October 29th, 1917.

To the Executive Council of the Government of the Province of Saskatchewan.

Hon. Gentlemen:

This petition is presented by the Saskatchewan Branch of the Canadian Society of Civil Engineers, which includes all members of the society residing in our province.

The Canadian Society of Civil Engineers founded by Royal Charter over thirty years ago, has now a membership of over three thousand, amongst whom are some of the most prominent men in the scientific, industrial and technical world of our Dominion. The educational requirements and the years of experience necessary for qualification to the various grades of membership are the most stringent, insuring utmost efficiency of all members in the particular branch of their profession.

The provinces of Quebec and Manitoba passed legislation in our favor considerable time ago, restricting the term "civil engineer" and the practice of our profession within these provinces to members of our society, and at present a legislative committee of our parent society at Montreal has been nominated to draw up suitable proposals to be submitted for legislation in our Dominion.

Our profession in its manifold branches does not only form an essential, creative factor in our life, carrying and aiding civilization, providing it with its necessities, enabling communications, manufacturing, etc., but the present titanic world struggle might properly be termed a "war of engineers." Mechanical, structural, nautical and the various other branches of engineering are feverishly exercising and straining their inventive and constructive faculties for a supremacy in the three elements—air, land and water.

In Great Britain and the United States the large engineering societies are always consulted before any extensive works are undertaken, and we daresay that considerable waste of public moneys in our various provinces could have been prevented if a similar course of action had been taken.

We beg to put our services at the disposition of the government of this province and hope to be able to cooperate to the fullest extent when called upon.

We would consider it a favor to be consulted in any new legislation touching upon our activities and would be glad to give any information at our disposal, either as a "consulting body" or in an advisory capacity concerning qualifications of members of our profession.

In conclusion, we beg to state that a similar movement in the province of British Columbia has been promised the most earnest consideration on behalf of the executive council of that province.

The committee which presented the petition consisted of Messrs. L. A. Thornton, chairman of the branch; O. W. Smith, past chairman, and J. N. De Stein, secretary-treasurer.

A meeting of the Manitoba Branch of the Canadian Society of Civil Engineers was held in the University of Manitoba, Winnipeg, Thursday, November 1st, when V. J. Melstead read a paper on "The Fixation of Atmospheric Nitrogen."

REPORT OF COMMITTEE ON WATERS AND WATER POWERS*

By Leo G. Denis
Hydro-Electric Engineer, Commission of Conservation.

DURING the year two important reports were published under the direction of the Committee on Waters and Water-powers, namely the reports on the "Waterworks and Sewerage Systems of Canada" and the "Water Powers of Manitoba, Saskatchewan and Alberta."

The report on "Waterworks and Sewerage Systems" is the second edition of this publication, and includes much more detailed and extensive data than the first. The main portion of the report is devoted to physical and financial data of all waterworks and sewerage systems of the Dominion. There are, in addition, a number of tables, summarizing the most salient points extracted from the information contained in the body of the report. Thus, some 528 waterworks and 279 sewerage systems are described in as much detail as space would allow, while the tables reveal data, throwing light on the importance of these systems in Canada. For instance, the 528 waterworks plants represent a capital outlay of nearly $124,000,000, while the 279 sewerage systems have cost over $77,000,000.

Water filtration is being used in connection with many of our domestic water supplies, but not as generally as might be expected; for instance, out of 216 systems obtaining their supply from possibly polluted sources, we find that only 72 have adopted filtration. Most of the unfiltered systems disinfect the supply with hypochlorite, or similar treatment, but this cannot be considered satisfactory, except as a precautionary measure pending installation of filtration. The importance of the gravity system, where the supply is obtained from distant lakes or streams, is also to be noted. There are over one hundred of these systems; among the larger cities thus supplied are Halifax, St. John, N.B., Quebec, Fort William, Calgary, Victoria, Vancouver and New Westminster, while Winnipeg will also soon be included.

Excessive Water Consumption

Excessive water consumption in most of our cities is another important point. The average daily consumption is 111 gallons per capita, while individual centres of fairly large size reach as high as 292 gallons. These figures could unquestionably be lowered; in many municipalities in Great Britain the consumption is as low as 25 gallons, and in but few is it more than 70 gallons per capita.

As stated in the first edition of this report, the pollution of our inland waters by untreated sewage is becoming a serious problem. More than 60 of our inland water systems receive sewage without the least attempt being made to prevent it spreading disease; 180 municipalities contribute to this very undesirable state of affairs. It is to be noted, however, that conditions in this respect are rapidly improving, particularly in the western portions of the Dominion. New sewerage systems have either been constructed with treatment plants, or are being designed and installed with a view to having treatment plants added in the near future, at the minimum expense.

The report on "Water Powers of Manitoba, Saskatchewan and Alberta" was published during the latter part of the year, its publication having been delayed to allow of the inclusion of later data which had become available, thus adding greatly to the value of the report, and bringing it up to date. This additional information was obtained principally through the Water Power and Irrigation branches of the Department of the Interior, the organizations charged with the administration of water power and irrigation, respectively, in the Prairie Provinces.

The report contains a complete compendium of all available information on the subject and will prove most useful as a reference book, especially to anyone contemplating the development of, or who is, otherwise, interested in, water-powers in this portion of the Dominion. An important fact brought out is that, while portions of the territory in the south are deficient in water-powers, the northern portions abound in this very desirable natural resource, and the information contained in this report should correct the erroneous opinion sometimes expressed that similar conditions obtain in the north as are found in some of the better-known portions of the provinces.

With the publication of the report, now in press, Mr. A. V. White, on "Water Powers of British Columbia," complete preliminary information on the importance and possibilities of even our remotest water-powers will have become available, while, from accompanying maps, the position of each power may be ascertained. This survey was of great importance, one of its principal objects being to pave the way to further and more detailed investigations of these natural resources.

In this connection it is gratifying to note that the measures which the Commission of Conservation has consistently urged since its creation, relative to the disposal of water-powers by the Crown, to stream flow and to other investigations regarding them, are enforced and being practised in almost every province.

Nova Scotia, in 1914, appointed the Nova Scotia Water-Power Commission, with power to make regulations regarding the disposal and administration of water-powers. The commission has been very active during the past two years in systematic investigations of detailed power possibilities, and in the establishment of stream gauging stations, this work being carried on in co-operation with the Dominion Water Power Branch, Department of Interior.

It is expected that similar action will shortly be taken by New Brunswick.

In Quebec the government has two organizations working in co-operation in connection with its water-powers. The Hydraulic Branch of the Department of Lands and Forests has charge of leasing and administering them, while the Quebec Streams Commission, organized in 1912, is actively pursuing water-power investigations and undertaking important conservation storage projects, such as at La Loutre, on the St. Maurice, the third largest in the world, as well as on the St. Francis and other rivers. Regulations for the disposal of water-powers in Quebec are now adequate, and the emphyteutic, or conditional long term, license given for periods of from 25 to 99 years, assures development within a limited time under government supervision and provides for a fair remuneration to the Crown, thus encouraging bona fide projects.

Ontario was one of the first provinces to undertake proper regulation and administration of its water-powers. The administration, which comes under the jurisdiction

*From Eighth Annual Report, 1917, by the Commission of Conservation, Canada.

of the Minister of Lands, Forests and Mines, as well as investigations in connection with these, is in the hands of the Hydro-Electric Power Commission of Ontario, created in 1906, and the regulations for granting water-power privileges embody strict conditions, limiting licenses to 20 years, and provide for approval of plans, also government supervision of development, which must be completed within a limited time and, if necessary, later, extended to satisfy public demand. This Commission is very active in its investigations regarding undeveloped power, and, according to its last report, has 69 regular stream measurement stations and many other temporary ones. Besides this work, the Hydro-Electric Power Commission has followed its primary object with excellent results, namely, to serve as a medium, both physically and otherwise, between interests generating hydro-electric energy and the users or municipalities. Upward of 200 of the latter are now supplied with electric energy through the Commission, for which purpose, extensive electric transmission lines have been constructed.

In the Prairie Provinces, water-powers are under Federal control, and the Department of the Interior both administers and conducts investigations in connection with these. All water-powers are licensed for a term of 21 years, which is renewable for three further similar periods with certain readjustments, while development within specified time is provided for and further assured by having an agreement for the period of construction and granting the license proper only after completion of work to the satisfaction of the Minister. Investigation work, surveys and explorations are being pursued in connection with the northern water-powers, while detailed surveys of some of the large rivers in the south have permitted elaborate plans and estimates to be prepared in connection with possible water-power development. Numerous stream measurement stations have been established, and surveys and other investigations in connection with irrigation are also included.

The water-powers of British Columbia are under the control of the Provincial Department of Lands, through its Water Rights branch, and are administered under the Water Act of 1914. The latter provides for the disposal of water-powers by license, with fair annual rental, the latter being readjusted every five years, also, for the approval of plans and the completion of works within limited time. The Water Rights branch also pursues systematic investigations and reconnaissance surveys. The more accessible portions of the province are being thoroughly covered, while upward of 200 regular stream measurement stations have been established in connection with the work.

This work should be further encouraged and extended, as the proper and intelligent disposal, administration, utilization and conservation of our water-powers can only be expected after thorough investigations and surveys, which should be undertaken by the various government organizations interested, and not left to private parties, as has often been the case in the past.

Stream Flow and Level Variation

A commencement has been made at collecting stream flow and level variation. These data, which are otherwise not available, are mostly being obtained by correspondence with operating hydraulic plants, or with private parties. The province of Quebec has practically all been covered, and the results are very encouraging. The correspondents appreciate the value of the work, and companies and individuals keeping records have willingly gone to considerable trouble to supply the desired information, while others have expressed a wish to co-operate in keeping future records. In this connection, studies of the flow of the St. Lawrence River were also undertaken and have progressed satisfactorily.

As an outcome of the power survey recently undertaken by the Commission, it has been found advisable to obtain additional and more detailed descriptive information, respecting the electric power plants throughout the Dominion. The importance which electric energy has at present, and, in the near future, will have in the industrial development of Canada is appreciated. While this is particularly true of hydro-electric energy, steam, gas and oil operated electric plants also offer special interest with regard to power conditions. These latter plants are usually of large size, and, as the question of economical production of power is the principal item, they can usually be taken as a criterion, so far as power conditions are concerned. The additional data are being obtained by correspondence, and, when complete, will prove of much value.

Many articles and short reports have been supplied during the year, either on our own initiative, or in answer to special requests. The various subjects include summary reports on the water-powers of the province of Quebec and of the Prairie Provinces, developed and undeveloped water-powers in Canada, water-power regulations, water-power conditions at Sault Ste. Marie, water supply and sewerage situation in Canada, floods, electric heating and the industrial importance of our water-powers.

Shortage of Power

One of the most important considerations in many portions of the Dominion during the past year has been that of need of additional power. This has been particularly emphasized in the Niagara district, where the principal cause may be attributed to the enormous quantity exported. Other indications are the permission for the full diversion of the St. Mary River (Sault Ste. Marie) at its minimum flow and the recent statement of one of the officials of the Shawinigan Company which supplies power to Montreal from its plant on the St. Maurice, that they were taxed to their full extent, with heavier demands still being made. In the above, as well as in other cases which could be cited, it is noteworthy that, where the supply is not equal to the demand, this condition has usually been brought about, not through actual lack of water-power, but more frequently through the improper timing of improvements, extensions and new developments; instead of keeping ahead of the demand, the hydro-electric companies have allowed themselves to be overtaken by it. The large amount of power required by munition factories is an important factor in the increased requirements, but other industries are also large buyers of energy.

Water Diversion

Closely allied with the power shortage at Niagara, as well as at all water-powers of the St. Lawrence, is the question of water diversion through the Chicago Sanitary Canal. One feature, which has perhaps not been sufficiently emphasized in connection with this scheme, has been forcibly brought out in recently published figures respecting the power plant, which evidently is a very important factor of the project. The figures show that the disposal of sewage is only a secondary consideration, when compared with the financial aspect of the hydro-electric power development. This is further accentuated

by the fact that the estimated profits from the extensions now under construction would be about 100 per cent. Figures showing the growth of the power plant give 15,278 h.p., with earnings of $130,936 for the year 1908, while, in 1915, these figures had reached 55,640 h.p. and $932,566, respectively. Although the authorized diversion is but 4.167 cubic feet per second, it is notorious that about 8,000 cubic feet per second is actually flowing through the Chicago River.

LINING AN IRRIGATION CANAL WITH GUNITE

SEVERAL years ago D. C. Wheeler, Inc., stock-growers and ranchers at Reno, Nevada, erected a wooden bench flume for irrigation purposes. After serving its purpose it was discovered a short time ago that the cost of keeping it in repair and the loss of water

Fig. 1.—Showing Retaining Wall on Downhill Side of Canal

consequent upon leaks was becoming quite a serious source of expense.

This flume has now been replaced by a form of construction which is fully illustrated herewith, and which has solved the problem so far as that part of the canal system is concerned.

The new ditch is about four thousand feet long, and is all of the same character as shown in the photographs.

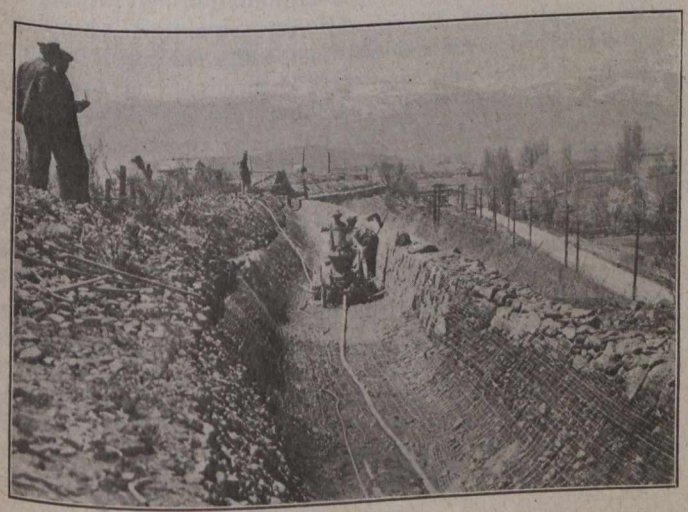


Fig. 2.—Reinforcing in Place Ready for Gunite

The cross-section is five feet wide at bottom, from eight to ten feet wide at the top, with an average depth of four feet.

After the wooden flume which had been in use for many years had been dismantled levelling was done and the bottom and bank side trimmed to grade.

The ditch, it will be seen, runs along the side of a hill. The wall on the lower side was built of boulders and rock taken from the side of the hill, laid up dry in most of the length, mortar only being used in a few places where the

Fig. 3.—Shooting Gunite

wall is quite high and thick enough to form a gravity section retaining wall, as shown in Fig. 1.

For reinforcing fencing No. 11 wire was used throughout. This was placed on the bottom and sides with end and side joints thoroughly lapped and wired. (See Fig. 2.) After the reinforcing was placed the gunite was shot to a thickness of two inches on the bottom and uphill side of the ditch, while on the wall the open joints were shot full inside and out and to a thickness of about half an inch over the reinforcing. (See Fig. 3.) No reinforcing was used on the outside of the wall.

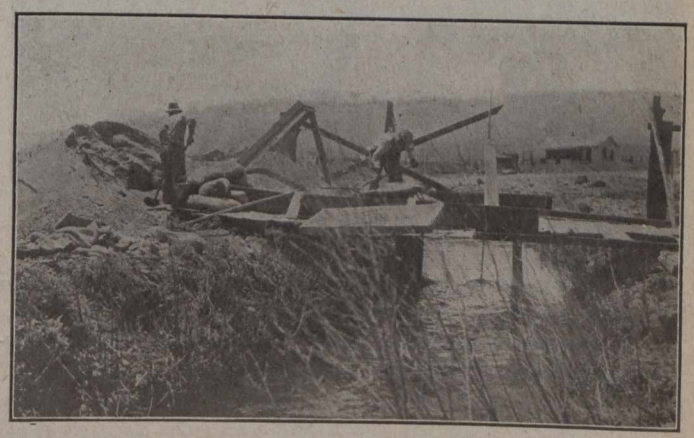


Fig. 4.—Mixing Plant

Sand had to be hauled a considerable distance and was delivered on the hill above the ditch. Another canal parallels the south side canal a short distance above it and about the crest of the hill. This made it necessary to mix the material above the upper canal and chute it across to a hopper located over the canal which was being lined and from where it was brought to the gun in wheel-

barrows. This arrangement is shown in Figs. 4 and 5. All sand was put through a half-inch mesh screen.

After the cement-gun got under way progress was made at the rate of three to four thousand square feet of lining per day.

During the past irrigating season, water has been in the canal constantly. The saving of water is strikingly

Fig. 5.—Loading Wheelbarrow from Hoppers

evidenced by the withering of all the weed and willow growth which had previously been quite dense on the hillside below the flume.

Despite the fact that the gunite was placed without expansion joints there are no apparent leaks or cracks in the lining.

The cement-gun used was the standard N-Z size made by the Cement-Gun Co. and the compressor was a port-

Fig. 6.—Showing Finished Canal Ready for Filling

able 8¾-in. x 12-in. direct connected fuel-oil-driven machine.

The work was done by the Nevada Gunite Manufacturing and Construction Co.

Of the two large drydocks to be built at either end of the Panama Canal, the one at Balboa is to be the largest. This dock will be 1,000 ft. long, the entrance width will be 110 ft., and at mean low water the depth over the keel blocks will be 29.3 ft. The structure will be of concrete, and the entrance will be closed by mitre gates. Here it will be possible to repair the largest vessels afloat, as the main repair shops in the canal are also situated at Balboa. This dock is to be completed late in 1917. The dock that will be built at Cristobal, on the Atlantic side of the canal, is to be started very shortly, and will be 300 ft. long.

A SANITARY INTERPRETATION OF WATER ANALYSIS*

By E. C. Richardson

A SANITARY analysis of a water is made along two distinct lines, bacteriological and chemical. The former attempts to show the presence or absence of sewage contamination through the finding of living bacteria that are characteristic of sewage. A sanitary chemical analysis, on the other hand, does not consider living bacteria, but attempts to show by the presence or proportion of certain chemical substances that sewage has found entrance into a water supply.

The usual kind of germs found in water are non-pathogenic—those which will not produce disease. The constituents of sewage-contaminated water that are directly detrimental to human safety are the pathogenic microbes of some infectious disease. The detection of such microbes in a water supply is the most direct evidence of the unfitness of such water for human consumption.

All sewage and sewage-contaminated water, however, contains the wastes from human bodies, and such wastes are almost sure, sooner or later, to contain the bacteria of infectious disease. For this reason most of the bacteriological examination is directed toward detecting microbes that normally inhabit the intestine instead of detecting those of specific disease. This is a safe procedure, since water-borne diseases, such as typhoid, dysentery and cholera, have their seat of activity in the intestines.

Organisms of these diseases come from persons specifically affected, hence there is more or less uncertainty attending the search for such bacteria, unless there is an epidemic. Normal intestinal bacteria serving as a basis for the detection of sewage contamination are those belonging to the Bacillus Coli group. Its presence in water is indicative of pollution, but to be sure of pollution by sewage its abundance rather than its mere presence must be considered as the criterion. The test for Bacillus Coli, in order to be of definite value, therefore, must be not only qualitative but quantitative.

Single isolated determinations of the number of bacteria in surface water are of little value, unless accompanied by a full knowledge of the conditions under which the sample was collected, since rainfall, streamflow, wind and many other factors materially influence the number of organisms present. A single examination may, therefore, lead to erroneous interpretations. Sometimes, however, it may afford some evidence as to the sanitary character of the water; and scattered determinations are often useful in showing the relative character at different times, of water obtained from any particular source. Quantitative bacterial determinations are of special value as affording the best index of the efficiency of filtration. Here each separate test is of some importance.

In the collection of samples of water to be analyzed great care should be exercised in securing a characteristic sample, since it is only by the utmost care in all steps leading to a final interpretation that error can be reduced to a minimum. The sample bottles should be sterilized and care should be exercised to avoid bringing the hand or other objects against the parts of the bottles which come into contact with the water. Hold the stopper by the handle when collecting a sample. Do not lay it down.

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*Journal of the Cleveland Engineering Society.

Unstopper the bottles only when ready to put the water in and stopper them immediately afterward.

In collecting a sample from a pump, use the pump for at least three minutes just before sampling, taking care that the waste water is carried to a distance so that it will not wash back into the well or cistern. Collect the water directly into the bottle.

In collecting a sample from a bucket, draw up three or four buckets of water and allow the water to waste, using care that the waste water does not wash back into the well. Pour from the bucket directly into the bottle. In collecting samples from a faucet, allow the water to run at least three minutes, then collect the sample directly into the bottle. In collecting samples from a reservoir, lake or river, hold the bottle by the bottom and plunge its mouth downward into the water to a depth of about six inches; then turn it horizontally, and as it fills move the bottle mouth forward and then upward. In other words, do not let the washings from the hand enter the bottle. The samples should be packed in ice and shipped to the laboratory as soon as possible.

Equal care should be exercised in collecting chemical samples as in collecting water for bacteriological examination.

The chemical determinations that in general constitute a sanitary chemical analysis are: the amount and character of suspended matter, oxygen consumed, oxygen dissolved, nitrogen as albuminoid ammonia, nitrogen as free ammonia, nitrogen as nitrites, nitrogen as nitrates, and chlorine. The results are expressed in parts of the substance determined in a million parts of water.

The object of these determinations is to find out whether organic material from sewage has gained entrance to the source from which the supply of water is drawn. Organic matter of this kind is readily acted upon by bacteria, and during the decomposition, compounds are formed which can be identified and determined with accuracy by chemical methods. The decomposition products of nitrogen containing organic matter are the ones that can be determined most accurately. Nitrogen in albumin-like compounds (or that which is liberated by alkaline potassium permanganate), indicates the presence or absence of the undecomposed animal or vegetable matter containing proteins. Any abnormal amount of these compounds shows the water is polluted.

Nitrogen as free ammonia in any considerable quantity shows that bacterial action on the protein compounds has been carried a step farther, and that ammonia compounds of urea are present. Nitrogen as nitrites yields the information that the bacterial process has gone a step farther, and that oxidation of the nitrogen is taking place. Nitrogen as nitrates shows that the organic material has been completely transformed to a mineral salt which is relatively stable. On the Atlantic coast the chlorine determination is of great value as an indicator of contamination by animal excrement, for every district has a normal value for chlorine. Any excess over this normal amount shows that the water is receiving drainage which probably contains urine. The determination is of little value in the middle west on account of the salt beds underlying the country.

The oxygen consumed tells us how much oxygen is necessary to completely oxidize any undecomposed organic matter.

It may be stated that it is only by comparison with the every-day results that the contamination of water may be determined. The quality of water has generally been judged by the degree of sparkle, of turbidity, of temperature, and since the introduction of soap, of hardness. These standards have their value, but they are considered by sanitarians to be superficial criteria for determining wholesomeness. Water may be hard, warm, flat and turbid and yet be safe to drink; it may also be soft, cold, clear and sparkling and still carry infection.

Wholesomeness depends upon comparative absence of salts and organic matter, deleterious to health. Injurious salts, while inducing disturbances of a more or less discomforting nature, even causing permanent injury if long continued, do not create such serious consequences as polluting organic matter, especially if this takes the form of pathogenic micro-organisms.

Analytical determinations which relate to the general attractiveness of water are those of taste, odor, color, turbidity and sediment. As these quantities increase the water becomes less attractive for drinking purposes until finally a point is reached where people refuse to drink it. For this, however, a personal element enters. Some people drink a water with relish, while others condemn it. Habit and association have much to do with this.

When it comes to using water for other purposes than for drinking, other attributes have to be considered. Hardness makes a water troublesome to wash with and to use in boilers; iron makes trouble in the laundry; chlorine corrodes pipes and makes work for plumbers; presence of carbonates and sulphates of lime and magnesium affects the paper maker, the brewer, the tanner, the dyer, and the bleacher.

The inconveniences of the use of hard waters are perhaps more important than the money loss involved. In using hard waters for washing the hands and for bathing, the calcium and magnesium stearates are precipitated by the soap and give rise to unsightly scums in the wash bowl and bath tub. They tend to fill the pores of the skin, preventing a thorough cleansing. They also prevent the formation of a good lather in shaving. For culinary operations such as in making tea, hard waters are less satisfactory than soft waters, as they increase the color but decrease the aroma.

The point at which a water becomes objectionably hard has never been exactly defined. The ordinary person washing his hands considers the water soft if the soap will quickly produce suds without curdling. A hardness of 10 parts per million is practically unnoticeable, a hardness of 20 to 30 parts per million being required to produce curdling. Waters which have a hardness below 25 parts per million seldom cause much inconvenience, but when the hardness rises above 50 the water may well be called hard and above 100, very hard. In Kansas a hardness of over 300, which is excessive hardness, is often found. Experiment shows that the hardness of water has a substantial effect on the use of soap. Tests made by G. C. Whipple, in 1903, showed that one pound of the average soap softens 167 gallons of water having a hardness of 20 parts per million. This is equivalent to about three tons of soap per million gallons. It was also found that for every increase of one part per million of hardness the cost of soap increased about $10 for each million gallons of water completely softened. Number of gallons per capita per day completely softened has been estimated by different authorities all the way from 1 to 10. It will certainly be a conservative estimate to assume that one gallon per capita per day is thus softened. On this basis the depreciation of water on account of its hardness may be expressed by the formula $D = H/10$ where D is depreciation in dollars per million gallons, and H the hardness of the water in parts per million. Applying this formula

to a hardness of 112, which I believe is about the hardness of Cleveland water, will give depreciation in dollars per million gallons as $11.20; this takes into account only the cost of soap used for domestic purposes and does not include the incidental losses and inconveniences attendant upon the use of hard water in households. These, if they could be expressed in terms of dollars and cents, would probably more than equal the cost of soap.

In most surface waters the physical characteristics vary greatly at different times of the year. During the spring and fall, for instance, the color and turbidity may be high on account of rains, while during the summer the water may have a bad odor due to microscopic organisms.

In Cleveland, during the spring the death rate due to typhoid fever increases rapidly. It was found upon investigation that when the ice breaks up along the lake front it carries contamination with it out to the intake pipes. So the sanitary characteristics of a water may vary at different seasons of the year.

The average man, when confronted with an adverse analysis of his water supply, is likely to be surprised, declaring that it is the best water in the country and that it has been used for years without producing sickness. Granting that he be right, immunity in the past is no guaranty for the present or the future. Some connection may have been established between the well and outhouse or the cesspool, and apparently he has not happened to harbor a typhoid-infected person on the premises. Nothing is needed but the carrier of the specific organism to begin trouble.

Rural water supply is generally obtained from springs, wells, or cisterns. From a sanitary standpoint, springs and deep wells, deep in the sense of entering below the first impervious stratum, are the most reliable sources. The usual excellence of these, and, in fact, of all good ground water, is largely due to the filtering property of the soil. Springs, especially those flowing through fissures, and deep wells, reap the benefit of prolonged filtration through the earth. Both may be subject to contamination, particularly springs, which are often open to surface washings from sewage drains and the like, located farther up the slope. Hence it is advisable to inspect the watershed above a spring; also to guard it from the surface washings by a wall or ditch.

Driven wells and dug wells reach only to ground water, differing in this respect from many springs and all deep wells. Their shallowness brings them at times into proximity to drainage from privy vaults, cesspools, or leaky drains, and anyone sinking a well near these sources of filth must rely upon the filtering action of the soil to remove pathogenic bacteria. The filtering efficiency of the soil, in serving to protect wells from contamination, depends upon such factors as the extent and the nature of the intervening soil and also upon the direction of the ground water drainage.

The distance that should exist between a well and a source of pollution is, because of these, so variable that probably no definite rule would be trustworthy in all localities, other than the greater the distance the better. The course of ground water drainage toward its natural outlet affects the liability of a well to pollution. While it usually follows the direction of the superficial slope, it may take a different route, owing to peculiar sub-soil formation. Therefore, while it is better to locate a well on higher ground than a cesspool or outhouse, it is also prudent to have some distance intervening as an additional precaution.

A well-known principle of sanitary science is that of protecting wells against chance of pollution from surface drainage or infiltration. By proper construction and location of a well there is little danger of contaminating the well unless the ground water itself be polluted by larger sources than privy or cesspool.

Finally, it may be said that the maintenance of a wholesome water supply of any kind requires constant attention. To dig a hole to water anywhere, and expect good results forever afterward is unreasonable. With the exercise of common sense, based on the knowledge of ordinary sanitary principles, a person should live in comparative security from water-borne disease.

WHY THE VICTORY LOAN IS AN EXCELLENT INVESTMENT

1. **Security of principal.**—The wealth of Canada is back of the bonds issued by the government. Since the present organization of the Dominion in 1867 no debts have ever been repudiated. The money borrowed has always been repaid.

2. **Security of income.**—The return upon the principal invested is the income or interest. The interest on these bonds is a part of the government's expense. Should the power of our government fail, not even cash would be of value, so high is Canada's standing.

3. **Fair income return.**—The income will probably be about 5½ per cent., which for such high-grade security is an excellent return. In addition the bonds are likely to bear the privilege of convertibility into a higher rate of interest if the government has to borrow more money at a higher rate.

4. **Marketability.**—The Canadian war loan bonds are active in the open market. Those offered for sale find a purchaser more quickly than any other securities. Bond houses and banks handle them as readily as cash. These bonds can be sold at any time throughout the country.

5. **Value as collateral.**—They have the greatest value as collateral of any security, because the credit of the Canadian government ranks with that of the leading nations. Banks or individuals will readily loan money on such security.

6. **Tax exemption.**—The government bonds of our Victory Loan, to be issued next month, will probably be exempt from federal income tax, as was the case with the three war loans issued previously.

7. **Freedom from care.**—Bonds can be registered in the name of the holder and the interest thereon will be sent them every six months direct from the government.

8. **Acceptable duration.**—The period of time over which a loan continues will be in the case of the Victory loan bonds of great advantage. Both long and short-term bonds are likely to be offered.

9. **Acceptable denomination.**—The bonds will be issued in denominations to meet the requirements of small and large investors.

10. **Potential appreciation.**—There is every reason to believe that Canada's Victory Loan bonds will increase in value after the war is over, to judge by the fact that in the past war bonds did increase in value at the close of the war. In the event of the war ending within a short time these bonds would increase in value because of certain tax exemptions. Therefore people of wealth will want to invest in them and small holders will probably be able to sell at a profit. In the event of the continuation of the war over a long period a higher rate of interest will have to be paid, and this maintains the value of the bond.

WATER PURIFICATION IN WAR TIME*

By George A. Johnson
Consulting Hydraulic Engineer, New York.

IT is vitally important that the health and well-being of our body politic shall be promoted to the utmost during these days of supreme trial, for while those who go to battle are the bulwarks behind which we hope to live on in liberty, in happiness and in peace, upon our national prosperity must those who fight our physical battles depend. We must grow more food; our industries must produce more and better goods; our natural resources must be drawn upon to a greater extent than ever before; our inventive minds must be developed, sharpened and whipped to greater accomplishments. In this way we who remain behind the battle-fronts may best help those who risk their all for us, and we can fulfil our duty best when we care for our health, that the results of our endeavors may be a fair measure of our maximum abilities.

What part in the conservation of the public health is played by water purification? A big one; a tremendously big one.

The vast majority consume their drinking water without a thought of whether it is pure or impure, but more or less unconsciously fulfil a natural impulse for moist refreshment to repair the depleted mucous membranes, and as an occasional liquid piston to force sundry bites of solid food into the stomach.

Water is something we all must have. When we discover goods which do not agree with us we eliminate them from our menus, sometimes, but pure water has no effect but for good on anyone. Impure food touches only a part of a community. Impure water reaches all. Impure foods ofttimes bear sensible red flags of danger which warn the prospective consumer against them, but impure water may be served in the guise of cleanliness, and in its crystal, wholesome appearance be consumed with entire confidence and still be heavily charged with the harbingers of disease and death.

Our forefathers obtained their drinking water supplies from shallow wells and springs, as many communities do to-day. Only as a last resort did they go to the nearest stream. This was not because they thought the waters from such sources were dangerous—for they knew nothing of the typhoid germ; in fact, none of us knew anything about it thirty years ago—but for the far simpler reason that spring and well waters usually are not only clear, but cool.

As communities grew in size such primitive water-works as had sufficed in the past were outgrown, and the public waters, lakes, ponds and rivers were drawn upon more largely. There was enough typhoid in those days, anyway, which came from other sources, but with the more general use of contaminated public waters sharp and widespread epidemics of typhoid fever occurred, and the score of endemic typhoid was greatly enlarged. As the population increased these waters received more and more pollution, but the germ theory of disease had not yet been established and the public paid a heavy debt to convenience in water-borne disease.

Slowly but surely people began to realize that rapid growth in population could only be followed by a corresponding increase in the pollution of the lakes and rivers of the country from which the bulk of public water supplies are drawn. With increasing pollution of the public water supplies must come increasing sickness and death unless those supplies are purified before use. And so the practice of filtering the water supplies of our cities and towns began to grow rapidly, the decision to adopt filtration being hastened by the increasing death toll from that commonest of water-borne diseases, typhoid fever, and by the profitable example of such communities as were wise enough to adopt filtration, and thereafter show a marked minimization in their death rates from water-borne diseases.

There is, of course, no precise way in which the influence of municipal water purification on the public health can be shown. Analogical reasoning, based upon the proportion of our population using filtered water and the typhoid fever death rates in different periods, gives us a pretty firm footing for the statement that water purification has been the most potent agency in cutting down the tremendously high typhoid toll of years ago to the fairly reasonable figure which exists to-day. We know that the introduction of water filters in a city whose water supply is polluted will reduce the death rate from typhoid fever by close to 75 per cent. We also know that for every death from typhoid fever thus saved at least two deaths from other causes are avoided. The records are plain on these points.

Water purification works, well-built and efficiently operated serve as an infallible prophylactic against water-borne disease. In war time, they are more than ever necessary, yet the high cost of labor and building materials, ranging from 50 to 150 per cent. in excess of the normal, seems to dull the minds of some city officials to their need. Pure water is always worth far more than was ever paid for it. Before the war the average cost of furnishing filtered water in large and small cities was about 40 cents per capita per annum. Let us say, for the sake of argument, that it is now $1. In a city of 100,000 population it is necessary to save but seven lives from typhoid fever, and the some fourteen other lives that are coincidently saved from death from other causes, in order to break even on the cost of pure water.

*From an address delivered before the Annual Convention of the New Jersey Utilities Association, October 26, 1917.

The output of coal in France during the first half of this year was 13,105,019 metric tons, as against 10,626,544 tons last year. The monthly output will probably soon reach 2½ million tons, which will make this year's output rise to about 28 million tons, as against about 20 million tons last year. About 40 per cent. of the total output has been produced in the Pas-de-Calais.

The production of finished steel in Great Britain in 1916 is reported by the Iron and Steel Federation as follows:—Bloom, billets and rods, 1,945,000; sheet bars, 1,272,000; rails, 271,000; plates, 1,153,000; sheets, 78,000; shapes and angles, 757,000; beams and girders, 346,000; galvanized sheets, 132,000; tin plates, 577,000; total, 6,531,000 gross tons. The production of steel castings was 207,000 tons, of which 18,000 tons were made in electric furnaces. The production of wrought iron was 960,000 tons.

In connection with the recent celebration of the four hundred and twentieth anniversary of the discovery of Newfoundland, it may be observed that this country's railway system starts at St. Johns, and proceeds due north, parallel with the western coast, and then turns south-west and ends at Port aux Basques, a distance of 546 miles. In 1875 a survey was made for a more direct railway between these points which would have reduced the distance to about 300 miles. From Port aux Basques to Sydney, at the head of the railway system in Cape Breton, the distance is 103 miles. From Port aux Basques to Aspey, in the north-west corner of Cape Breton, but without railway accommodation, the distance is but 67 miles. Across Canso Straits, from the southern end of Cape Breton to Nova Scotia, there is a train ferry.

Letter to the Editor

Specifications for Asphalt Paving; Alternates for Native and Oil Asphalts

Sir,—A circular copy of a letter addressed to Mr. Frank P. Smith, chairman of the sub-committee on asphalt paving of the American Society of Municipal Improvements, by Mr. C. N. Forrest, chief chemist of the Barber Asphalt Paving Company, under date of September 25th, 1917, has recently been forwarded to members of the American Society. This letter makes the proposal that the society so amend its standard specifications for asphalt paving as to differentiate between the native asphalts and the oil asphalts; to which proposal we are most emphatically opposed, and our objections are stated below:

Mr. Forrest advances several reasons for urging the amendments that he proposes, and these we may take up separately, as follows:

First—"To differentiate sharply between the two kinds of asphalt available for sheet asphalt, *viz.*, native asphalts and oil asphalts."

Reply—We do not know of any difference or differences between the hard crudes or native asphalts and the soft crudes or oil asphalts, of sufficient interest to the paving industry from the viewpoint of quality in the resulting asphalt cements, to make it either necessary or desirable to divide asphalt pavements into two classes along this line. The native asphalts must be manufactured into paving cements by refining and fluxing; while the oil asphalts may be so manufactured by refining only. No reason has yet been advanced that convinces us a pavement properly laid of one class of material will last longer or give better service than a pavement properly made from material of the other class.

Second—"To identify, for purposes of record, the kind of asphalt entering into any specific piece of pavement."

Reply—Materials may be identified, for the purpose of record, in other and more desirable ways. The contractor should be required to furnish the asphalt cement manufacturer's certificate of materials and methods; and the city should reserve to itself the right to inspect both the manufacturing plant and its manufacturing records. The sample submitted at the time of bidding, or directly after, should be carefully tested and all shipments checked against such tests. Careful municipal records, showing gradings of aggregate, bitumen content, temperatures, etc., should be kept. These things will make a real record, while the specifying of a given type of asphalt will not even prove that the type specified was used in the pavement. A specification is not a record of work executed, but of work proposed to be done. It establishes promises, not accomplishments.

Third—"To permit municipalities to select the kind of asphalt which, in the judgment of their officials, is best suited for the type of improvement under consideration."

Reply—Standard specifications, we believe, are an attempt to get away from the condition where the officials of each city had to select the kinds of asphalt that, in their judgment, were best suited for the type of improvement under consideration. Most such officials have no proper facts upon which to base such a judgment, and we know only too well how often such judgments are even now based upon improper facts. The differentiating specifications suggested would make the course of the latter judgments easier to travel by seeming to have the justification of the American Society; where, at present, the official adopting preferential or monopoly-creating specifications has his own explaining to do.

Fourth—"To prevent condemnation of asphalt pavements as a type because of the failure of an unrecorded kind of asphalt to function satisfactorily."

"Reply—As a real record of the asphalt used in a given pavement can be easily kept otherwise, as a specification is not a real record of what actually went into a pavement, and as pavements improperly laid with both types of asphaltic material have already scored discreditable failures in some instances, we see no merit in the fourth reason advanced for the adoption of specifications differentiating pavements to be made with native and with oil asphalts.

Fifth—"To meet the existing demand of many municipalities preferring specifications which differentiate between native and oil asphalts."

Reply—We do not know of any legitimate demand now being made for specifications differentiating native from oil asphalts. Except for clever promotion work, probably no such demand would exist at all. If some of those city officials now clamoring for differentiating specifications would consult an independent asphalt paving chemist and engineer, instead of dependent salesmen, to find out what is wrong with their pavements, the cities for which they work would probably receive some material benefit, both in the quality and the economy of future work.

Mr. Forrest states that "it is well known that there are several essential points of difference between the native and oil asphalts which can not be covered in a blanket specification for both kinds." We do not know several such points that are essential to a degree that would justify the society in adopting specifications differentiating asphalts along the lines suggested, and we presume there are others quite as ill-informed as ourselves. Therefore, we would request that Mr. Forrest state in detail the points he has in mind and the reasons they are essential in the degree claimed. Coming from Mr. Forrest, we shall at least be certain our time will not be wasted in arguments that are merely selling talk; the society is entitled to something more.

Specifications of the blanket type are always unsatisfactory at the best; but why differentiate along the lines of native and oil asphalts? Also, would a blanket specification covering either all the native asphalts or all the oil asphalts be any more satisfactory? It would be more logical, considering the public's point of view, to draw a specification for each one of each type of the asphalts, though at present this does not seem desirable.

C. A. MULLEN,
Director of Paving Dept.,
Milton Hersey Co., Ltd.

Montreal, P.Q., October 29th, 1917.

In more than one respect coal is the most important mineral mined in India. It gives direct employment to about 180,000 persons, its value at the place of consumption in India or the port of export is greater than that of all the other minerals taken together, and nearly the whole quantity is used in industrial processes in the country, exports to places outside India being for the last six years under 5 per cent. Practically every industry in India is dependent upon coal for the production of power.

BOARD OF ENGINEERS REPORT AGAINST HYDRO RADIALS

DURING the latter part of the year 1916 a great deal of discussion took place in Hamilton over the proposal to construct a Hydro-Electric railway from Port Credit through Hamilton to St. Catharines, as part of a through electric radial railway system from Toronto to the Niagara frontier. A by-law was submitted to the ratepayers in January last, and defeated. The discussion, however, kept up. A number of Hamilton citizens, not satisfied with the information which had been given out by the advocates of the scheme, met and decided to get the desired information for themselves, and with that end in view, wrote to the Toronto branch of the Canadian Society of Civil Engineers requesting that a board of engineers be appointed to report on the matter.

The request of these citizens was conceded to and five eminent engineers were appointed, *viz.*, Sir John Kennedy, W. F. Tye, Lieut.-Col. R. W. Leonard, L. A. Herdt and Walter J. Francis. The board appointed Mr. Leonard chairman and Mr. Francis secretary.

The following are extracts from the completed report of the board of engineers, which is in the form of a letter, and is now in the possession of C. W. Cartwright, chairman of the citizens' committee of Hamilton:—

Public Necessity.—The first specific feature in the letter is the determination of the public necessity for the proposed Port Credit-St. Catharines line. Your board finds that no public necessity exists for the construction of the proposed line, because the particular district is at the present time thoroughly well provided with steam, electric and water transportation facilities; because the province, of which the district forms a part, is also amply provided with transportation facilities, and because the number of transportation companies already operating in the district makes it quite unnecessary to inaugurate a new and distinct system.

Operating Revenue, Fixed Charges and Operating Expenses, and Extension to the Frantier.—The second, third and fourth specific features in the letter refer to financial matters. A request is made for the estimated operating revenue based on the conditions in the territory to be served by the proposed lines; the estimated annual fixed charges and operating expenses based on the estimated cost as stated by the commission, $11,360,363, and an estimate of the cost of the construction of a proposed extension from St. Catharines to the Niagara frontier, coupled with an estimate of the earnings probable on through traffic obtainable at the frontier when such an extension shall have been made.

Your board estimates that the financial statement of the proposed line under local traffic conditions will be as follows:—

Revenue from operation, 59.6 miles, at $6,000 per mile	$357,600
Operating expenses, 61 per cent. of $357,600	218,136
Net operating revenue	$139,464
Fixed charges— Interest on $11,360,363 (as given by the Hydro-Electric Power Commission), at 5½ per cent.	$624,820
Yearly deficit, exclusive of taxes and sinking fund	$485,356

(Sinking fund is not chargeable during the first ten years.)

Your board further estimates that the financial statement of the proposed line under all traffic conditions will be as follows, after ten years:—

Revenue from operation, 59.6 miles, at $16,000 per mile	$953,600
Operating expenses, 65 per cent. of $953,600	619,840
Net operating revenue	$333,760
Fixed charges— Interest on $11,360,363 (as given by the Hydro-Electric Power Commission) at 5½ per cent.	$624,820
Sinking fund, 1 per cent.	113,604
	$738,424
Yearly deficit, exclusive of taxes	$404,664

The cost of an extension to the frontier has been estimated at about $2,280,000, arrived at from a consideration of the figures given by the commission for the line from Port Credit to St. Catharines.

The effect of good roads on transportation questions generally is of very great importance. Your board finds that it would be much more in the interest of Hamilton if good roads were seriously taken up rather than the proposed Port Credit-St. Catharines line. The amount proposed to be expended on the proposed line would build at least 800 miles of good roads in the Hamilton district.

The information regarding terminal facilities is so indeterminate that your board has not been able to satisfy itself regarding the obligation of the city of Hamilton in connection with the essential terminal expenditures and costs.

The system of financing and apportionment of losses or profits, being entirely arbitrary, and not within the control of Hamilton, is sure to cause dissatisfaction.

The proposed by-law and agreement is vague and indefinite in many particulars. By it the city of Hamilton would become responsible for nearly $6,000,000, and would start into the railway business, from which it would have practically no opportunity to withdraw, and over the operation of which it would have no control. One of the parties to the agreement would have entire control without any responsibility, financial or otherwise, while the other party would have no control, and would be, at the same time, responsible to the last dollar. The agreement would prevent Hamilton from entering into any arrangement with any transportation company without the consent of the Hydro-Electric Commission. The city could be required to give a free right-of-way over the corporation property. The apportionment of losses or profits has not been definitely stated. The question of assistance in operating the line under unavoidable and uncontrollable circumstances is not fairly stated. The agreement would require the city to give the proposed railway practically exclusive interests. The renewal clause makes the agreement virtually a perpetual one. No audit is provided for. The agreement as a whole is indeterminate and obscure, although it is definitely stated that the municipalities shall bear all losses in operation, while the Hydro-Electric Power Commission is definitely relieved from any and every responsibility, at the same time having the final and binding decision in all matters. Generally, Hamilton would be placing itself entirely in the hands of a commission over which, by the terms of the proposed agreement, it would have absolutely no control or authority. The board con iders this a very important matter, as the city

is called upon by the proposed agreement to guarantee over half the cost of the proposed line.

Conclusion.—Your board has reached the unanimous conclusion that it is not in the interest of Hamilton to enter into the proposed agreement.

CANADIAN SOCIETY OF CIVIL ENGINEERS ELECTIONS AND TRANSFERS

At a meeting of the council of the Canadian Society of Civil Engineers held October 30th, the following elections and transfers were announced:—

ALEXANDER, FREDERICK WILLIAM, of Calgary, Alta., transferred from associate member to member. Mr. Alexander was with the Bangor and Aroostook Railway for several years; also with the Restigouche & Eastern Railway. At present he is division engineer, C.P.R., Calgary, Alta.

BROWN, LE ROY, of Sault Ste. Marie, Ont., transferred from student to associate member. Mr. Brown is a graduate of the University of Toronto, class of 1915, and is at present principal engineer in charge of construction and operation of hydro-carbon recovery plant, Toronto Chemical Co., Sault Ste. Marie.

BUTEAU, JOSEPH AMEDEE, of Quebec, B.A.Sc. Ecole Polytechnique, 1909, elected as associate member. From 1911 to date Mr. Buteau has been a professor at Ecole Technique, Quebec.

CATON, EDWIN VICTOR, of Winnipeg, elected as member. Mr. Caton is chief engineer of the civic light and power department, Winnipeg.

CHANDLER, RALPH BORTHWICK, of Port Arthur, Ont., elected as associate member. Mr. Chandler is a graduate of Toronto University, class of 1912, and is at present resident engineer in charge of construction of hospital elevator for Grain Growers' Grain Co., Limited, and terminal elevator for Saskatchewan Co-operative Elevator Co., Limited, at Port Arthur, Ont.

FERGUSON, ALEXANDER DALE, of Winnipeg, transferred from student to associate member. Mr. Ferguson was born at Cardiff, South Wales, in 1890, and is a graduate in civil engineering, University of South Wales, class of 1911. He is at present draftsman and office assistant to division engineer, Hudson Bay Railway, The Pas, Manitoba.

GENDERS, PERCY ROBERT, of Regina, Sask., elected as associate member. Since 1913 Mr. Genders has been employed in the Surveys Branch, Land Titles Office, Regina, Saskatchewan.

HANNA, JOHN JEFFERY, of Calgary, Alta., elected as associate member. Mr. Hanna is a graduate of Toronto University, class of 1914, and was with the C.P.R. for some time. Prior to enlistment in 1914 he was assistant in the roadways department, Calgary. He is now lieutenant with the 3rd Tunnelling Company, Canadian Engineers, France.

HOWARD, LAWRENCE JAMES MEREDITH, of Ottawa, elected as associate member. For a number of years Mr. Howard was with the C.P.R. During 1916 he was on the valuation staff of the Commission of Inquiry into Railways and Transportation, and at present is engaged in valuation work for the Imperial Munitions Board.

IRVINE, JOSEPH HOLMES, of Prince Albert, Sask., transferred from student to associate member. Mr. Irvine is a graduate in civil engineering, Manitoba University, class of 1912. From 1913 to 1915 he was assistant city engineer, city of Prince Albert. He is at present lieutenant, 15th Canadian Reserve Battalion, on active service.

MANN, HENRY CECIL, of Duncan, B.C., elected as associate member. Mr. Mann was born in Dublin, Ireland, in 1874. At present he is assistant to the district engineer, Department of Public Works, Victoria.

MCDONALD, DUNCAN HAROLD, of Antigonish, N.S., elected as associate member. From 1912 to date Mr. McDonald has been assistant engineer, Public Works Department of Canada, under District Engineer E. G. Millidge at Antigonish, N.S.

PACY, ERNEST HAROLD, of Montreal, transferred from junior to associate member. Mr. Harold was for three years draftsman and shop inspector for the Dominion Bridge Co., and has also been with the C.P.R., I.C.R. and G.T.R. as inspector of bridges. From 1914 to date he has been employed by the Board of Engineers, Quebec Bridge, in an engineering capacity.

PARR, FRANCIS HILL PARKER, of Winnipeg, elected as assistant member. Mr. Parr was born at Darlington, England, in 1874. During 1913 he was engineer of the rural municipality of Kildonan, Man. Since 1914 he has been on the teaching staff of the Kelvin Technical High Schools, Winnipeg. He is a member of the Institute of Municipal and County Engineers, England.

PATRICK, GILBERT HASTINGS, of Strathmore, Alta., elected as associate member. Mr. Patrick is at the present time senior canal superintendent, Irrigation Branch, Department of Natural Resources, C.P.R.

RANDALL, HENRY EDWARD, (JR.), of Montreal, Que., elected as junior member. Mr. Randall is a graduate of the Massachusetts Institute of Technology, class of 1913. He is at present with the Shawinigan Water and Power Company in charge of the sales department in an engineering capacity, and also has to do with distribution of electric power.

STEVENS, HUGH EDMUND, of Courtenay, B.C., elected as associate member. Mr. Stevens was born at Maidenhead, England, in 1883. From 1902 to 1912 he was with the C.P.R. In 1912 he was resident engineer on the Kettle Valley Railway lines, Penticton, B.C. At present Mr. Stevens is assistant to the district engineer, Provincial Public Works Department, Courtenay, B.C.

YOUNG STEWART, of Regina, Sask., elected as associate member. Mr. Young is a graduate of Toronto University, class of 1912, and at present holds the position of surveyor and engineer for the Department of Highways, province of Saskatchewan.

The largest hydraulic power installation in South Africa is at Barberton, and is capable of developing 3,000 horsepower. Only about 1.1 per cent. of the power of the Union is obtained from water.

With the County of Renfrew joining the good roads movement, there are now 32 counties in line in the Province of Ontario. Renfrew will have 214 miles of improved highway. Five counties of the province have not as yet entered the movement.

Ships of concrete are to be built near Detroit by the Torcrete Shipbuilding Company, recently organized in Chicago. The company is now negotiating for a suitable site on which to begin building 1,200-ton reinforced concrete vessels, after what is known as the Torcrete system. Steamers are to be built here for the Great Lakes service. Additional yards will be established later. It is said, in New York, New Orleans and Los Angeles.

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PRINCIPAL CONTENTS OF THIS ISSUE

THE SURVIVAL OF THE FITTEST

In contradiction to accepted belief, there are always alternative methods of doing anything. Judgment is the choice of expedient, not the determination of the absolute. Politics have been termed a matter of selection between alternative blunders, decision being always wrong but the choice of the lesser evil. In engineering matters, improvement being always possible, the practice of to-day may prove a blunder to-morrow.

If practice were absolute, the ultimate possibility would have been attained, but actually current practice is but one stage in an endless evolution. Improvement is the elimination of past mistake. The business of an engineer is alive, in that growth and evolution are continuous. Adaptation to new environment, to fresh circumstances, is the rule and not the exception.

Experience is not simply the sub-conscious record of our own mistakes. The exact means whereby we hoist ourselves out of trouble certainly adds to our mental stature and enhances our value; yet so far from being confined to this, the shrewd learn from the mistakes of others no less than from their own. To err is human, but it is by elimination of error that mechanical evolution is furthered. If improvement were impossible, invention would be vain.

Practice is conditioned by circumstance; revision is due to many factors. The novel method of yesterday may be medieval after a few years. This is true in every department of engineering activity. There is little permanence. One solution serves to stimulate another. Design, material, method, workmanship, all undergo periodical revision; progress is rapid and each phase necessitates reconsideration of the whole. Change, not for the sake of difference but made by necessity, alters practice. No profession revises itself more energetically than does that of engineering.

Every other industry has been radically altered by engineering effort. The application of the same unvarying law in the engineer's own work leads to rapid revision and expression. No man can hope to compass the whole field of effort even in a cursory manner. One branch of engineering effort is so far removed from some others as though it were an entirely different world. Still, the fact remains that the classification of engineer applicable to so many related but diverse fields covers one of the most active professions. To be in association therewith in any capacity is a distinction. To be master in one section is a certificate of mental competency.

The evolution of the modern world, of civilization itself, largely rests upon the engineer's shoulders. As his numbers increase and his talents are more and more exercised, the future must inevitably look to him in an increasing manner for the solution of its difficulties. To-day the engineer is a servant to many other interests; to-morrow—since only the fit survive—he may dominate and control those interests. The future largely belongs by right of conquest to the engineer.

INCREASED RAILROAD RATES

A despatch from Washington last week announced that the Interstate Commerce Commission had given the Pennsylvania Railroad permission to file without formal hearing increased commodity rates on iron and steel from points in eastern trunk line territory to destinations in West Virginia, Pennsylvania and Ohio. This is an important ruling and means virtual approval of the higher rates

A number of increases have been approved on commodity rates in the United States since the 15 per cent. rate decision, the general plan being to adjust domestic rates on iron and steel on the same basis as the export rates, which were increased some time ago. It is understood that the new rates will mean a considerable increase in revenue, which in connection with the indication of the commission's favorable attitude toward higher rates, relieves railroad officials of much anxiety—in the United States.

What about Canada? We must be prepared to bear also a substantial increase in railway rates. It is not a matter of the relative merits of railroad operation by government or corporations. Were the government to own and operate all our railroads to-morrow, they would find it absolutely necessary to increase rates. The only alternative would be the creation of deficits which the taxpayers would carry, and that would be only another way of paying the increase necessary in railway rates.

Railroad transportation is one of the few commodities in this country which has been compelled to maintain prewar prices, despite the substantially increased cost of labor, materials, and other things which the railroad corporations have to buy. The Grand Trunk System, for example, is doing at present an immense volume of business. It is using its equipment to the limit, and is getting little or nothing for it. For the present calendar year the company's gross earnings will be the greatest in the history of the company, and its net earnings (owing to increased costs) will be practically the lowest on record. There are in England thousands of debenture holders who

are dependent on their investments in the Grand Trunk for their maintenance, and their cause is just.

What the railways ask for is such an increase in rates as will enable them to go on and to cover a portion of the extra expense to which they have been put owing to the changes due to the war.

PERSONALS

H. ROLPH has been appointed president of the John S. Metcalf Company, Limited, Montreal, grain elevator designers.

ALLAN K. GRIMMER, C.E., has opened an office in Fredericton, N.B. Mr. Grimmer is an associate member of the Canadian Society of Civil Engineers.

LLOYD HARRIS, president of the Russell Motor Car Co., of Toronto, has been appointed representative of the Imperial Munitions Board at Washington, D.C.

T. D. MYLREA recently resigned his position as engineer of tests of the city architect's department, Toronto, to become chief engineer of the Trussed Concrete Steel Company, Toronto.

EDWARD D. MCCORMACK, for many years manager of the supply department of the Canadian General Electric Company, has established an electrical brokerage business with offices in the Bank of Hamilton Building, Toronto.

W. R. HARRIS, M.Can.Soc.C.E., has accepted the position of engineer with the Cement Products Bureau of the Portland Cement Association, Chicago. Mr. Harris was until recently managing director of the Canadian Lock Joint Pipe Co., Limited.

Major A. C. LEWIS, secretary of the Toronto Harbor Commission, who was reported wounded on September 1st, is in a London hospital to undergo an operation and for treatment for nerve disorder. He went overseas as second in command of the 216th Battalion.

Lieut. R. T. C. HOIDGE, Toronto, a student at the School of Applied Science, class 1916, has been awarded the Military Cross which he won in June last. He saw service originally as second lieutenant with the Royal Garrison Artillery, but transferred in August to the Royal Flying Corps.

Major H. LEFEBVRE, Jr.Mem.Can.Soc.C.E., Montreal, has been awarded the Military Cross. He went overseas with the first contingent, and was later attached as a lieutenant to the 10th Canadians, with which he went to France. Major Lefebvre has been twice promoted for conspicuous bravery.

Lieut.-Col. J. S. DENNIS, assistant to the president, C.P.R., and president of the Canadian Society of Civil Engineers, has been raised by the militia department from the rank of lieutenant-colonel to full colonel, in recognition of his efforts in connection with the British recruiting commission in the United States.

C. W. JOHNSON, who was superintendent of the combined plants of Allis-Chalmers and Bullock, at Montreal, from 1904 to 1907, was elected vice-president of the American Institute of Metals at its recent meeting at Boston. He is at present general superintendent of the East Pittsburgh works of the Westinghouse Electric & Manufacturing Co.

A. SHERWOOD, of Fredericton, N.B., manager of the Fredericton and Grand Lake Railway Co., and of the New Brunswick Coal and Railway Co., has resigned. V. A. HARSLEAU, of Montreal, has been named to succeed Mr. Sherwood. He was formerly with the Canadian Pacific as superintendent at Woodstock, and Brownville, Me. Two years ago he was called to the head offices of the company at Montreal.

Flight.-Lieut. S. V. ROSEVEAR, R.N.A.S., has been awarded the D.S. Cross, having brought down the sixth German machine, and done effective work in destroying a company of Germans. Prior to enlistment he was a student at the School of Applied Science, Toronto, class of 1916. He first joined the University of Toronto Overseas Training Company, from which he went to England as a provisional flight officer last January. His home is in Port Arthur.

H. MCCALL, formerly superintendent at Melville of the Grand Trunk Pacific Railway Co., has been appointed by the company as general superintendent of all rail lines west of Edmonton. I. A. MACPHERSON, who for several years has been the assistant to the general superintendent at Winnipeg, will succeed Mr. McCall at Melville and C. B. MUTCHLER will succeed Mr. Macpherson at Winnipeg. J. A. HEAMAN has been appointed assistant chief engineer, with headquarters at Winnipeg.

OBITUARIES

Lieut.-Col. THOMAS C. IRVING, D.S.O., commanding officer of the First Canadian Engineers, and son of Mr. T. C. Irving, of the Bradstreet Company, Toronto, has been killed in action. As a captain, Lieut.-Col. Irving went overseas at the outbreak of war with the 2nd Field Company of the Canadian Engineers. During the autumn of 1914 his unit laid out Valcartier Camp. A year later he was promoted in rank. This was followed by the decoration of the D. S.O. and his promotion to a lieutenant-colonelcy. Lieut.-Col. Irving was an associate member of the Canadian Society of Civil Engineers and a member of the Engineer's Club, Toronto. Prior to enlistment he was vice-president of Robert W. Hunt & Co., Limited, Toronto.

Lieut. CHARLES KENNETH MACPHERSON, of Goderich, Ont., a student at the School of Applied Science, Toronto, class of 1916, has been officially reported killed in action. He enlisted in the 161st Battalion and held the rank of captain, but reverted in order to get to France.

Lieut. J. H. CARDEW, M.C., a graduate in the Faculty of Applied Science of McGill University, died on October 5th of wounds received in action. He was at one time electrical engineer of the Indian government state railways. He was the eldest son of Lieut.-Col. C. E. Cardew, of Wadebridge, England.

Coast to Coast

Brantford, Ont.—The by-law calling for authority for the establishment of a civic fuel depot in this city was defeated by the ratepayers.

Brantford, Ont.—The necessary order-in-council was passed on October 25th, directing that a commission be appointed to govern the administration of the suburban roads in Brant County adjacent to this city.

Comeauville, N.S.—The Comeau Shipbuilding Co., Ltd., contemplates the establishment of a shipbuilding plant. Secretary-treasurer, E. L. Comeau.

Chatham, Ont.—Building permits issued during the month of October total $43,950, showing a substantial increase of $26,350 over the value of permits for the corresponding period last year.

Duncan, B.C.—At a recent convention of the newly-formed Good Roads League of British Columbia, it was decided to divide the province into ten districts, each of which will supply two members to the board of directors. Future annual meetings will be held in proximity to the Union of British Columbia Municipalities' convention. The question of a national highway from Vancouver Island to Glace Bay was foremost in the discussion. Officers were elected as follows:—Reeve W. A. McKenzie, Penticton, president; Alderman Gale, Vancouver; Alderman Coburn, Nanaimo; J. Walters, M.L.A., Merritt, vice-presidents; J. S. Hales, Penticton, secretary; Mayor Dill, Enderby, treasurer.

Edmonton, Alta.—Work is proceeding steadily on the construction of the Canadian Pacific Railway subway on Jasper Ave., and it is expected to carry it on to completion before the freeze-up comes.

Fergus, Ont.—The town has been authorized by the Ontario Railway and Municipal Board to establish a municipal coal yard.

Hamilton, Ont.—Ald. John H. Hodgson, Ald. W. C. Thompson, Councillor H. Dickenson and Councillor Mahoney have been appointed members of the Suburban Road Committee, recently authorized by W. A. McLean, Deputy Minister of Highways, Ontario. The fifth appointee, though not definitely named as yet, is likely to be J. J. MacKay, C.E.

London, Ont.—The building permits issued by Building Inspector Piper for the month of October numbered 75 for a total of $143,100. In October, 1915, there were 118 permits issued for a total of $110,145, showing an increase of practically $30,000.

Montreal, Que.—Lands and Buildings, Ltd., Montreal, has been incorporated with a capital of one million dollars, to erect buildings and deal in building materials, etc. H. W. Jerry, Montreal, is interested.

North Sydney, N.S.—A. C. Ross proposes to construct concrete vessels.

Port Burwell, Ont.—A million-foot gusher struck recently near here promises to be one of the richest gas wells in the district.

Quebec, Que.—The large dry-dock on the St. Lawrence is now nearly completed. The boilers and machinery have been tested, the new gates are in position, and the cofferdam, or false gate, blown up. Within a few weeks it is hoped to fill the dock for the first time, but as the approach has not been thoroughly sounded, it is not expected that any ship will enter the dock this year.

Quebec, Que.—The Quebec Shipbuilding Company have established a shipyard on the St. Charles River.

Rossland, B.C.—Preliminary work has commenced on the extension of the high power line of the West Kootenay Power Co. to Copper Mountain near Princeton. The main extension will be about 100 miles in length by air line and will run via Camp McKinney with branches to Penticton and Princeton. It is understood that the cost of the new line with laterals and substations will be between $2,000,000 and $2,500,000.

Sarnia, Ont.—One hundred and fifty carpenters and laborers and fifty teams are rushing operations on the new mammoth plant of the H. Mueller Manufacturing Company at Port Huron. The plant is expected to be in operation within a month or six weeks.

Saulnierville, N.S.—The Acadian Shipbuilding Co., Ltd., contemplates the establishment of a shipbuilding plant. Secretary-treasurer, Denis D'Entremont, Meteghan River.

Sherbrooke, Que.—A civic delegation from this city, consisting of Aldermen J. K. Edwards, Wm. Brault, S. Fortier, J. S. Tetrault and G. Delorme, all members of the city's waterworks commission, recently went to Montreal to inspect the filtration plants in that vicinity with a view of installing an up-to-date plant in this city.

St. John, N.B.—Building permits issued to the end of October totalled $521,250 as compared with $447,350 for the ten months of 1916.

St. John, N.B.—The Negro Point breakwater was considerably damaged by a recent storm.

Toronto, Ont.—According to a statement made by H. S. Van Scoyoc, chief engineer of the Toronto-Hamilton Highway Commission, work on the highway will be finished in four weeks' time, weather permitting. Up to the present time the line is laid from the city line at the Humber to Etobicoke Creek, with the exception of a stretch in Mimico between Mimico Avenue and Symonds Avenue, and a stretch about 350 feet just west of the O'Connor Road.

Toronto, Ont.—Building permits issued for the first ten months of this year represent an increase of $870,282 over the first 10 months of last year, and are regarded as very satisfactory. The figures for this year are, $6,375,079, and for last year $5,504,797. The permits issued during the past month number 513, and total $786,225, while those of October last year numbered 436, at a value of $496,148.

Toronto, Ont.—Fire completely destroyed the Cluff Ammunition Company's plant at 28 Atlantic Avenue last week. The total damage is estimated at approximately $200,000.

Toronto, Ont.—The new street railway line from the Queen Street bridge over the Don to the Harbor Board's new industrial area in Ashbridge's Bay may shortly be opened, permission having been given by the Ontario Railway Board.

Toronto, Ont.—The Rosedale section of the Bloor Street viaduct is now open for traffic. This section extends from the head of Parliament Street to Castle Frank Road. There was no ceremony in connection with the opening. According to Works Commissioner R. C. Harris, the Don section of the Bloor Street viaduct will not be opened to the public until next year. He stated that it would be folly to attempt to lay the permanent pavement and car tracks at this time of the year, as the work could not be completed before the winter set in.

Vancouver, B.C.—Hope that the Dominion Government would give a subsidy of at least $12,000 per mile for the completion of the Pacific Great Eastern Railway, not only to Prince George but on to the Peace River, was expressed by Hon. H. C. Brewster, premier, following his return from the east where he discussed the railway situation with the Ottawa authorities. The Premier intimated that the Government proposed to proceed with its suit against the directors of the Pacific Great Eastern and the Foley, Welch, Stewart and Fauquier Company.

Victoria, B.C.—A request that the Provincial Government should take over and maintain the four bridges connecting the municipalities of Richmond and South Vancouver was urged upon Dr. King, Minister of Public Works, by a deputation representing the two municipalities which waited upon the Minister recently.

Winnipeg, Man.—Dr. Bruce, of the geological survey, is preparing a report on Manitoba's molybdenite discovery, at the request of the Munitions Board.

Winnipeg, Man.—Hon. T. H. Johnson, Provincial Minister of Public Works, recently announced the results of the split log dragging competition, held by the Provincial Government. According to Mr. Johnson, the success of the competition has been far above expectations and a demonstrator may be appointed to cover the whole dragging season.

Winnipeg, Man.—The Manitoba Good Roads Association will hold its annual banquet at the Royal Alexandra on November 15th, when the prizes won in the drag-log competitions will be presented.

Construction News Section

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or projected, contracts awarded, changes in staffs, etc.

▲—Denotes an item regarding work advertised in *The Canadian Engineer.*
+—Denotes contract awarded. The names of successful contractors are printed in CAPITALS.

ADDITIONAL TENDERS PENDING

Not Including Those Reported in This Issue

Further information may be had from the issues of *The Canadian Engineer* to which reference is made.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Barrie, Ont., erection of a Collegiate Institute	Nov. 20.	Nov. 1.	46
Barrie, Ont., reconstruction of old Collegiate Institute	Nov. 20.	Nov. 1.	46
Chapleau, Ont., turbine pump	Nov. 15.	Oct. 25.	54
Coronation, Alta., erection of school	Nov. 10.	Oct. 25.	46
Dover Tp., Ont., drainage work	Nov. 15.	Nov. 1.	50
Myrnam, Alta., erection of school	Nov. 10.	Nov. 1.	46
Toronto, Ont., sundry work on schools	Nov. 8.	Nov. 1.	54
Winnipeg, Man., cast iron gate valves, air valves and sluice gates	Nov. 26.	Nov. 1.	50
Winnipeg, Man., construction of pipe line	Dec. 3.	Nov. 1.	50
Winnipeg, Man., freight elevator	Nov. 9.	Nov. 1.	54
Winnipeg, Man., gate house, etc.	Nov. 16.	Nov. 1.	50
Winnipeg, Man., pipe line material	Dec. 3.	Nov. 1.	50
Winnipeg, Man., Portland cement	Nov. 10.	Nov. 1.	54

FACTORIES AND LARGE BUILDINGS

+—Ashcroft, B.C.—Department of Public Works, Ottawa, let contract to EDWARD HUNT, Victoria, for addition to public building.

Bridgewater, N.S.—The Gray Marine Motor Company contemplates the erection of engine works.

+—Byron, Ont.—JOHN HAYMAN & SONS, 432 Wellington St., London, have the general contract for $10,000 vocational school for the Government Hospital Commission.

Calgary, Alta.—Tenders will be called shortly for the erection of a stone and brick post office for the Department of Public Works, Dominion Government. Chief architect, E. L Horwood, Robinson Building, Ottawa.

Dalhousie, N.B.—The P. Q. Lumber Co. is erecting a large saw mill here.

Dartmouth, N.S.—School Board contemplates erection of a $20,000 addition to Victoria School. Secretary-treasurer, A. Elliott, Pleasant St.

Drumheller, Alta.—The Standard Bank, head office, Toronto, contemplates the erection of a $7,300 two-story brick bank. Architects, Holman and Mitchell, 212 Bay Block, 326 Eighth Ave. W., Calgary.

East End, Sask.—The Village Council contemplates the erection of a hospital. Secretary-treasurer, A. H. Stevens.

Galt, Ont.—Tenders have been received for the erection of a bank building for the Merchants' Bank. Head office, Montreal. Old building will be wrecked.

Halifax, N.S.—C. M. Jack, Birchdale Hotel, will erect a concrete addition to warehouse on Grafton St.

+—Hamilton, Ont.—Contract let to P. H. SECORD & SON, 133 Nelson St., Brantford, for $25,000 one-story brick factory addition for the Frost Wire Fence Co., Sherman Ave.

+—Hamilton, Ont.—Permit issued to St. Joseph's Convent for alterations to building on Park St. North. Architect, Walter Scott. Contractors, MURRAY & CONNOR. Cost, $13,000.

Hull, Que.—Matthews-Blackwell, Ltd., Hull, and 44 Nicholas St., Ottawa, contemplates the erection of a factory addition.

Kamloops, B.C.—The Limit School District contemplates the erection of a school. Address, Public Works Engineer A. E. Foreman, Parliament Buildings, Victoria.

Kindersley, Sask.—The Town Council contemplates the erection of a hospital. Clerk, H. R. Dyer.

Kingston, Ont.—Plans are under way for the establishment of another military hospital here.

+—Lamont, Alta.—W. C. McARTHUR, 1160-95a St., Edmonton, has the general contract for $9,000 addition to hospital for the Hospital Board.

Lampman, Sask.—The municipalities of Benson and Browning plan erection of an $18,000 union hospital. Clerk of Lampman, H. D. Buller.

Langley Prairie, B.C.—Tenders will likely be called soon for the erection of a warehouse for Brack-Ker Milling Co., Ltd., Carrall St., Vancouver. Architect, A. E. Henderson, 155-13th Ave. W., Vancouver.

Langley Prairie, B.C.—The Vancouver Milling and Grain Co., 236 Smithe St., Vancouver, plans erection of a warehouse.

Lanigan, Sask.—The Town Council plans erection of a hospital. Clerk, W. L. Craddock.

+—Milk River, Alta.—School Board let contract to A. McDOUGALL, Grain Exchange Building, Calgary, for erection of $15,000 brick school.

Moncton, N.B.—Plans are being prepared for an $18,000 one-story garage for L. Higgins, Main St. Architect, H. C. Mott, 13 Germain St., St. John.

Monkton, Ont.—The Farmers' Club, of Elmira, is contemplating the erection of a warehouse here.

Montreal, Que.—The Canadian Steel Foundries, 120 St. James St., will erect a $6,000 one-story frame factory.

Nanton, Alta.—The Nanton School District and Parkland School District have under consideration the erection of a school.

New Glasgow, N.S.—The Nova Scotia Steel and Coal Co., Ltd., contemplates extensions, repairs, etc., costing $4,000,000. General manager, F. H. Crockard.

Regina, Sask.—The Canadian Avery Co., Ltd., 8th and Osler Streets, will erect two one-story warehouses on Osler St. N.

Renfrew, Ont.—Thos. A. Low and F. D. Vickers plan erection of factory addition.

Rosetown, Sask.—The town of Rosetown and District contemplate the erection of a hospital addition. Clerk of Rosetown, J. W. Heartwell.

+—Saskatoon, Sask.—Contract for erection of $150,000 cold storage plant for J. H. Early, First and 23rd Streets, let to A. W. CASSIDY & CO., 332 First St. N.

Spirit River, Alta.—The Alberta Pacific Grain Co., Ltd., Elevator No. 7, North C.N. Railway, Edmonton, contemplates the erection of an elevator.