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The Canadian Engineer

A weekly paper for Canadian civil engineers and contractors

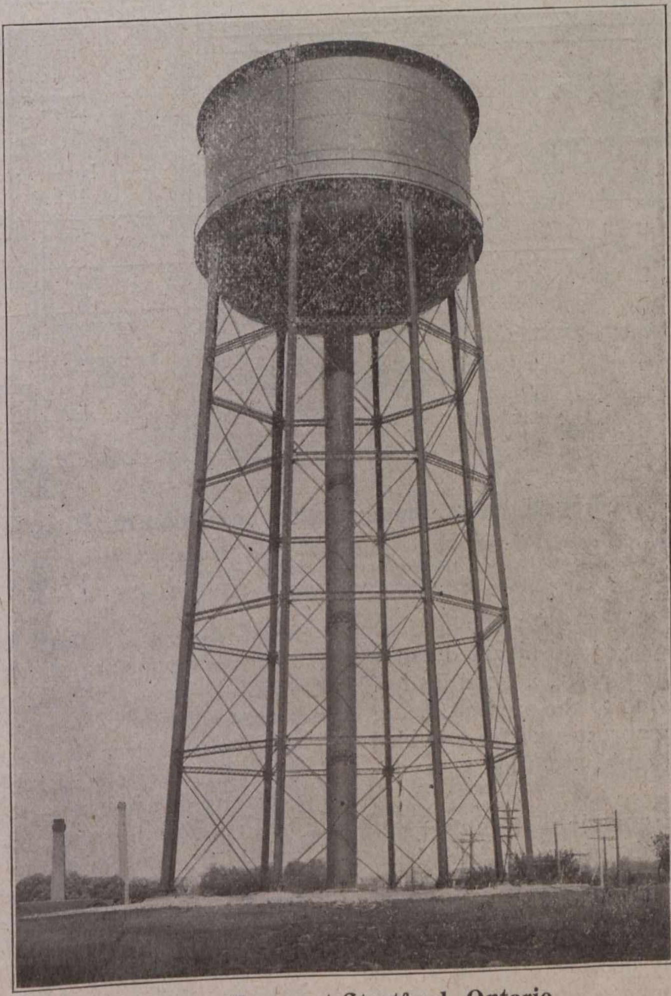
Steel Water Tower of 500,000 Gallons Capacity

Erected at Stratford, Ont., by the Hydro-Electric Power Commission of Ontario—Factors Governing Decision Regarding Location, Height and Type of Structure—Total Weight on Foundations, 2,755 Tons When Tank is Full

By A. S. L. BARNES, A. M. I. E. E.
Hydro-Electric Power Commission of Ontario

VERY considerable extensions and alterations have, during the past few years, been carried out in connection with the municipal waterworks department of the progressive city of Stratford, Ont., a place of some 16,000 inhabitants.

One important item on the programme of work done has been the provision of a steel water tower, of a height and capacity which are not exceeded in many places on this continent.



Water Tower at Stratford, Ontario

Like that of many another small municipality, the Stratford waterworks, prior to the installation of this water tower, pumped direct into the mains, a procedure which, as is well known, is not conducive to economy in operation.

A waterworks system run on this plan is like an electric generating station which, being without storage capacity, has to provide sufficient generating plant to deal with the maximum peak load and also requires some additional reserve capacity for use in case of emergency. The difference between the waterworks and the electric station, however, is that failure to provide suitable storage capacity in the latter case arises from physical disability; in other words, it is almost impracticable, except in the case of d.c. stations, and none too satisfactory there, while in the case of the former it arises either from financial disability, so far as the raising of the necessary capital is concerned, or from lack of mental capacity on the part of the authorities concerned to realize the benefits to be gained by providing it.

It will be well to review briefly what these benefits are. Suitable storage capacity, such that the maintenance of an adequate pressure at all times is assured, has the following advantages:—

1. More even pressure is obtained on the mains, giving better satisfaction to consumers, as well as better working conditions for the pumping plant.

2. Some reserve capacity is provided which is able to instantly take care of small fires (very many fires are checked by such means); even for larger fires the advantage of this immediately available capacity, if only at a moderate pressure, cannot be despised.

3. The operation of the pumping plant, from a financial standpoint, is greatly improved, because, in the first place, less plant capacity is required, thus reducing capital cost and overhead charge on plant, buildings, land, etc., and in the second place, the load can be maintained practically at a steady value throughout the twenty-four hours, or any desired portion thereof, resulting in increased economy of operation.

A little while previous to the outbreak of the war, it became apparent to the local waterworks authorities in Stratford that various changes should be made in order to comply with the requirements of the fire underwriters as revealed in their report. The matter was taken up with the engineering department of the Hydro-Electric Power Commission of Ontario and the whole question thoroughly gone into. The pumping requirements for fire service were considered but it is not intended to deal here with that part of the work. At the same time it was desirable that suitable storage capacity at some convenient pressure should be provided.

Local topographical features were such that a standpipe or elevated tank would furnish the only means of providing storage, with pressure, within a reasonable distance of the city's mains.

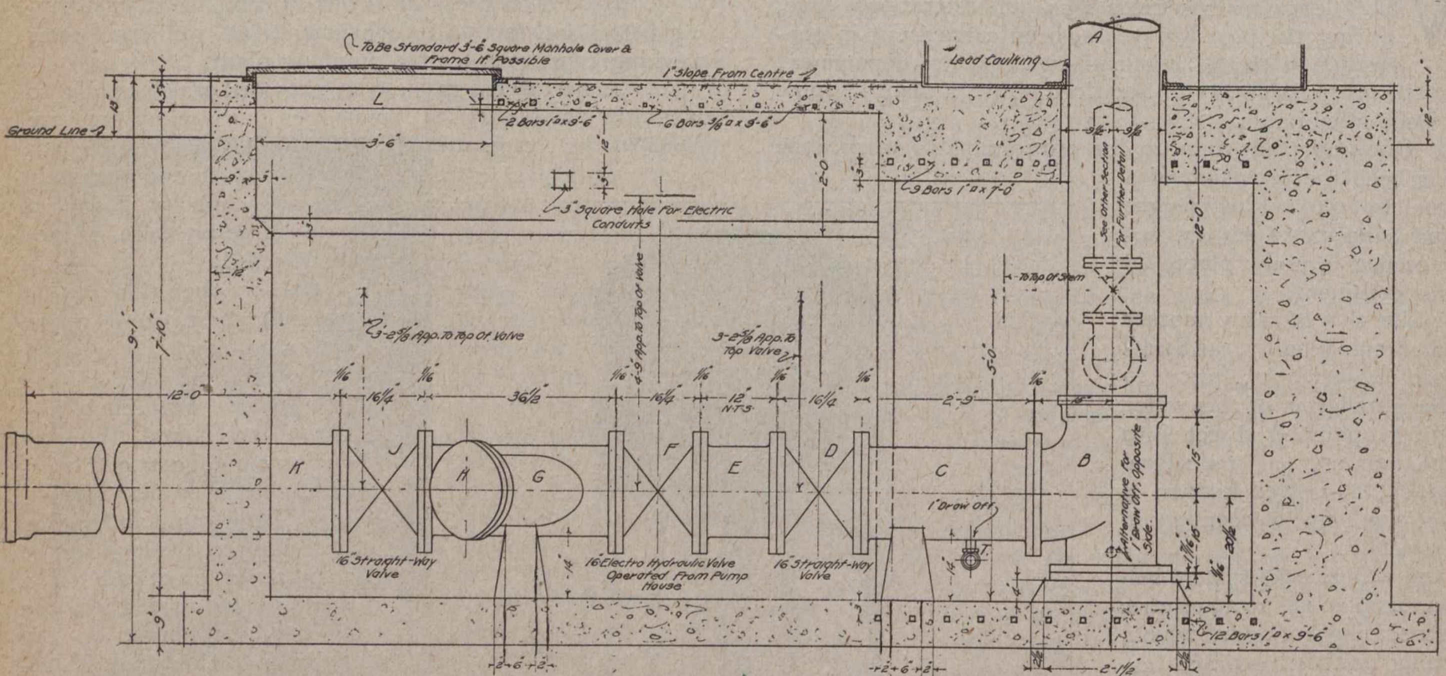
Since the cost of an elevated tank increases more rapidly than its height from the ground, it was evident that the site to be chosen for its location should be as high as possible, so that the actual height of the supporting structure should be a minimum; it was seen also that there would be advantage in having the tank fairly close to the pumping station.

Fortunately, quite near to the station is some rising ground, the summit of which is about 30 feet higher than the station itself and above most of the surrounding terrain.

It was therefore decided to locate the proposed standpipe or elevated tank at this spot and, as by this time it had been practically settled that 80 lbs. would be a suitable maximum pressure to be maintained, it was arranged that the actual elevation of the highest water level, when the tank was full, should be $(80 \times 2.31) - 30 = 155$ feet.

Very careful consideration was given to all of these—eleven in all—in order that their relative merits, both as to engineering features and price, might be properly appraised on an equitable basis. The tender of the Canadian Chicago Bridge and Iron Co., Limited, of Bridgeburg, Ont., was the one accepted.

The specifications called for the supply, delivery and erection of one circular steel tank of 500,000 Imperial gallons capacity, elevated on a steel tower so that the level of the water when the tank was full would be 155 feet above the ground at the base of the tower. The diameter of the tank is 54 feet and its depth 39 feet 9 inches; the bottom is elliptical, of such shape that expansion and contraction of the riser drum is effectually taken care of without an expansion joint. This bottom, being much shallower than a hemispherical one, also has the effect of appreciably raising the mean water-level.



Vertical Section Through Valve Chamber and Foundation for Riser Drum

A, length of c.i. bell and spigot pipe; B, special c.i. single sweep tee with blind flange; C, special length c.i. 16" pipe, flanged; D, 16" straightway non-rising stem gate valve; E, same as C; F, 16" electro-hydraulic valve; G, standard 16 x 16 x 12 c.i. Y piece, flanged; H, standard 12" c.i. blind flange; J, same as D; K, length of c.i. 16" pipe, flange and bell; L, manhole frame and cover, 3 ft. 6 ins. square; T, 1" brass angle valve, screwed ends.

The relative merits of stand-pipes and elevated tanks were considered; and since, in the former, a good deal of the water is practically useless owing to the pressure being too low, while the structure to support it must be provided just as in the case of an elevated tank, attention was concentrated on the latter.

The question of capacity was gone into and, after approximate prices on various sizes of tanks had been obtained, it was decided that storage for 500,000 Imperial gallons should be provided, partly because this quantity would be sufficient to meet requirements for some considerable time to come, and partly because the cost of the smaller sizes, per gallon, was found to be much higher than for the larger.

The four primary items of location, height, type of structure (*i.e.*, whether stand-pipe or elevated tank) and capacity having been settled, the question of steel versus reinforced concrete was raised.

Specifications for an elevated water tank were prepared and tenders were invited on both steel and reinforced concrete structures.

The supporting structure consists of eight legs built up of 14-inch "H" section columns with the necessary braces and stays.

The riser drum is of steel and is 6 feet in diameter; the idea of having one of such large size being to obviate the necessity of using any frost casing.

In connection with this large riser drum it was realized that at the bottom of the tank there would be an opening 6 feet in diameter with a sheer drop of some 115 feet down the riser drum to the ground and that this would constitute a serious danger to any workmen who, in repairing or cleaning the tank, might have the misfortune to lose his balance; it was therefore specified that this opening should be protected with a suitable iron grating.

In order that the riser drum might be conveniently connected to the water mains running out from the pumping station the specifications required a 16-inch pipe to be set vertically in the bottom plate of the drum, with an elbow at its lower end; this pipe extends about 5 feet into the drum so that sediment can settle around it at the bottom, a manhole being provided in the riser so that cleaning out may be readily done when required.

The tank has a conical all-steel roof, and also a steel balcony (incorporated with the circular girder which rests on the eight legs, and to which the tank itself is attached) entirely surrounding the tank, provided with a suitable railing and a ladder giving access from the ground, although, to prevent boys, or other unauthorized persons, from climbing it, this ladder only reaches to about 8 feet from the ground.

To enable the entire outside of the tank and roof to be conveniently inspected or painted, there is a revolving iron ladder reaching from the roof finial to the balcony; and, to provide similar access to all parts of the interior, a painter's trolley has been provided.

For the purpose of indicating the water level in the tank there is a pressure gauge in the pump-house and a float level gauge with a large, legible scale on the outside of the tank, and, in addition, an electric alarm whereby a loud bell in the pump-house is rung when the tank is nearly full or nearly empty.

In regard to painting, one shop and one field coat were specified, and for the interior of the tank special paint, suitable for that surface, has been employed.

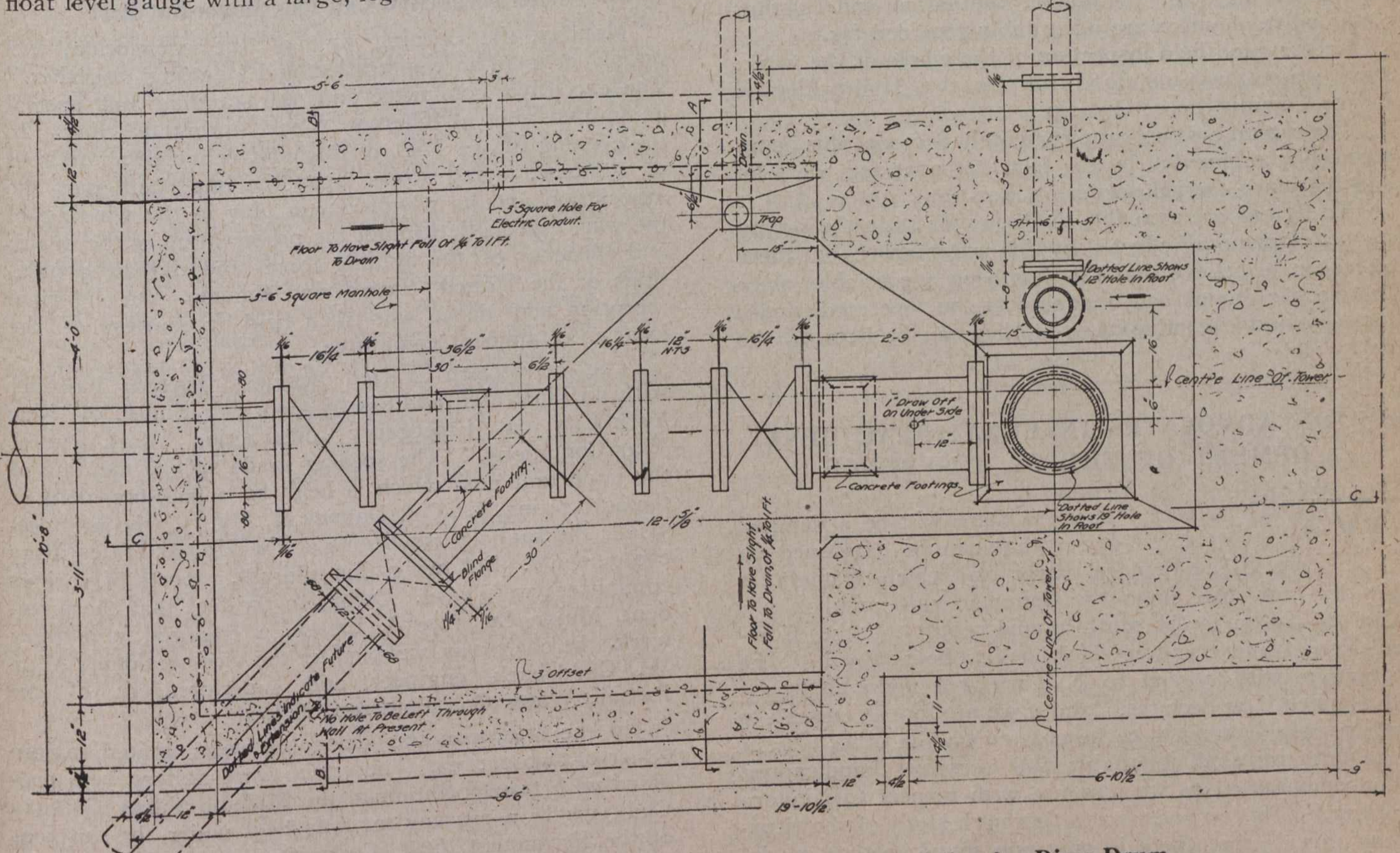
The maximum unit stress in plate work does not exceed 12,000 lbs., with a joint-efficiency designed for 70 per cent. The compression joints are all milled and carefully fitted and there is sufficient number of rivets to carry 50 per cent. of the load at unit stresses consistent with the above. All metal in the structure is made to "Manufacturers' Standard Specifications."

The entire weight of the structure was estimated to be about 511,000 lbs., or over 255 tons, and actual weights later checked this figure closely. The weight of the water when the tank is full is 2,500 tons, so that the total weight on the eight concrete footings on which the steel legs rest, is a little more than 2,755 tons of 2,000 lbs. each.

Much consideration was given to the question of foundations for so ponderous a tower, and test borings were made to ascertain the nature of the ground in which the massive concrete footings would have to be set.

This ground was found to consist of approximately 3 feet thickness of clay on the top, underneath this being about 10 feet of coarse gravel, which gradually gets finer to a depth of about 20 feet. This gravel ridge extends to a sufficient distance horizontally to have warranted the assumption, which was made, that it would be safe to locate the tower on the spot selected. The foundations were designed for a maximum pressure on the soil of two tons per square foot.

The accompanying photograph of the completed water tower shows very plainly its great height and large size, and also the shallowness of the elliptical bottom. It is easy to realize that the tower forms a good land-mark for miles around.



Horizontal Section Through Valve Chamber and Foundation for Riser Drum

For the eight concrete foundations required to support the tower legs, 570 cubic yards of earth had to be excavated and 310 cubic yards of concrete were required. Each of the eight foundation piers is 15 ft. 6 ins. square at the base and 5 ft. square at the top. These piers are 9 ft. in depth and extend 1 ft. above the ground level. The anchor bolts are 1½ ins. in diameter and 6 ft. long.

Specifications for these foundations, and also for the valve chamber referred to below, were drawn up and tenders invited from firms located in and near Stratford. The contract was awarded to Messrs. Everitt and Marson, of Stratford.

In addition to the provision of the tower proper, with its foundations, it was necessary to construct a valve chamber, to accommodate, primarily, a valve required by the fire underwriters, capable of being instantly shut in case of fire, so that fire pressure could be put on the mains.

Besides this valve, which is of the electrically controlled, hydraulically operated type, there were installed two others—ordinary hand-operated, non-rising stem, gate valves—one on either side of it, so that, in case of trouble with the electro-hydraulic valve, there would be no difficulty in cutting it out and attending to it.

Figs. No. 1 and No. 2 show the lay-out, in plan and elevation respectively, of this valve chamber.

Excavation for this chamber amounted to about 62 cubic yards and the concrete required to 33 cubic yards; the large amount of concrete is due to the fact that one end of the chamber forms the footing for the riser drum, which on account of the great weight (= that of a column of water 6 ft. diameter and 155 ft. high plus the weight of the riser drum plus the compression, at times, on the riser drum, due to expansion) to be supported, is of necessity rather massive. Drainage, ventilation and lighting of the valve chamber are all suitably provided for.

Factory and field inspection of the whole of the work, at all stages, was arranged for by the Hydro-Electric Power Commission of Ontario.

The capital cost was approximately $30,000, this being somewhat augmented by the fact that contracts were let and the work carried on during war-time.

No figures are available to the writer as to the saving in cost of pumping effected by this water tower, but there is reason to believe that this has been appreciable, since the electric pumps can undoubtedly be operated under more favorable conditions, *i.e.*, they can be kept off the peak.

SIFTON ADVOCATES INTERNATIONAL DEVELOPMENT OF THE ST. LAWRENCE

WITHIN a very few years there will be a demand for every horse-power that can be developed on the St. Lawrence River to which Canada is entitled for use upon the Canadian side, predicts Sir Clifford Sifton in the ninth annual report of the Commission of Conservation which has just been issued. "The situation with regard to Niagara will undoubtedly be duplicated," he declares, "and if we are foolish enough to allow vested interests to be created on the other side of the line, we shall inevitably find ourselves handicapped and embarassed as we now are with respect to Niagara power." He contends that a thorough study of the situation reveals that there is only one sound method of developing these powers, *viz.*, "an international commission under which the best use of the powers will be made, the most economical development effected and a just and equitable division of the power will take place for the benefit of the people who are directly concerned in its use."

Special prominence is laid in the report on power and fuel problems. Following a comprehensive review of the progress of conservation in 1917, by Sir Clifford Sifton, are addresses on "Peat as a Source of Fuel," by Dr. Eugene Haanel; "The Fuel Situation in Canada," by Fuel Controller C. A. Magrath; "Power Possibilities on the St. Lawrence," and "The Niagara Power Situation," by A. V. White; and a comprehensive treatment of the subject of railway electrification, by S. T. Dodd, of the General Electric Company, and W. F. Tye, C.E.

A full account is given of the work accomplished by the commission during the year in regard to water-powers, town-planning, mining, agriculture and game conservation. An interesting feature is a chart showing how the German buying combination controlled the metal markets of the world before the war.

AMERICAN WATER WORKS CONVENTION

(Special Correspondence)

ST. LOUIS, MO., May 20th.—Officers and members of the American Waterworks Association have reason to be gratified at the success which attended the thirty-eighth annual convention, held last week in this city. The war, the scarcity of materials, the shortage of labor, and the transportation difficulties are factors that to some degree must affect gatherings of men who are concerned with the design, construction and maintenance of waterworks plants. Nevertheless, more than 400 delegates and 200 guests registered, many of them arriving on Sunday afternoon, May 12th.

Waterworks Men Can Play Important Part

Monday, the opening day of the convention, was mainly devoted to registration and "getting together." The executive committee and the standing and special committees met at different times during the day. In the evening Mayor Kiel, of this city, delivered an address of welcome, laying stress upon the important part the association and its members can play in the winning of the war, especially through the preservation of the health and efficiency of the fighting forces and civilian populations of the United States and Canada. An informal reception and dance was then held by courtesy of the local entertainment committee.

The convention started business Tuesday morning with an illustrated address by Geo. W. Fuller, of New York City, on "Emergency Construction Work Due to War Conditions." The speaker made special mention of the important post which is held by a past-president of the association, Lt.-Col. Dabney H. Maury, who is supervising the sanitary conditions at the United States army cantonments. Following this address, reports of various committees were read. Owing to the fact that the president, Major Theodore A. Liesen, is engaged in military work, the chair was occupied by the vice-president, Allan W. Cuddeback, engineer and superintendent of the Passaic Water Co., Paterson, N.J.

In the afternoon the delegates were invited to join either of two parties. Those who were golfers were provided with transportation to the Midland Valley Country Club, where a tournament was held under the auspices of the Permanent Golf Committee of the Waterworks Manufacturers' Association and the American Waterworks Association. Twenty-seven members entered the tournament. The other delegates and their guests were taken by special cars to the Anhauser-Busch brewing plant, which employs about 6,200 people, where the automatic machinery was inspected.

Technical Papers Were Read

Tuesday's evening session was devoted to the reading of the following papers (while the ladies were entertained at a card party through the courtesy of the Waterworks Manufacturers' Association):—

"Management of Public Utilities in Cantonments," by Major P. Junkersfeld; "The Artesian Water Supply of Savannah, Georgia," by E. R. Conant; "Design of a Tilting Dam and Its Relation to Back Water on the Gunpowder River," by V. B. Siems; "Water Treatment Conditions at Council Grove, Kansas," by Louis L. Tribus.

Four papers were read on Wednesday morning. These dealt with various phases of the waterworks here, and were particularly timely in view of the fact that a trip of inspection to the waterworks plant had been arranged for Wednesday afternoon. The titles of the papers were:—

"Some Phases of Distribution Work," by W. A. Foley; "Double Fo ty-Eight-Inch Manifold at Bissell's Point," by C. M. Daily; "New 110-Million Gallon Pump at Chain of Rocks," by L. A. Day; and "Some Aspects of the Chemical Treatment at St. Louis Waterworks," by A. V. Graf.

Seventy Members From Canada

After these papers had been presented, the nominating committee was elected; then the suggesed places for holding the 1919 convention were voted upon. The Dominion of Canada has now seventy members in the American Waterworks Association, so H. Hymmen, of Kitchener, Ont., was elected from District No. 1 as the district's representative on the nominating committee. This district includes the Dominion of Canada and the states of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, Michigan and Wisconsin. Only two cities made a decided bid for the 1919 convention,—Buffalo and Detroit. Buffalo got 114 votes; Detroit, 52; so the next convention will be at Buffalo, N.Y.

At noon (Wednesday) the delegates sailed up the Mississippi River for about twenty miles, to the mouth of the Missouri River. On the return trip a stop was made at the city's waterworks, and the pumping and filter plants were inspected. The supply is pumped from the Mississippi River into seven settling basins that have a combined capacity of 200 million gallons. The mechanical filter plant, which was installed by the Pittsburg Filter Manufacturing Co., has a registered capacity of 160 million gallons per 24 hours, and is the largest filter plant in the world.

The pumping equipment consists of four Allis-Chalmers engines, with a capacity of 40 million gallons per day; twin De Laval steam turbine pumps, with a capacity of 30 million gallons per day; and a 110-million-gallon De Laval steam turbine pump which is now under construction.

Toronto Member Killed at the Front

Three papers were read Wednesday evening:—"The Literature of Field Water Supply," by Jack J. Hinman, Jr.; "The Practicability of Adopting Standards of Quality for Water Supplies," by Robert Morse and Abel Wolman (see page 485 of this issue); and "The Preliminary Analysis of the Degree and Nature of Bacterial Removal in Filter Plants," by Abel Wolman.

Thursday was "Superintendents' Day," and was devoted to general discussion on water mains, water consumption, frozen service pipes, fire hydrants, office records, pipe-laying, etc. In the evening two papers were read:—"Loss of Head in Service Cocks and Service Pipes," by B. J. Bleisteine; and "Lead Pipe Couplings," by J. A. Jensen.

Four amendmens to the constitution, which were sent out to the members some weeks ago, were adopted almost unanimously.

The service flag of the association, which hung outside the door of Secretary Diven, showed that 109 members are serving in the allied armies and navies. Only one member has been called upon to pay the supreme sacrifice, Lt.-Col. T. C. Irving, of Toronto, who was killed October 30th, 1917.

Officers were elected for the coming year as follows:—President, Charles R. Henderson, manager of the Davenport Water Co., Davenport, Iowa; vice-president; Carlton E. Davis, chief of the Bureau of Water, Philadelphia, Pa.; treasurer, James M. Caird, consulting chemist, Troy, N.Y.; trustees, J. J. Hinman, Jr., State Board of Health, Iowa, Ia.; and Allan W. Cuddeback, Passaic Water Co., Paterson, N.J.

At a meeting of the American Waterworks Manufacturers' Association, held during the convention, the following officers were elected for the ensuing year:—President, T. C. Clifford, of the Pittsburg Meter Co.; vice-president, E. D. Kingsley, of the Electro-Bleaching Gas Co.; secretary, John A. Kienle, of the Electro-Bleaching Gas Co.; treasurer, Chas. R. Wood, of R. D. Wood & Co.

Fifty Exhibits, All Uniform

Owing to transportation difficulties, it was deemed advisable to confine the exhibits chiefly to displays of models, photographs, drawings, etc. Each exhibitor was limited to 50 lbs. as the weight of his exhibit. There were about fifty booths, all uniform in size and arrangement. The general appearance of the exhibition was very attractive, as the booths were handsomely decorated. Among those who had booths were the following:—

Birch-Hintz Co., Chicago. Represented by W. T Birch, of the Chicago office.

Buffalo Meter Co., Buffalo. Represented by E. W. Widdows, of the Chicago office.

Builders Iron Foundry, Providence, R.I. Represented by A. B. Coulters, of Providence, and D. J. Purdie, of New York.

Dixon Crucible Co., Joseph, Jersey City. Represented by A. T. L. Smith, of St. Louis.

Eddy Valve Co., Waterford, N.Y. Represented by Harry A. Holmes, of Waterford.

Electro-Bleaching Gas Co., New York City. Represented by E. D. Kingsley, president; John A. Kienle; G. R. Ellis; S. W. Jacobs; and D. K. Bartlett, who recently joined this firm after having been with the Builders Iron Co. for several years.

Harrison Bros., Inc., Philadelphia, Pa. Represented by J. J. Haas.

Leadite Co., Inc., Philadelphia, Pa. Represented by Geo. McKay, Jr., and James P. McKay.

Modern Iron Works, Quincy, Ill. Represented by Dwight P. Child, assistant manager.

Mueller Mfg. Co., Decatur, Ill., and Sarnia, Ont. Represented by Fred B. Mueller and E. E. Pedlow.

National Water Main Cleaning Co., New York. Represented by Burt Hodgman.

Neptune Meter Co., New York. Represented by S T. Hard and H. A. Beynon.

New York Continental Filtration Co., New York. Represented by Arthur M. Crane, general sales manager.

Pennsylvania Salt Mfg. Co., Philadelphia, Pa. Represented by N. E. Bartlett, of Philadelphia.

Permutit Co., New York. Represented by J. L Cheney.

Pitometer Co., New York. Represented by E. S. Cole, president, and E. D. Case, manager.

Pittsburg Filter Mfg. Co., Pittsburg, Pa. Represented by J. P. Leopold and E. W. Bacharach.

Pittsburg Meter Co., Pittsburg, Pa. Represented by T. C. Clifford, F. H. Bradford, R. M. Stottler and S. G. Swaffield.

R. U. V. Co., New York City. Represented by Mason Hullet, of New York City, and Dr. Harry M. Hill, of the Kansas City office.

Rensselaer Valve Co., Troy, N.Y. Represented by Irving K. Rowe and Geo. A. Keefer, both of Troy.

Ross Valve Co., Troy, N.Y. Represented by Wm. Ross, of Troy. *(Concluded on next page)*

Smith Co., A. P., East Orange, N.J. Represented by A. T. Halpin, W. A. Start, A. C. Nilman and J. W. Strackbein.

Sullivan Machinery Co., Chicago, Ill. Represented by D. H. Hunter, of the St. Louis office. This firm showed drawings of their air lift pumps.

Wallace & Tiernan Co., New York. Represented by M. F. Tiernan, president; R. E. Murphy, of New York City; and C. A. Jennings, of Chicago.

Wood & Co., R. D., Philadelphia, Pa. Represented by Chas. R. Wood, J. Wistar and Vincent McCarthy.

C.N.R. ARBITRATORS' REPORT

PLACING the value of the 600,000 shares of common stock of the Canadian Northern Railway at $10,800,000, and determining that each party shall pay its own share of the costs of the arbitration, the award unanimously agreed upon by Sir William Meredith, Hon. R. E. Harris and Hon. Wallace Nesbitt has been officially announced. The maximum payment was limited to $10,000,000 by act of parliament, and while the arbitration board places the value at $800,000 more than that figure, probably only $10,000,000 will be paid, as the Mackenzie & Mann and Canadian Bank of Commerce interests are said to have agreed to accept that sum in case a larger valuation should be awarded by the arbitrators. The report is as follows:—

"We, the Honorable Sir William Ralph Meredith, chief justice of Ontario; the Honorable Robert Edward Harris, chief justice of the supreme court of Nova Scotia; and the Honorable Wallace Nesbitt, of the City of Toronto, the arbitrators appointed under the provisions of an agreement bearing date the first day of October, nineteen hundred and seventeen, between His Majesty the King, represented herein by the minister of finance and receiver-general, and the minister of railways and canals, acting under the authority of an order-in-council, dated the fifteenth day of November, nineteen hundred and seventeen, of the first part, and Mackenzie, Mann & Company, Limited, of the second part, and the Canadian Bank of Commerce of the third part, to determine the value of the six hundred thousand shares of the capital stock of the Canadian Northern Railway mentioned therein, as of the date of the agreement, having taken upon ourselves the burden of the reference and heard the parties by their counsel and the evidence adduced, do award and determine:—

Value Was $10,800,000

"1.—That the value of the said six hundred thousand shares as of the date of the agreement was the sum of ten million eight hundred thousand dollars.

"2.—That the parties shall respectively pay and bear their own costs of arbitration, except that the government of Canada shall pay the expenses of taking and transcribing the evidence, the remuneration of the secretary and messenger employed by us and the incidental expenses incurred by the secretary.

"The question to be determined by the arbitrators was one of great difficulty and one which, of necessity, admitted of great diversity of opinion. We heard much testimony and had the benefit of assistance of experienced and able counsel on both sides, and carefully investigated every matter which seemed to throw any light upon the question to be determined. As to whether or not there was a surplus of assets over liabilities was naturally a subject which engaged much time and consideration. It is, of course, not a conclusive test as to the value of the stock, but it is an element which cannot be ignored. Its importance was perhaps emphasized by the fact that a royal commission had reported the assets and liabilities of the company to be about equal. This report which was made in a proceeding to which the company and its shareholders were not parties, was admittedly based on a misconception of some of the facts, and there were omissions of both assets and liabilities. It should also be pointed out that the work of the royal commission had reference to a date anterior to the first day of October, 1917, and there were changes in the interval.

"In arriving at the surplus of assets over liabilities, the report of Prof. Swain as to the reproduction cost new of the physical property based on pre-war prices, and also his estimate of the depreciation, has been adopted, and after a careful examination we found the surplus of assets over liabilities of the company on the first day of October, 1917, on a conservative basis, to be not less than twenty-five million dollars, after deducting the full amount of depreciation found by Prof. Swain, and making such reduction in the value of the land grants and other assets as deemed reasonable.

Reproduction Less Depreciation Not Accurate

"It is to be pointed out that a valuation of the physical property of a railway company by the reproduction new method, less depreciation, is not to be regarded as an ascertainment of the actual value. It is only a means to that end, but as it was the best, and in fact the only estimate available, it has been adopted as a basis for the foregoing calculations.

"While the surplus of assets over liabilities is an element for consideration, as has been already pointed out, it is not conclusive as to the value of the stock of the company. Its prospective earning power is perhaps more important than any other element in ascertaining such value, and in arriving at a conclusion we have given careful consideration to the past history of the company, its earnings and expenditures, the present financial position of the company, the location of its lines and their construction, the other railways already existing in competition, the rate of interest on the funded and other debts of the company, the probable future growth of the population and business of the country, and all other factors which seemed to us to have any bearing upon the question.

"It is apparent that there was great room for difference of opinion in a matter involving so many elements of uncertainty and speculation, but after taking into consideration all the circumstances which appeared to us to be entitled to weight in determining so difficult a question, we came to the conclusion we have mentioned.

"In witness whereof we have hereunto set our hands this twenty-fifth day of May, 1918.

"Signed, published and declared (in triplicate) in presence of E. Oliver. W. R. Meredith; Robt. E. Harris; Wallace Nesbitt.

Manitoba spent $466,946 during 1917 under the Provincial Good Roads Act. Of this amount the province contributed $220,996 in cash to the municipalities, besides the services of the provincial highway engineering department. A total of 264.81 of roads were constructed during the year, of which 174.07 were earth roads and 90.74 were gravel. Up to the beginning of this year there had been constructed altogether, under the act, 580.76 miles of roads, of which 365.82 were earth roads, 191.69 were gravel and 23.25 were asphalt or concrete.

ENGLISH AND AMERICAN PRACTICE IN THE CONSTRUCTION OF TAR SURFACES AND PAVEMENTS*

By Arthur H. Blanchard, M.Can.Soc.C.E.
Consulting Highway Engineer, New York City

TAR was used as a material for the construction of pavements as early as 1820, when a tar macadam pavement was laid in London. In 1834 an English patent was issued covering some of the features of the modern Pitchmac pavement. Tar concrete pavements were first built probably about 1840, in Nottingham, England. In Canada, tar concrete pavements were constructed in Ontario in the period from 1880 to 1891. Highway engineers in the United States have used tar concrete pavements in municipalities since 1870. It was not until 1906, however, that tar concrete was given consideration as a pavement for use on State highways. After conducting service tests for three years, Rhode Island, in 1909, was the first state to adopt the tar concrete pavement as a standard type for use on highways outside urban districts. Tar was first used for surface treatments in France in 1871. In the United States, thin tar surfaces were first employed in 1894, in Montclair, N.J. In America, however, the rapid development of the use of tar for surface treatment did not begin until 1906.

Tar Surfaces

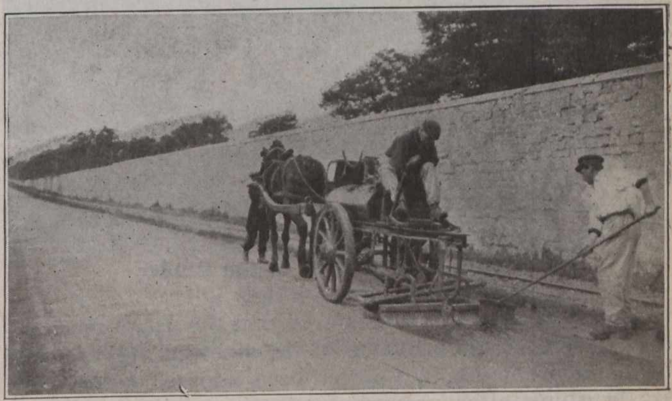
Classification—Tar surfaces may be considered as divided into two classes.

The first class consists of thin superficial coats of tar with or without the addition of such materials as stone chips, fine gravel or sand. When this type of tar surface has been under traffic for from one to two years, the road metal, or other material composing the wearing course, is exposed.

The second class consists of coats of tarred material of appreciable thickness, usually over ½-inch, and are formed by the application of one or more treatments of tar with sand, gravel or stone chips added. Surfaces of this class are known as tar carpets or blankets. They rarely wear down uniformly to the wearing course and hence increase unevenly in thickness by retreatments.

English Hand Spraying Machine

Construction—Before constructing a tar surface on a broken stone or gravel road, every precaution should be taken to secure the best subdrainage which is practicable under the local conditions. All depressions, pot-holes, ruts or other irregularities should be filled with thoroughly compacted, tar-coated stone so that the whole surface of the roadway is even. All surplus dust must be removed so that the larger pieces of broken stone of the roadway surface are exposed, but without breaking the bond. This cleaning process is accomplished by the use of horse sweepers and fine bass brooms, with coarse fibre brooms and fine bass brooms, or by a vacuum process. If there is caked mud on the surface of the roadway, wet brushing will prove advantageous.



French Gravity Distributor Equipped with Brushes

It is apparent that the character of the cleaned surface will be affected by the method which was used in the original construction of the roadway. If there be followed the practice of some English and American engineers in using large-size stone varying from 1 to 2½ inches in longest dimensions for the top course of a broken stone road, and if the stone be hard and tough, the desired surface can be easily secured. The surface of the large stones in such a roadway are easily cleaned by brushing, without the dislodgment of stones in the surface. A clean mosaic surface is of the utmost importance from the standpoint of the formation of a satisfactory bond between the broken stone and the tar. The maintenance of tar surfaces on wearing courses of large broken stone is economical, since after the tar surface wears away in spots, the mechanically interlocked large stones will of themselves generally have sufficient stability to withstand the effects of traffic until retreated.

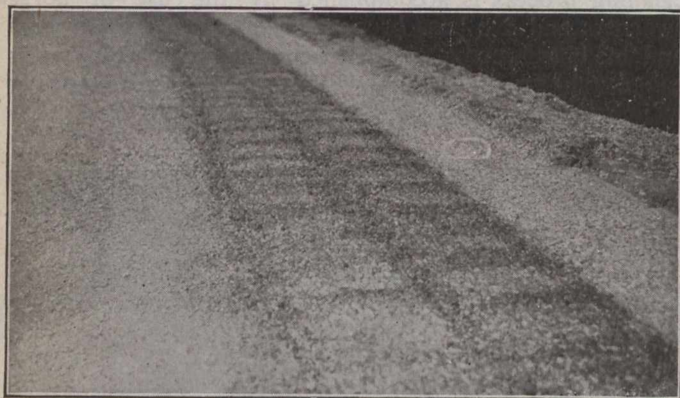
On the other hand, if the top course of a broken-stone road has been constructed of a product varying in size from ¼ to 1¼ inches, it will be very difficult, if not impossible in the case of soft stone, to secure an even, clean surface. Even after thorough brushing, a film of impalpable dust usually covers the surface of the roadway. During hard brushing small depressions will probably be formed by the displacement of pockets of dust and the smaller sizes of stone. Furthermore, the wheels of vehicles may adhere to the tar and thus tear up the small mineral matter adhering to it. As soon as the tar surface wears out in spots, rapid disintegration of the exposed broken stone or gravel surface, with the consequent formation of pot-holes, is apt to occur.

If a tar surface is to be constructed on a new broken-stone or gravel road, or on one which has just been resurfaced, the tar should not be applied until the crust has had time to consolidate under the action of traffic and with the aid of the binding action of dust and moisture. If it be impracticable to postpone the surface treatment, special care should be taken to secure a maximum consolidation of the crust of the roadway by puddling and rolling.

*Address delivered May 8th, 1918, at Canadian Good Roads Congress.

When the tar is applied, the roadway surface should be bone dry. If the surface is damp, it will be difficult to secure a good bond. Distribution of the tar is accomplished by two methods, (1) flow by gravity, (2) mechanical pressure.

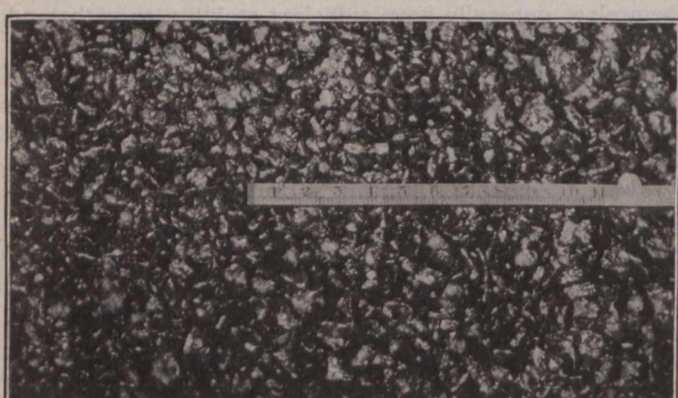
The use of gravity distributors has not been developed to its fullest extent in America, in that the use of mechanical brushes, or the brushing of the material into the road by hand brooming, has never been adopted extensively. By brushing after gravity distribution, it is possible to distribute uniformly 1/4 to 1/5 gallons of tar per square yard. In some cases, when the distribution is accomplished by hand brooming, the adhesion of the material to the road metal is as good as when the material is applied under pressure. The advantages claimed for pressure distributors are the following:—



Uneven Distribution of the Binder

Aid in cleaning the surface of the roadway; even application; distribution of small amounts per square yard; satisfactory adhesion obtained between the tar and the surface of a clean, dry roadway; and rapid, economical distribution.

As a general rule, from 1/4 to 1/2 gallon per square yard is used for the first treatment, preferably in two applications. The amount applied per treatment depends upon the kind of tar, the character and condition of the surface, and the details of the method of application. For example, a smooth surface composed of large-sized, tough, hard stone, well compacted by traffic, would require from 0.25 to 0.35 gallon; for a somewhat rough surface of stone having a medium toughness and hardness and recently resurfaced, it would be necessary to use from 0.35 to 0.5 gallon per square yard to form a satisfactory thin tar surface.



Surface of Tar Concrete, Class A, Before Application of Seal Coat

The superficial coat of tar is usually covered with either coarse sand, fine gravel or stone chips varying from 1/8 to 1/2 inch in longest dimension. Material containing clay should not be used, as disintegration may result by the emulsifying of the clay and water on the tar surface. The amount of sand, stone chips or gravel used per square yard depends upon the quantity and kind of the tar and the character of the surface of the roadway. From 5 to 20 pounds per square yard have been used satisfactorily for thin tar surfaces; 5 to 12 pounds for from 0.1 to 0.25 gallon of tar per square yard; 10 to 17 pounds for 0.25 to 0.35 gallon; and 15 to 20 pounds for from 0.35 to 0.5 gallon.

Cost Data—Under normal conditions, with labor and foreman at $2 and $4 respectively for an 8-hour day; teams, $5 per day; refined tar, applied, 7 to 9 cents per gallon; and top covering, $2 to $2.25 per ton, delivered; the cost of tar surfaces, using from 0.25 to 0.4 gallon of tar per square yard, will vary from four to eight cents.

Tar Macadam Pavements

Definition—A tar macadam pavement is one having a wearing course of macadam with the interstices filled by a penetration method with a tar cement.

Pitchmac on Princes Avenue, Liverpool

Foundations—Usually tar macadam pavements are constructed on broken-stone or gravel foundations. In cases where traffic conditions require rigid foundations, or where materials satisfactory for cement-concrete may be secured at a much lower cost than broken stone, cement-concrete foundations have been used and have been found to be satisfactory and economical. The more general use of cement-concrete foundations is advisable on trunk or other highways where traffic is likely to increase rapidly both in amount and weight. When it is necessary to construct a more durable type of wearing course than tar macadam, the cement-concrete foundation previously constructed proves a valuable asset and allows reconstruction to be accomplished economically.

Physical Properties of Road Metal—The weight to be given to toughness and resistance to abrasion depends primarily upon the traffic to which the pavement will be subjected and the details of the method of construction adopted. For example, for many highways serving as feeders to State trunk routes, a rock having a toughness of not less than six and an abrasion loss of not more than 6% would prove economical and satisfactory; but if used on State trunk highways subjected to horse-drawn or motor-trucks, rock having a toughness of not less than thirteen and an abrasion loss of not more than 3.5% should be employed. In cases where rock with suitable toughness and wearing quality is not locally available, satisfactory results may be obtained by importing the broken stone for the surface of the pavement and using local rock for the lower part of the crust.

In order that road metal should interlock during compaction and thus provide a stable wearing course, a proper angularity is an important prerequisite. The road metal should not contain over 5% of particles having small acute angles, nor should the product contain slivers. Road metal which has a rough or coarse grain or pitted surface is preferable to material with smooth or glassy surfaces, as the tar cement adheres more satisfactorily to the former than to the latter. Cleanliness is an essential quality of road metal for the wearing course of tar macadam pavements. It is difficult and usually impossible to secure a good adhesion of the tar cement to road metal which is not clean.

Construction—In the construction of tar macadam pavements it is desired to secure (1) a stable wearing course consisting of broken stone or similar material thoroughly rolled so that it will be well compacted and keyed together, and with the several sizes of material uniformly distributed; and (2) a uniform distribution and penetration of the tar within the upper 1½ to 3 inches of the crust.

Construction of Pitchmac Pavement, Liverpool

Several methods of construction have been devised with a view to meeting the above prerequisites. Careful supervision, based on experience, is necessary to prevent non-uniformity in the density of the wearing course of broken stone and in the amount of tar applied per square yard. It is evident that uniform application of the tar will depend upon the method of distribution employed. In using vehicular distributors, one cause of uneven distribution of the tar is overlapping of applications. The use of strips of tar paper or wrapping paper, from 3 to 5 feet in width, placed at the edge of an application, has prevented sections of the wearing course receiving double the amount of tar cement specified.

A typical American method of construction is as follows: The metalling of the wearing course is a uniform product of about 1 or 1½ inches in size or a product similar to or larger than one passing over a 1½-inch and through a 2½-inch screen, and the voids in the upper part of the wearing course are filled after the tar cement is applied. Practice varies with reference to the amount of rolling of the wearing course prior to the application of the tar cement. For traffic medium or heavy in weight and amount, the best results have been secured by thoroughly rolling the road metal and thus securing maximum interlocking of the particles and thereby securing the highest degree of stability practicable by this method. The tar cement is applied in an amount varying from 1½ to 2 gallons per square yard, after which ⅜-inch stone chips, or a product similar to one passing a ½ inch and through a 1-inch screen, is spread and thoroughly rolled. Usually the surface is then broomed with stiff brooms, removing the excess loose broken stone, and another coat of tar cement, from ⅓ to 1 gallon per square yard, is ap-

Wrong Way to Use Pouring Cans

plied, covered with a layer of stone chips or pea gravel, and rolled.

A tar macadam pavement called "Pitchmac" by its inventor, J. A. Brodie, city engineer of Liverpool, England, has been used to a considerable extent in that country and has been adopted as a standard type by the English road board. It is constructed on a foundation of stone. The wearing course of broken stone varies from 2 to 4½ inches in depth, dependent upon traffic conditions. If the wearing course is from 2 to 3 inches in thickness, it is constructed in one layer; and if from 4 to 4½ inches, in two layers. The single layer (or, in the case of two layers, the upper layer) is composed of broken stone ranging in size from 1¼ to 2½ inches. After thorough rolling, the tar compound is applied to the single layer or to each of the layers of the two-layer wearing course. The tar compound used in England consists of hot sand mixed with tar pitch. From 1¼ to 2 gallons per square yard are used for the one-layer wearing course, and from 3¼ to 3½ gallons for the two layers.

Right Way to Use Pouring Cans

To assist in completely filling the voids, chips varying in size from ⅜ to ¾ inches are applied during the rolling of the tar-grouted layer.

The oldest sample of Pitchmac in Liverpool was laid in Princes Avenue, in 1901, near the end of Eversley Street, and has been in continuous use ever since without repair. This avenue carries a large volume of light motor and carriage traffic, as well as some of a heavier character, the traffic amounting to 120,000 tons per yard width per annum.

Pitchmac has been used to a limited extent in Massachusetts. The writer is indebted to Arthur W. Dean, chief engineer of the Massachusetts Highway Commission, for the following authoritative and instructive data covering the cost of construction and maintenance of Pitchmac pavements in Massachusetts having top courses of two inches, filled with tar and sand, and foundation courses of 4 inches of broken stone:—

Roads	Year Built	Cost	Maintenance Per Sq. Yd.	Traffic
Tyngsboro W. .	1913	$1.01	$0.0118	Medium
Natick E.	1914	1.12	0.0191	Heavy
Newton	1914	1.21	0.0118	Medium
Reading S.	1914	1.18	0.0266	Very heavy
Wayland	1914	1.46	0.0175	Very heavy
Gloucester W. .	1915	1.15	0.0141	Medium
Boston	1916	1.20	0.0000	Heavy

Notes:—The condition of all these roads is good. The character of traffic on the several sections is as follows:—

Tyngsboro W.—Heavy pleasure travel, truck and logging teams in spring and fall.

Natick E.—Pleasure cars, trucks between Framingham and Boston.

Newton—Pleasure cars 70%, trucks 15%, teaming 15%.

Reading S.—Pleasure cars, very heavy trucking.

Wayland—Pleasure cars, very heavy trucking.

Gloucester W.—Pleasure cars 80%, trucks 10%, teams 10%.

Boston—Mostly trucks and teaming, pleasure cars 30%.

The maintenance cost quoted is the average per square yard per year since the surface was laid, and with the exception of the Reading S. road, is entirely for sanding. There having been no repairs made nor necessary, nor probably will be for some years. At Reading the contractor had poor workmen and early corrections were necessary on that account. The sanding was necessary mostly on account of surplus tar on surface, and perhaps 25% for slipperiness during cold weather. Notice no repair expense at Boston, due to perfect workmanship. This was partly the result of experience, as it was the latest piece laid and can be equalled under favorable conditions.

Distributors—The appliances used in the distribution of tar cements may be classified as gravity distributors and pressure distributors. The market is supplied with so many different types, that a thorough investigation should be made preceding the purchase of a machine. The following factors should be given consideration when selecting a distributor:—

(1) Character and range of work upon which the distributor will be used.

(2) Present and probable requirements in specifications pertaining to type and details of distributors and the work to be done.

(3) Different types and grades of tar cements which the machine will distribute, and the range in the amount per square yard which can be applied.

(4) Gravity or pressure distribution, and, if the latter, the range in pressure per square inch.

(5) Method of controlling uniformity and amount of distribution.

(6) Accessories of distributors for heating material, recording temperature of tar cement, amount in tank and amount of pressure, and for shutting off tar cement at end of run.

(7) Width of distribution and means for modifying same.

(8) Motive power.

(9) Width of tires and loads per linear inch of tires when tank is full.

(10) Ease of operation and repair.

(11) Structural strength.

(12) Amount and character of labor required to efficiently operate the distributor.

(13) Economics, including overhead operation and maintenance charges.

Cost Data—The cost of tar pavements built by penetration methods varies with the amount and kind of tar cement and road metal used and the method of construction employed. An average cost, using 6 to 8 inches of compacted broken stone and a total of 2 to 2¾ gallons of tar cement per square yard, varies from 25 to 40 cents per square yard in excess of the cost of waterbound broken stone roads, or from 70 cents to $1.25 per square yard.

Tar Concrete Pavements

Definition—A tar concrete is one composed of broken stone, broken slag, gravel or shell, with or without sand, portland cement, fine inert material or combinations thereof, and a tar cement incorporated together by a mixing method.

Classification—Tar concrete pavements may generally be grouped into three classes. The essential characteristics of these classes are as follows:—

Class A—A tar concrete pavement having a mineral aggregate composed of one product of a crushing or screening plant.

Class B—A tar concrete pavement having a mineral aggregate composed of a certain number of parts by weight or volume of one product of a crushing or screening plant, and a certain number of parts by weight or volume of sand, broken stone screenings or similar material, with or without a filler.

Class C—A tar concrete pavement having a predetermined, mechanically graded aggregate composed of broken stone, broken slag, gravel or shell, with or without sand, portland cement, fine inert material or combinations thereof.

Patent Litigation—In connection with the design or selection of a suitable type of tar concrete pavement, it is necessary to consider the possibility of an infringement suit being brought by one of the patentees of proprietary pavements. Highway engineers and contractors are primarily interested in the types of tar concrete pavements which may be constructed without danger of litigation rather than in a voluminous discussion of the probabilities of successfully defending infringement suits.

Class A—There is ample evidence at hand that tar concrete pavements of this class may be constructed without danger of litigation proceedings.

Class B—The history of litigation cases indicates that the construction of unpatented tar concrete pavements of this class on a large scale will in all probability lead to an infringement suit.

Class C—With the exception of the class of tar concrete pavements having mineral aggregates similar to that covered by the Topeka decree, the extensive use of non-patented tar concrete pavements of this class will usually lead to litigation proceedings.

Foundations—Many failures have occurred due to laying tar concrete pavements on weak foundations. Of the more common types of foundations, satisfactory results have been obtained under medium traffic with thoroughly filled and compacted broken stone and tar-concrete foundations. Cement-concrete foundations should generally be used.

Construction—Under Class A, two types of pavements will be considered. The most efficient type, as laid in America, has a mineral aggregate which will comply with the following requirements:—

All of the broken stone or broken slag shall pass a 1¼-inch screen; not more than 10% nor less than 1% shall be retained on a 1-inch screen; not more than 10% nor less than 3% shall pass a ¼-inch screen.

This aggregate, for small jobs, may be mixed with hot tar cement by hand methods. Usually, however, mechanical heating and mixing plants should be used. In a complete plant for the manufacture of tar concrete, the aggregate is carried by bucket elevators to rotary dryers, where it is dried and the dust exhausted. From the dryer the aggregate is raised by elevators to storage bins. When required the aggregate is drawn from the bins to a weighing device, and from there deposited into a mixer. Such plants are also equipped with tar cement heating tanks and weighing buckets. A plant of this type should have a capacity of from 800 to 1,000 square yards of 2-inch wearing surface per day. For the type of tar concrete under consideration, it has been found that the tar mixture should contain between 5% and 8% of bitumen.

An important detail of laying is thorough rolling. An even surface and adequate compaction, with thorough interlocking of the particles of broken stone, may be readily obtained by the proper use of a tandem roller weighing between 10 and 12 tons.

Many methods have been developed for the application of the seal coat of tar. It has been found that seal coats of from ½ to 1 gallon of tar cement per square yard are distributed most uniformly by the use of hand-drawn gravity distributors, followed by a squeegee.

The average cost of this type of tar concrete under normal conditions, when laid as a 2-inch wearing course, should be from 25 to 40 cents in excess of a waterbound broken-stone wearing course of the same thickness.

The second type of tar concrete of Class A is the two or three-course pavement in which each course consists of one product of a crushing or screening plant. The excellent tar slag concrete pavements which have been laid in England since 1903 are of this type. Although used by various municipalities, the largest yardage of this type has been constructed by Tarmac, Limited. One of the Tarmac plants is located at Wolverhampton, adjacent to that of a company producing large quantities of blast-furnace slag. The large molds of slag are transported by small cars from the iron works on a narrow-gauge track and dumped near the Tarmac works. These large blocks, while still warm, are broken by sledge-hammers to a size suitable for the crusher. After it is crushed and screened into sizes varying from ¼ to 2½ inches, it is mixed with a tar compound. Since the slag is warm even after it has been crushed, no heating preliminary to mixing is necessary.

Although in some cases two courses of tar slag concrete are used, usually more than two layers of tar-coated slag are employed, as was the case with tar slag concrete pavement laid at Brighton-on-Sea. The details of construction follow:—

On a well-compacted gravel foundation was spread a scattering of tar-coated slag chips. The bottom layer was composed of 2½ inches of compacted 1¼ to 2½-inch tar-coated slag. The second course consisted of 2 inches of compacted ½ to 1½-inch tar-coated slag. The third course was composed of a thin layer of ⅛ to ⅜-inch tar-coated slag chips, which layer was thoroughly rolled. The pavement was finished by rolling a top dressing of uncoated fine slag screenings.

Tar concrete pavements of Class C, with mineral aggregates similar to the modern Topeka grading, were laid in Pittsburgh, Pa., about 1890. The pavement laid on Lang Avenue has been in service, with only nominal repairs, for the past twenty-six years. Many similar pavements were constructed in several cities of New England as early as 1885. Since 1913, tar Topeka pavements have been laid in several States throughout the middle west of the United States and also in cities of New England. Some of the best examples of this type of tar concrete pavement have been constructed with about 8% of tar bitumen in the mix, and with a light seal coat of refined tar.

PRACTICABILITY OF ADOPTING STANDARDS OF QUALITY FOR WATER SUPPLIES*

By Robert B. Morse† and Abel Wolman‡

Maryland State Department of Health

IN spite of the fact that the attempt to establish a so-called standard to serve as a basis for interpreting or classifying the quality of potable waters has met with but little success in the past, endeavors are still being made to standardize the consideration of analytical results so as to eliminate personal judgment as a feature of interpretation. The difficulties besetting these efforts, such as the undetermined significance of the bacterial test made by various methods, the importance of varying chemical content and the evidence of sanitary surroundings, are still present in probably a greater degree than in the past, on account of the development of the science of water bio-chemistry and the added confusion created by the ever-changing methods, media, temperature, and differentiations.

Before establishing a measure of the quality of a potable water, it is necessary to determine by what units such measurements are to be evaluated. In the case of water supplies, the choice of appropriate units becomes difficult, since the question immediately arises as to whether the bacterial count, the B. coli test, the chemical determinations, or the sanitary inspection, should be the sole criterion; or if a combination of these factors, as to what their relative importance should be in any proposed unit of measure. Manifestly, a standard in its simplest terms could be predicated upon any single one of the abovementioned units, if we assume that such a standard would fulfil the requirements of a universal measure of quality. Even then the problem still remains of deciding what unit of bacterial content, for instance, shall be chosen as the basis for comparison.

A unit of measure must be found upon the existence of an absolute uniformity of condition and of material which can be made to serve as the immutable basis for future comparative readings. The unit of length, for example, is that distance between the ends of a bar of definite material, in a definite place, measured and corrected for predetermined conditions of atmospheric pressure and temperature. Such a unit immediately establishes a precise standard by means of which further measurements of length under all conditions may be carried out. The search for a "quality standard" for water should be first directed, therefore, towards determining whether there

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*Abstracted from paper read at convention of the American Water Works Association, St. Louis, May 15th, 1918.

†Chief Engineer.

‡Division Engineer.

are available any definite units in sanitary science which could serve as the basis for a standard.

If the water analysts have agreed upon well-defined methods of water analysis, then the evaluation of a standard would be at least possible, if not valuable, for interpretation. In order to learn whether any degree of uniformity existed in the laboratory examination of water supplies, a questionnaire was submitted to thirty-three state department of health laboratories in the United States. Thirty-two answers were received and sufficiently detailed information was obtained to warrant the conclusions later to be discussed. With these data at hand, the practicability, at the present time, of formulating a standard of quality for water, in the light of present-day analytical practice, may be discussed with more precision.

Total Bacterial Count

The total number of bacteria in a stated quantity of water has been used frequently in establishing a maximum allowable pollution in potable waters. One of the more recent of these is the requirement of the United States Treasury Department that water supplied to common carriers should contain no more than 100 bacteria per c.c. (37° 24 hours agar). The creation of such standards presupposes a unanimity of opinion as to the significance and importance of particular bacterial counts obtained by definite procedures, over others found by any other methods. Such an agreement would be reflected, of course, in the routine procedures of such laboratories of which we have record. The data in Table I. disclose, however, a disconcertingly wide difference, rather than agreement, of attitude toward the various methods. If official water analysts differ in their choice of the method of making total counts, it is reasonable to conclude that their disagreement would be even greater in a choice of a "standard" total count. Since the relative significance, for instance, of the total number of bacteria on a plain agar plate at 37° C., as compared with the count on a gelatine plate at 20° C., is still a moot question, it is clear that more confusion in interpretation will result when several additional different combinations of media, temperatures, and periods of incubation are to be considered.

It is also of striking interest to note that, in spite of the fact that the 37° C. agar count at 24 hours incubation has been for several years an official standard procedure of at least two organizations (American Public Health Association and U.S. Treasury Department), only 19, or

Table I.—Method of Obtaining Total Bacterial Count in Laboratories of Various State Departments of Health

Name of State	20° C. Gelatine		20° C. Agar		37° C. Gelatine	37° C. Agar		Lit. Lact. Agar	
Hours:—	48	96	48	96	48	24	48	24	48
Alabama	No definite information								
California	.	.	.	.	.	x	.	.	.
Connecticut	x	.	.	.	.	x	.	.	.
Dist. of Columbia	.	.	x(a)	.	.	.	.	.	.
Florida	.	.	.	.	.	.	x	.	.
Georgia	.	.	.	.	.	x	.	.	.
Illinois	x	.	.	.	.	x	.	.	.
Indiana	.	.	.	.	.	x	.	.	.
Iowa	.	.	x	.	.	.	.	x	.
Kansas	x	.	.	.	.	x	.	.	.
Kentucky	.	.	.	.	.	x	.	.	.
Maine	x	.	.	.	.	x	.	.	.
Maryland	.	.	x	.	.	x	.	.	.
Massachusetts ..	.	.	.	x	.	.	.	x	.
Michigan	.	.	.	.	.	x	.	.	.
Minnesota	.	.	.	x	.	.	.	.	.
Missouri	.	.	.	.	.	x	x	.	.
Montana	.	.	.	.	.	x	.	.	.
New Hampshire	No definite information								
New Jersey	.	.	x	.	.	x	.	x	.
New York	.	.	.	.	x	x(b)	.	.	.
North Carolina..	x	.	.	.	.	.	.	x	.
Ohio	.	.	x	.	.	x	.	.	.
Oklahoma	.	.	.	.	.	x	.	.	.
Pennsylvania ...	.	.	.	.	.	.	x	.	.
Rhode Island ...	.	.	x	.	.	.	.	x	.
South Carolina..	.	.	.	.	.	x	x	.	.
South Dakota...	.	.	.	.	.	.	x	.	.
Vermont	.	.	.	.	.	x	.	.	.
Virginia	.	.	.	.	.	x	.	.	.
West Virginia ..	.	.	.	.	.	.	x	.	.
Wisconsin	.	x(c)	.	.	.	.	.	.	x
Wyoming	x	.	.	.	.	.	x	.	.

(a)—25° C. (b)—Infrequent. (c)—15° to 20° C.

NOTE.—Data in above table obtained by letter in 1917 from officials of various state departments of health.

Table II.—Method of Making Presumptive Tests for B. Coli in Laboratories of Various State Departments of Health

Name of State	Medium Used: Lact. Broth	Medium Used: Lact. Bile	Period of Incubation: 48 hrs.	Period of Incubation: 72 hrs.
Alabama	No definite information			
California	x	.	x	.
Connecticut	x	.	x	.
Dist. of Columbia	.	x	x	.
Florida	x	.	x	.
Georgia	x	.	x	.
Illinois	x	.	x	.
Indiana	x	.	x	.
Iowa	x	.	x	.
Kansas	x	x	x	.
Kentucky	x	.	x	.
Maine	.	x	x	.
Maryland	x	.	x	.
Massachusetts ...	x	.	x	.
Michigan	x	.	x	.
Minnesota	x	.	x	.
Missouri	x	.	x	.
Montana	x	.	x	.
New Hampshire..	.	x	x(36 hrs.)	
New Jersey	x	x(a)	x	.
New York	No presumptive test			
North Carolina ..	.	x	x	.
North Dakota ...	.	.	.	.
Ohio	x	.	x	.
Oklahoma	x	.	x	.
Pennsylvania ...	No presumptive test			
Rhode Island	x	.	x	.
South Carolina ..	.	x	.	x
South Dakota ...	x	.	x	.
Tennessee	.	.	.	.
Vermont	Lactose neutral red		x	.
Virginia	.	x	x	.
West Virginia ...	x	.	x	.
Wisconsin	No presumptive test			
Wyoming	No definite information			

(a)—Infrequent.

NOTE.—Data in above table obtained by letter in 1917 from officials of various state departments of health.

Table III.—The Effect of an Increased Period of Incubation in the Presumptive Test Upon the Possible Number of Confirmatory Tests

Total Number of Tubes Incubated and Giving Gas = 495

Gas Formation at End of	Number Tubes Showing Gas		Per Cent. Tubes Showing Gas		Number Confirmed		Per Cent. of Total Tubes Confirmed	Per Cent. of Total Samples Confirmed
	Total	Additional	Total	Additional	Total	Additional		
24 hours	18	18	3.6	3.6	17	17	6.2	3.4
48 hours	263	245	53.1	49.5	197	180	66.0	36.0
72 hours	448	185	90.5	37.4	264	67	24.6	13.4
96 hours	495	47	100.0	9.5	273	9	3.3	1.8

Note—Data obtained from routine analytical determinations in laboratory of Maryland State Department of Health during 1917. Presumptive tests in lactose broth. Confirmatory tests consisted of Endo, secondary lactose broth, and agar slant.

approximately 60 per cent., of the laboratories in question have seen fit to use this exact procedure as a routine measure. The percentage is undoubtedly higher than that which would represent the individual opinions of the analysts in these laboratories, in view of the fact that some of them have adopted the aforementioned methods on account of their official stamp rather than as a result of the conviction that they are superior to others. This conclusion is borne out by the fact that it has been by no means firmly established that the bacterial count, obtained as outlined by the Federal requirements, serves as the best index to the quality of a drinking water. In the light of the data illustrating the wide discrepancy in the method of obtaining the bacterial count, it would appear that effort should be directed towards further study of individual types of bacteria and their relative significance rather than towards an attempt to predicate a standard upon such an elusive and variable factor as the general bacterial count.

B. Coli

An index to sewage pollution in potable waters is an excellent asset in determining the safety of a supply if it "indicates." Some years ago, perhaps, the presence of B. coli in small quantities of water was considered sufficient evidence upon which to condemn the supply. He certainly would be venturesome who would issue a manifesto to-day as to the allowable frequency of B. coli in a safe water. He would indeed be skilled who can gather sufficiently consistent data out of the present chaotic conception of the significance of B. coli, and of how to obtain it, to be able to establish even a fairly elastic measure of quality.

Table II. illustrates, for instance, that the use of a medium for testing even the elementary phenomenon of gas formation is still open to question, while the significance of gas formation itself is disputed by authorities. Considerable evidence had supported previously the use of lactose bile, but the wind has apparently shifted in recent years and the balance now rests upon the importance of lactose broth as a better medium for an initial B. coli test. Each day brings forth another experimental factor to make the confusion greater as to the significance of lactose fracture.

The data given in Table II. show a close agreement in the laboratories as to the necessary period of incubation in the B. coli presumptive test. In the face of the almost universal choice of a 48-hour period, it is found in the Maryland State Department of Health laboratory that about 25 per cent. of all typical B. coli isolations are obtained from those tubes which show gas only after 72 hours incubation. It is somewhat doubtful, with the evidence shown in Table III., whether even the apparently settled question of period of incubation is not still debatable.

Uncertainty of Fermentation

In 1907, Phelps discussed a method of estimating the numbers of B. coli from fermentation tube results. His system of numerical interpretation has served, until recently, as a basis of practically all quantitative estimates of B. coli in various waters. A misconception of the method proposed at that time has been responsible in a degree for the eternal cry for standardization. The realization of the fact that "the method is obviously of no value for single tests and finds its most useful application in routine studies in water purification and sewage treatment extending over long periods of time" would tend to emphasize the utility, but uncertainty, of fermentation. Granting the value of establishing a maximum allowable pollution of "x" B. coli per 100 c.c., we are confronted still with the difficulty of estimating such numbers from data afforded by our present bacteriological methods.

Frequent Sampling Necessary

Past standards for B. coli content have shown a surprisingly patent disregard of the importance of stipulating the necessary frequency of sampling of a source before its quality may be safely postulated. In fact no standard comes to mind at the present time in which the number of samples is apparently considered of sufficient importance to warrant even a cursory establishment of a necessary minimum. In certifying a public water supply to com-

Table IV.—Number of Samples Necessary to Establish a B. Coli Content to Within the Probable Errors of 5 and 10 Per Cent.

(From Stein, "Engineering News-Record," May 24, 1917.)

Per Cent of Positive Tests in a Series	No. of Samples to Establish Coli per c.c. to Probable Error of ± 10 per cent.	± 5 per cent.
5	1,900	7,600
10	900	3,600
15	760	3,040
20	627	2,508
25	485	1,940
30	365	1,460
35	320	1,280
40	282	968
45	235	940
50	204	816
55	190	760
60	171	684
65	165	660
70	162	648
75	155	620
80	156	624
85	160	640
90	178	712
95	210	840

mon carriers, how many state departments of health insist upon a large series of samples before passing judgment upon the analytical findings? Some of these we know collect samples two or three or four times a year and then certify or do not certify on the bacterial content of some 500 c.c. of water out of a total consumption of millions of gallons per year. It is useless to justify such procedure upon the score that neither time nor finance are available to health officials to follow adequately, by frequent sampling, the condition of the supply. Infrequency of sampling, with consequent inaccuracy of interpretation, is not always recognized by sanitarians as dangerous. It is for this blindness to the invalidity of findings based on essentially variable phenomena and methods, that "standards" are in a measure directly responsible.

Stein has pointed out within the last year the extreme importance of an adequate number of tests before any relatively precise conclusions may be projected. Table IV. contains a portion of the data developed by Stein to show the number of samples necessary to establish varying B. coli contents to within a 5 or 10 per cent. probable error. In the Treasury Department standard an allowable maximum pollution equivalent to 20 per cent. of all tests positive in 10 c.c. is fixed. Twenty per cent. was chosen, we infer, in the belief that such a series of results would be comparable with a density of 2 B. coli per 100 c.c. in the water. It is highly disconcerting to learn that, in order to obtain even a fair degree of precision and an approximate approach to the above number of B. coli, something like 600 samples are necessary. How meagre, then, is the analytical information afforded by even ten samples a year and how ludicrous is the certification of a doubtful supply upon the basis of only two examinations a year! . . . The method of making the B. coli examination of a single sample of water is capable of wide manipulation. The procedure in some laboratories usually consists in the inoculation of a series of fermentation tubes of different dilutions. The dilutions as a rule are in the usual geometric progression of 10, 1, 0.1, etc., cubic centimeters. There does not appear, however, to be any well-defined agreement among authorities as to the necessary number of fermentation tubes to be used at each dilution.

Chemical Determinations

The importance of chemical examinations in determining the quality of a supply has been given considerable discussion in past years. The necessity for the so-called sanitary determinations has ranged from the viewpoint of the advocate of continuous and complete chemical analyses, as in Massachusetts, to the more radical exponents of the complete omission of sanitary chemical tests, as, for instance, the public health officials of Minnesota. The establishment of chemical standards for quality of water need not be gone into here in any detail, since both the methods and the accuracy of results in the field of water analysis are far more advanced than in the case of the bacterial tests. The problem in this instance, however, as well as in the case of bacterial standards, seems to lie more in the further study of the relative significance of data rather than in the establishment of meaningless standards based upon incomplete and variable manifestations of hidden phenomena.

Summary

The establishment of a standard of quality for potable waters means the setting up by some accepted authority of a rule for the measure of quality. Since quality is a variable attribute, intricately dependent upon a series of natural physical, chemical and biological phenomena, its measurement becomes extremely difficult. The quality of a particular water cannot, in most instances, be measured adequately by means of the evaluation of only one of its characteristics. The real consideration or interpretation of the potability of a supply involves a series of mutually active attributes, each of which plays a part of importance in modifying and determining the character of the water. Any scientific and practical standard must include, therefore, a composite of all those features which influence a change in quality. The single ultimate unit of measure or the final standard becomes, in this way, an index number of properly weighted individual and fundamental units.

The prime requisites for the establishment of any standard are the existence of those basic units which are to be its components and of universal agreement as to the relative significance of such components. In the field of water supply neither of the two above requirements has been fully met. Basic or fundamental units for measurement of quality have not been established with any degree of exactness or accuracy. A unit of measure, such as the B. coli content, certainly cannot be predicated upon such variable procedures as are now followed, without resulting in a confusion of interpretation. The establishment of any unit demands an absolute consistency in its measurement. It is this consistency of measurement which is now absent in practically every available measure of quality.

If inconsistency reigns in the determination of the fundamental units, such as the total count, the B. coli content, the chemical constituents, and the sanitary survey, then the general standard of quality, a derived unit composed of basic measures, becomes of extremely little value. If we add to this consideration of inconsistent method of obtaining individual units, the fact that their relative significance is still unsettled, then a general standard becomes practically useless and even misleading.

From the above discussion, it becomes clear that the study of the method of evaluating a unit must of necessity antedate the attempt to establish limiting values of such a unit. A critical survey of past standards of quality seems to indicate an assumption that the method of unit-evaluation is fixed, and therefore that limiting values are the desiderata. It is not felt that the status of laboratory or field method of analytical examination warrants any such assumption. The field for future standardization of quality of water supplies would appear to lie more immediately in the consideration of such problems as the relative significance of different bacterial counts, the methods of obtaining the counts, the necessary frequency of sampling, of plating, of numbers of fermentation tubes, the numerical interpretation of usual fermentation tube results, the allowable variations from specified bacterial contents, the determination of real bacterial indices to sewage pollution, the importance of chemical determinations, and the standardization of field survey methods. More remotely, the problem of standards is concerned with the co-ordination of the results of such studies as the above in such a way as to construct a composite unit of measure. Until these studies have been made and a general agreement reached, a standard would have but little value.

Estimates giving the cost of the proposed Mimico Creek concrete bridge for the Toronto-Hamilton Highway Commission, are being prepared by Geo. Hogarth, chief engineaer for the department of highways, and will be submitted to the Ontario Railway and Municipal Board at the next hearing, which is slated for May 31st.

CONVENTION OF CANADIAN CHEMISTS

In conjunction with the annual meeting of the Society of Chemical Industry held May 21st and 22nd in Ottawa, Ont., there was a convention of Canadian chemists. There were approximately 110 delegates, representing all parts of Canada and including academic, professional and industrial chemists.

There was a thorough discussion of possible organization for the improvement of the status of chemists and for the protection of the public. A popular idea was that the association should act as a registration body for all qualified chemists, and that legal recognition of chemistry as a profession should be secured from the Dominion Government. A committee was appointed to proceed with organization and to report at the next meeting. The members of this committee are:—

Prof. Parker (chairman), University of Manitoba; H. J. Roast (secretary-treasurer), Montreal; Prof. L. F. Goodwin, Kingston; Dr. A. McGill, Ottawa; Prof. McIntosh, University of British Columbia; Mr. Gregeroff, of Canadian Explosives, Limited, Montreal; Prof. Ardagh, Toronto; and Joseph Race, city bacteriologist and chemist, Ottawa.

Mr. Schorman, of Imperial Oil, Limited, and Dr. A. McGill read a paper on "Standardization of Gasoline." During the discussion following this paper, Dr. McGill announced that the Department of Inland Revenue are now preparing standards for gasoline, this action being due to the numerous complaints received. Dr. McGill claimed that all gasoline on the market would give satisfactory results if properly used, the complaints being due to imperfect knowledge on the part of the users rather than to the gasoline.

The delegates visited the mint, the fuel-testing laboratory and the other laboratories of the Mines Branch, the plant of the E. P. Eddy Co., and the new parliament buildings, where they were taken over the work by the architect, Mr. Pearson. The last-mentioned visit was made in conjunction with the members of the Royal Society.

At a dinner given on Wednesday evening, the officers of the Society of Chemical Industry for the ensuing year were elected. The new chairman of the Canadian section is Prof. W. L. Goodwin, of Queen's University, Kingston. Various phases of the chemical industry were touched upon in the after-dinner speeches. Among the speakers were T. H. Wardleworth, of the National Drug & Chemical Co., who spoke on Imperial Munitions Board chemicals; Mr. Davies, of the Standard Chemical Iron and Lumber Co., who gave an address on wood distillation products; and Mr. Hambly, of the Electro-Reduction Co., Buckingham, P.Q., who spoke on electro-chemical products.

Work on the new north arm bridge of the Fraser River, near Vancouver, B.C., has begun. A 140-ft. Howe truss span will replace the one that required repairs.

The Governor-General has signed the bill authorizing the change in name of the Canadian Society of Civil Engineers, and beginning May 27th that society officially adopted the new name, "The Engineering Institute of Canada."

St. Louis, Missouri, is having 400 miles of water mains cleaned by the National Water Main Cleaning Co., of New York City. Another United States city reports that the capacity of a mile of 10-inch water main was approximately doubled after it had been cleaned. This main had been in service seventeen months and had carried very hard water from artesian wells. The incrustation removed averaged 7½ lbs. per foot of pipe. It is true conservation to keep water mains clean.

CANADIAN SOCIETY OF CIVIL ENGINEERS ELECTIONS AND TRANSFERS

At a meeting of the council of the Canadian Society of Civil Engineers held in Montreal on Tuesday, May 21st, the following elections and transfers were announced:—

Adamson, Ernest Kinnear, of Stave Falls, B.C., elected an associate member. Mr. Adamson was born at Forfar, Scotland, in 1885. He took an engineering course at Heriot-Watt College, Edinburgh, Scotland, from 1903 to 1905. From 1914 to 1917 Mr. Adamson was engaged in the design of sewers, outfalls and dam for the Vancouver and Districts Joint Sewerage and Drainage Board, and since 1917 to present date resident engineer and superintendent for Western Power Co. of Canada at Stave Falls, B.C.

Allen, Robert William, of Regina, Sask., elected a junior member. Mr. Allen was born at Middlesborough, Eng., in 1889. Since 1908 he has been employed in the works department, Regina, in various capacities, since 1917 being assistant city engineer.

Bishop, John Murphy, of Montreal, Que., transferred from the class of student to junior member. Mr. Bishop was born at Montreal in 1894 and received the degree of B.Sc. in mechanical engineering at McGill University in 1916. At the present time he is demonstrator in the department of mechanical engineering, McGill University.

Bothwell, Robert Scott Clemens, of Windsor, Ont., elected a junior member. Mr. Bothwell was born at Toronto in 1894, and received the degree of B.A.Sc. at the University of Toronto in 1917. From 1916 to 1917 he was associated with the department of public works, Toronto, on harbor improvement work, and later in charge of all surveys, etc. At present Mr. Bothwell is on the engineering staff of the Canadian Steel Corporation, Limited, Ojibway, Ont.

Bridges, FitzJames, of Walkerville, Ont., elected a junior member. Mr. Bridges was born at Windsor, Ont., in 1887. From 1909 to 1912 he was with the Trussed Concrete Steel Co., and is at present in the district engineer's office, public works department, Windsor, Ont.

Brown, Donald Macdonald, of Edmonton, Alta., elected an associate member. Mr. Brown was born at Dundee, Scotland, in 1884 and received his education at the Morgan Academy and Technical College, Dundee. From 1906 to 1913 he was with the Grand Trunk Pacific Railway and from 1913 to 1916 with the Edmonton, Dunvegan and British Columbia Railway. Since 1916 Mr. Brown has been on active service.

Cassidy, John Francis, of Toronto, Ont., elected a junior member. Mr. Cassidy was born at Toronto in 1884. For some years he was associated with the Canadian Pacific and Canadian Northern Railways. In 1913-15 he was concrete inspector and assistant to C. MacN. Steeves with the Maritime Dredging and Construction Co. on construction of new wharves at St. John, N.B., and from 1915 to date, draftsman and assistant to John Sweeney, resident engineer, Toronto harbor improvements.

Collins, Charles Durham, of Brantford, Ont., elected a member. Mr. Collins was born at Peterborough, Ont., in 1872. He attended McGill University and the School of Practical Science, Toronto. He also took a special two-year course in mechanical engineering. In 1909-10 Mr. Collins was associated with the late J. J. Drummond, of Montreal, at Midland, Ont., and Geo. Macdougall, Dominion Steel Co., Sydney, N.S., on construction of a blast furnace at the Midland plant of the Canada Iron

Corporation, and was also in charge of erection and equipment of foundry for same company at Midland. During 1910-14 he was with the Waterous Engine Works, Brantford, Ont.; 1914-15 with P. H. Secord & Co., general contractors, Brantford, and from June 1st, 1915, to date, shell examiner.

Collins, Lawrence Edward, of Windsor, Ont., elected a junior member. Mr. Collins was born at Sherbrooke, Que., in 1893. He took a two-year course in civil engineering at Valparaiso University. At present Mr. Collins is with the Canadian Steel Corporation, Ojibway, Ont.

Crockard, Frank Hearne, of New Glasgow, N.S., elected a member. Mr. Crockard was born at Wheeling, West Virginia, in 1873, and received his education at Lehigh University and the Michigan College of Mines. From 1895 to 1897 Mr. Crockard was in charge of blast furnaces for the National Tube Co., Wheeling, W. Va. He was later assistant manager and afterwards manager of the Riverside Works, National Tube Co., until 1906; 1906-1917, vice-president, Tennessee Coal, Iron and RR. Co., Birmingham, Ala., and at the present time is president of the Nova Scotia Steel and Coal Co., New Glasgow, N.S.

Cummings, Alfred, of Fernie, B.C., elected an associate member. Mr. Cummings was born at Omemee, Ont., in 1880. He received his degree of B.Sc., at Queen's University in 1908. For some time past Mr. Cummings has been engaged in engineering work for the British Columbia government.

Fairbairn, Richard Purdom, of Toronto, Ont., elected a member. Mr. Fairbairn was born at London, Ont., in 1855. From 1877 to 1879 he was a member of the firm of Robinson, Tracy & Fairbairn, city engineers, London, Ont.; 1879, Public Works Department, Ontario, work included sewers and water supply, locks, dams, bridges and railway inspection, etc.; 1895-1910, assistant engineer Ontario government public works, later chief engineer; 1910 to the present time deputy minister, Public Works Department.

Hanson, Edward Christian Adair, of Saskatoon, Sask., elected an associate member. Mr. Hanson was born at Glasgow, Scotland in 1883, and took a four-year course in electrical engineering at the Glasgow and West of Scotland Technical College. In 1911 he was superintendent of construction for Canadian General Electric Co.; 1911-13, superintendent for Canadian Light, Heat & Power Co., Montreal; 1913 and at the present time city electrical engineer, Saskatoon, Sask.

Hogarth, George, of Toronto, Ont., transferred from associate member to member. Mr. Hogarth was born at Toronto in 1886 and graduated from the School of Practical Science, Toronto, in 1909. Since 1910 Mr. Hogarth has been with the department of public works, Ontario, and since 1916 has been chief engineer of highways.

Jacobson, Eric Anton, of Lindsay, Ont., elected a member. Mr. Jacobson was born at Stockholm, Sweden, in 1881. He took a three-year course at the Machine Technical College (Maskinyrkesskolan), Stockholm, Sweden, and studied hydraulics at die Technische Hochschule, Stuttgart, Germany. He also studied in the United States under State scholarship in 1904. From 1910 to 1915 Mr. Jacobson was hydraulic engineer with the Canadian Boving Co., Toronto, and later chief engineer with Böving & Co., of Canada, Limited, successors to the above company; 1915 and at the present time general manager of the Boving Hydraulic & Engineering Co., Ltd., Lindsay, successors to Boving & Co.

Kendall, Ralph, of Ojibway, Ont., elected a junior member. Mr. Kendall was born at Louisburg, C.B., in 1889. For some time he was associated with the Dominion Iron & Steel Co., Sydney, N.S., and is at present with the Canadian Steel Corporation, Ojibway, Ont., as chief of survey party.

King, John Albert Shirley, of Ottawa, Ont., elected an associate member. Mr. King was born at Peterborough, Ont., in 1882, and received the degree of B.Sc. at Queen's University (School of Mining) in 1909. For some time past Mr. King has been employed on work for the Dominion Government.

Marshall, John, of Regina, Sask., elected an associate member. Mr. Marshall was born at Eastbourne, Eng., in 1880. He enlisted in December, 1915, as private in the 68th Battalion C.E.F., went to France with the 2nd Field Co. C.E.

McKenzie, James Edgar, of Calgary, Alta., transferred from the class of student to associate member. Mr. McKenzie was born at Minneapolis, Minn., in 1889 and received the degree of B.Sc. at Queen's University in 1912. At present he is president and manager-director of J. E. McKenzie, Ltd., general contractors and engineers.

Pratt, George Robert, of Winnipeg, Man., elected an associate member. Mr. Pratt was born at London, Eng., in 1876. From 1906 to 1910 he was inspector and engineer on construction of C.P.R., Winnipeg shops, under J. E. Schwitzer, and from 1911 to 1918, mechanical and fuel engineer, western lines, C.P.R.

Puntin, James Henry, of Regina, Sask., elected an associate member. Mr. Puntin was born at Gatehead-on-Tyne, England, in 1878 and was educated at Gatehead and Owens College, Manchester, Eng., and Royal Institute of British Architects. From 1915 to 1917 Mr. Puntin was on active military service and at present is practising as architect.

Rannie, John Leslie, of Ottawa, Ont., elected an associate member. Mr. Rannie was born at Newmarket, Ont., in 1886 and received his degree of B.A.Sc. at the University of Toronto in 1909. Mr. Rannie is at present supervisor of triangulation on Geodetic Survey of Canada.

Reilly, Francis Bell, of Regina, Sask., elected an associate member. Mr. Reilly was born at Wardsville, Ont., in 1874. From 1909 to date he has been a member of the firm of Reilly, Dawson & Reilly, architects, surveyors and engineers, Regina.

Smaill, William, of Winnipeg, Man., elected a member. Mr. Smaill was born at Montreal in 1870 and received his degree of B.A.Sc. at McGill University in 1890. At the present time Mr. Smaill is general superintendent of the Winnipeg Aqueduct Company.

Smith, William Raymond, of London, Ont., elected an associate member. Mr. Smith was born at Toronto, Ont., in 1888. From 1912 to 1913 he was in private practice for Coté, Tremblay & Pearson, civil engineers, Edmonton; 1913-14, resident engineer, Edmonton, Dunvegan & British Columbia Railway, and at the present time lieutenant, C.E.F., at Engineers' Training Depot, St. Johns, Que.

Somers, Newton L., of Sault Ste. Marie, Ont., transferred from junior member to associate member. Mr. Somers was born at Villa Nova, Ont., in 1888, and received the degree of B.A.Sc. at the University of Toronto in 1914. In 1913 he was draftsman and designer with James, Loudon & Hertzberg, Toronto; 1914-15, inspector of erection of bridges and building with the Canadian In-

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The Engineer's Library

Any book reviewed in these columns may be obtained through the Book Department of The Canadian Engineer, 62 Church Street, Toronto

HAND BOOK OF HYDRAULICS

Reviewed by Thos. Hogg
Asst. Hydraulic Engineer, Ontario Hydro-Elec. Power Com.

By *Horace Williams King*, Professor of Hydraulics, University of Michigan. Published by the McGraw-Hill Book Co., New York City, and Hill Publishing Co., London. First edition, 1918. 424 pages, 112 tables, 90 figures, 4 x 6¾ ins., cloth. Price, $3.00.

A knowledge of the fundamental principles of hydraulics is presupposed in this volume, which is a compilation of the commonly accepted formulæ, together with a certain amount of new information. It is intended primarily to assist in the solution of hydraulic problems and should aid the practising engineer in making the most reasonable application of the available data to each specific problem he meets.

The several chapters comprise the following subjects: Hydraulic units, hydrostatics, orifices, sharp crested weirs, weirs not sharp crested, flow of water through pipes, flow of water in open channels, measurement of flowing water, special problems, general reference tables, comparison of weir formulæ with experiments, comparison of Kutter and Manning and Bazin formulæ with Scobey's experiments.

This little handbook should prove invaluable to the engineer dealing with hydraulic problems. It is the best of hydraulic handbooks published to date.

TECHNICAL MECHANICS

Reviewed by Prof. E. Brown
McGill University, Montreal

By *Edward R Maurer*, Professor of Mechanics, University of Wisconsin. Published by John Wiley & Sons, Inc., New York, and Chapman & Hall, Limited, London; Canadian selling agents, Renouf Publishing Co., Montreal. Fourth edition. 381 pages, illustrated, 6 x 9 ins., cloth. Price, $2.50 net.

This edition of Maurer's Technical Mechanics is practically a rewritten book, many changes, both in the form of omission and addition, having been made. It is evidently the outcome of an earnest endeavor to present to the student of engineering science those fundamental principles of mechanics which underlie an intelligent study of the many problems which he has to face, and in the main the object has been well attained. Ten years' experience of the use of the earlier edition in the author's classes suggested many changes, and new examples have been developed suited to a course of instruction in an engineering school. These examples, numbering nearly four hundred, have been embodied at the end of the present volume, with references to the articles in the text which bear most directly upon the principles involved. They have been selected admirably, and the student of mechanics who can work successfully through them will have a thoroughly sound knowledge of the application of mechanics to technical problems. One regrets that answers are not given to the numerical questions, but the regret is tempered somewhat by the reflection that, after all, this is really a book for the student following a course under a capable teacher, and that a judicious selection of problems will be made, and worked out as a part of such a course. This is not to imply that an isolated student, assuming him to have the necessary knowledge of elementary mechanics and mathematics (including the calculus), would not benefit greatly by a study of this book. But for such, the addition of answers would be the greatest boon, and perhaps they may be added to later editions.

Referring to the text itself, the subject is treated in the order which most teachers find necessary, so that statics come first and then dynamics. The analytical conditions of equilibrium of systems of forces are clearly set forth and graphical methods are used freely. Throughout the various articles, examples are worked in illustration of the principles enunciated, and these are well chosen to fulfil the double purpose (*a*) of driving home the principle and (*b*) of giving the student a clear perception of the usefulness of the principle in his technical work. Attention is drawn to statically indeterminate problems, and to the futility of attempting to solve them by the conditions of statical equilibrium.

Succeeding chapters deal with friction, including wedges, screws and belts, and with centre of gravity and the problems met with in loaded suspension cables.

Much might be said in commendation of the later chapters dealing with dynamics, for in them there is evidence of endeavor to present *real* principles to students in connection with the dynamics of a rigid body. Too frequently, in this connection, "mechanics for engineers" means only the acquisition of certain formulæ written down by analogy from the equations of motion for a particle, in conjunction with an elementary treatment of moments of inertia. Pope said long ago that "a little learning is a dangerous thing," and this is profoundly true in the application of mechanics to technical engineering problems. Professor Maurer, however, devotes much space to a progressive treatment of the motion of a rigid body, giving simple illustrative examples wherever possible, but keeping close to his main object of presenting a logical statement of the fundamentals of the subject. Problems on rotating bodies, impulse, centre of percussion, compound pendulums, etc., are introduced, and there is a section dealing with the phenomena of the gyroscope and some of its applications such as in the gyroscopic compass, the steering of torpedoes, and the mono-rail car. An analysis of the theory of the gyroscope, suited to the degree of attainment of those who have mastered the principles previously explained, is also given.

Many references are given throughout the book to standard text-books in which matters under consideration are treated more completely. Appendices deal with the dimensions of units, and with moment of inertia of plane areas. This section also includes the product of inertia of areas, and one welcomes this, as it is a quantity entering into problems on the bending of unsymmetrical sections, and is too frequently ignored.

Minor criticisms would be out of place where there is so much to be commended, but the reviewer, in paying tribute to the many merits of this book, regrets that Prof. Maurer countenances the "slug" and the "gee-pound." These nicknames for the so-called "engineer's unit of mass" are not really needed. Engineers who understand mechanics do not have to think in terms of engineer's units of mass, and those persons who do not understand mechanics are not really helped by the introduction of any such special unit. They "get the answers" in terms of units used by engineers if they can "just remember where that 'g' comes in," but their understanding is in no sense broadened by the achievement. Engineers must, of course, continue to use the pound as their unit of force, and the "engineer's unit of mass," while unnecessary, has probably come to stay, but we do not need the "slug" and the "gee-pound." The reviewer considers that the "slug" is a nasty, disagreeable thing—its proper place is underground.

THE STRENGTH OF SHIPS

Reviewed by W. B. Macdonald
Plant Engineer, Canadian Aeroplanes, Ltd., Toronto

By *J. Bertram Thomas, A.M.Inst.C.E.* Published by Scott, Greenwood & Son, London. 295 pages, 114 diagrams, 31 tables, 4¾ x 7½ ins., cloth. Price, $1.25 net.

The books dealing with this subject at a moderate price are few in number, so this book should certainly be appreciated. The ground work of the book is a series of chapters dealing with beams, strength and flexure under various loadings, and is well written and instructive, the most interesting of the series being the one dealing with sheer stresses. It would be very difficult to write something new about beams, considering the amount of space devoted to this subject in engineering handbooks. The stresses set up in rectangular plates under water pressure and the relationship between stiffeners and plate are very ably dealt with, as is also the criticism of the various formulæ dealing with the strength of columns. Much useful information is given in that part giving approximate methods for finding a tentative load curve.

The book suffers a little owing to the want of care taken with the diagrams, both as regards clearness, size, lettering, and, in some cases, their place with regard to the text. The student might well ask, when he looks at the formulæ on page 249: "Force at $A — \frac{2 (60 \times 46) \times 20 \times 36}{12 \times 19} — 27.4$ tons," and Fig. 112, on page 250, where is *A*? Is the figure a plan or an elevation? Is the deck the cambered line, or does the deck lay on the same plan as the page? What depth is the girder shown on Fig. 113?

The strength of submarines can only have an academic interest to us here, but the subject of gun-mountings will be greatly appreciated, and might have been with advantage enlarged upon.

Only the outstanding features of the book have been mentioned, but the book is generally well written and easy to understand. It will make a splendid companion volume to, say, Attwood's "Theoretical Naval Architecture" and Walton's "Know Your Own Ship."

It might be noted that the ton used is the gross ton (2,240 lbs.), and that where the figure 35 is used it refers to the cubic feet of salt water in a gross ton.

PETROLEUM IN CANADA

By *Victor Ross*, financial editor of the Toronto Globe, Toronto, Ont. Published by the author. First edition. 109 pages, 102 illustrations, 5 x 8 ins., cloth. Price, $1.00 net.

This little volume gives a very interesting non-technical history of the oil industry in Canada. The facts are well condensed, yet presented in an interesting and readable manner, statistics being generally avoided, and dry facts concerning dates and names being relieved throughout by clever treatment and by a touch of the romance and adventure that has always accompanied the oil industry. Besides the introduction, this work is divided into eleven chapters, of which the titles are:—

Theories of the Origin of Petroleum; Petroleum Industry in Western Ontario; Early History of the Western Ontario Oil Fields; Drilling and Shooting of Oil Wells; Methods of Storing and Refining; Boom Days in Alberta; Petroleum in Western Canada; Petroleum in Eastern Canada; Companies, Refineries and Individual Producers; Some Products and Uses of Petroleum; Future of the Industry in Canada.

"Our own production at present," says the author, "is not merely an insignificant contribution to the world's output, but a small part of our own consumption. From 1865 to 1870 the yield in the Western Ontario field was about 200,000 barrels annually. The export demand produced wide fluctuations in the production and brought the output up to half a million barrels per year at times, until 1877. There ensued successive increases and declines until 1907, when the production reached 800,000 barrels, which would appear to be the maximum for the Canadian field."

Imperial Oil, Limited, of Toronto, have purchased a number of copies of this book, which they are distributing to their friends and customers.

Subsequent to the publication of this book, the author has been offered and has accepted a position as assistant to Walter C. Teagle, president of the Standard Oil Co., of New Jersey, who was president of the Imperial Oil Co. when this book was being written.

A TREATISE ON ROADS AND PAVEMENTS

Reviewed by W. A. McLean
Deputy Minister of Highways, Province of Ontario

By *Ira Osborn Baker, C.E.*, Professor of Civil Engineering, University of Illinois, Urbana, Ill. Published by John Wiley & Sons, Inc., New York, and Chapman & Hall, Limited, London; Canadian selling agents, Renouf Publishing Co., Montreal. 667 pages, 235 illustrations, 80 tables, 6 x 9 ins., cloth. Price, $4.50.

This is the third edition of a work first published in 1902. Progress in road and pavement design and construction during the past sixteen years has necessitated numerous radical changes in the text of the first edition, and the present edition, now up to date, should be of considerable value as the author has been intimately familiar with the development of the art.

The book is divided into two parts. The first part, consisting of ten chapters, is devoted to the subject of country roads, and the second part, also of ten chapters, to street pavements. As the author states in his preface, the present edition has been thoroughly revised and entirely re-written. Five chapters of minor importance have been omitted to allow for an equal number of new ones, and attention has been given to materials and forms of construction that affect the quality and cost of the road and pavement.

The chapter headings are as follows: Country Roads, Part I.—Road Economics and Road Administration; Road Location; Earth Roads; Sand and Sand-Clay Roads; Gravel Roads; Waterbound Macadam Roads; Portland Cement Concrete Roads; Bituminous Road Materials; Bituminous Surfaces for Roads; Bituminous Macadam and Bituminous Concrete Roads.

Street Pavements, Part II.—Pavement Economics and Pavement Administration; Street Design; Street Drainage; Curbs and Gutters; Pavement Foundations; Asphalt Pavements; Brick Pavements; Stone-Block Pavements; Wood-Block Pavements; Selecting the Best Pavement.

The subject of curves on country highways is very clearly defined in the chapter on road location, as also are location and re-location.

The chapter on cement concrete roads is most complete in its description of this type of road, thirty-nine pages being devoted to the subject. The advancement of such a surface has been rapid, the square yardage laid in the United States at the end of 1916 being forty-eight times as great as that laid at the end of 1909.

The eighth chapter deals at length with the subject of bituminous road materials, an added feature to the first edition. Chapters nine and ten are devoted to bituminous surfaces and bituminous macadam and concrete roads. These surfaces are thoroughly digested and are up-to-date in every detail. During the past ten years successful experiments have been carried out with both asphalt and tar products.

The subject of asphalt pavements dealt with in chapter sixteen has been much revised and enlarged to take care of the development made in the various types of this class of pavement. The various types, including asphaltic concrete, stone-filled sheet asphalt, Topeka mixture and several patent mixtures are all thoroughly discussed. Tables are given showing the standard gradings of the mineral aggregate in these pavements, together with recent costs of constructing and maintaining same.

In chapter fifteen, dealing with the subject of pavement foundations, valuable suggestions are to be found, with the addition of several pages on the construction of street railway tracks. Chapter seventeen discusses all the essential features of brick pavements and a valuable revision of the subject is contained therein, including the wire cut-lug hillside block. Special information concerning stone and wood-block pavements is to be found in the chapters relating to these pavements. The tables showing the cost of constructing these pavements are very explicit and the illustrations are instructive. Chapter twenty deals with the subject of selecting the best pavement and contains data on the solution of the problem.

The book is intended rather for the road engineer and the inspector than for the contractor. The style throughout is simple and practical, and the illustrations make the meaning abundantly clear. It would be impossible in a review to give many details of the contents of this book; it must suffice to say of the present edition that the revision makes it even better than its predecessors and that it has been most carefully and concisely written.

EVAPORATING, CONDENSING AND COOLING APPARATUS

Reviewed by A. S. L. Barnes
Hydro-Electric Power Commission of Ontario, Toronto

By *E. Hansbrand*, translated by *A. C. Wright, M.A., D.Sc.* Published by Scott, Greenwood & Son, London. Second English edition, 1916. 401 pages, 76 tables, 21 figures, 5½ x 8¾ ins., cloth. Price, $3.00 net.

The first German edition of this book was published in 1899 and was translated by Mr. Wright in 1902; the present volume is a translation of the second German edition of 1900.

Some errors which previously appeared have been corrected and conversion diagrams have been added for changing metric units into British ones.

The German author, in his preface, says: "The constant motive in writing this treatise has been the desire to provide as complete and reliable assistance as possible for the solution of the problems of the construction and working of apparatus for evaporating, condensing and cooling.

It would appear that a good attempt has been made to realize this object.

The earlier chapters discuss the fundamental principles governing heat transmission from solid to liquid and vice versâ, and formulæ for these are developed in a clear manner.

Practical problems are dealt with later on and as a help to the reader very numerous tables are provided giving the values of many formulæ for varying conditions. Some of the subjects included are: Evaporation by means of hot liquids, multiple effect evaporations, the diameter of pipes for steam, alcohol vapor and air, condensers, the cooling of liquids.

For the engineer possessing a moderate knowledge of mathematics, engaged in designing such plant as is dealt with, this book should be of considerable use.

MATHEMATICS FOR ENGINEERS—PART I.

Reviewed by A. S. L. Barnes
Hydro-Electric Power Commission of Ontario, Toronto

By *W. N. Rose*, B.Sc. Published by Chapman & Hall, Limited, London, 1918. 510 pages, 11 tables, 257 figures, 5½ x 8¾ ins., cloth. Price, $2.25 net.

This book is one of the "D.U." or "directly useful" technical series of which a former work, "Arithmetic for Engineers," was reviewed in these pages some little time ago.

The author states in his preface that "an endeavor has been made to produce a treatise so thorough and so complete that it shall embrace all the mathematical work needed by engineers in their practice and by students in all branches of engineering science."

The field as outlined above being so extensive, the work has been divided into two volumes. Part I. deals with the fundamental rules and processes of algebra, plane trigonometry, mensuration and graphs; Part II. will take up the calculus and its applications, etc.

This book is very carefully graded and takes the reader step by step through each section, and if the reader finds that any point has not been thoroughly grasped, a revision should soon set this right as the explanations are clearly given and numerous examples worked out. The principle of the book is evidently to plunge into practical application of the various algebraic and other rules as soon as possible after these have been explained and the author has succeeded well in carrying out his intention, as expressed in the quotation given above from the preface, so far as the ground covered by Part I. goes.

A special feature is Chapter I., "Aids to Calculation," in which a number of useful and handy methods are given for getting at rough approximations to the answers to problems, so that, for example, the placing of the decimal point in the answer found by slide rule will be simplified.

There are few engineers who would not find this book a great convenience either for the purpose of refreshing their memories or for extending their knowledge beyond existing limits.

If the editor of this series, W. J. Lineham, is successful in obtaining, for all his publications, the services of men who will write works of as much practical utility to engineers as this one by Mr. Rose, they are sure of a welcome. It should be stated that some acquaintance with the elementary principles of algebra, on the part of the reader, is assumed; also a knowledge of the slide rule.

PUBLICATIONS RECEIVED

Report of the Director of Forestry for 1917.—Issued by Forestry Branch, Department of the Interior, Canada.

Concrete Pressure Pipe.—Brochure issued by the Portland Cement Association, Chicago. Sent upon request.

Crouch Steel.—A sixteen-page brochure published by W. J. Crouch Company, Incorporated, 253 Broadway, New York City.

Wheeler Centrifugal Pumps.—Bulletin 108-B. Illustrated catalogue issued by the Wheeler Condenser and Engineering Company, Carteret, New Jersey.

The Levin Oxygen and Hydrogen Generator.—Bulletin G, issued by the Electrolytic Oxy-Hydrogen Laboratories, Inc., 15 William Street, New York, N.Y.

A Study of the Heat Transmission of Building Materials.—By A. C. Willard and L. C. Lichty. Bulletin No. 102, Engineering Experiment Station, University of Illinois, Urbana, Ill. Price, 25 cents.

More and Better Water for Our Farms.—Report of a conference called by the Lethbridge Board of Trade at Lethbridge, Alberta, on June 22nd, 1917. Issued by the Commission of Conservation, Ottawa, Ont.

The Storage of Bituminous Coal.—By H. H. Stoek, professor of mining engineering, University of Illinois. Published by the Engineering Experiment Station, University of Illinois, Urbana, Ill. Price, 40 cents.

Transactions of the Institute of Marine Engineers.—Containing a paper on "Aids to Prevent a Ship from Sinking," by Charles V. A. Eley, and discussion on same. Published by the Institute, The Minories, Tower Hill, London, Eng.

Canadian Douglas Fir—Its mechanical and physical properties. Prepared under the direction of J. S. Bates, Chem.E., Ph.D., superintendent of Forest Products Laboratories of Canada, by R. W. Sterns, B.Sc., chief of Division of Timber Tests. Bulletin No. 60, Forestry Branch, Department of Interior, Canada.

Report of Annual Meeting of Ohio Engineering Society.—Containing papers on "Brick Pavement Construction in Cleveland," by F. R. Williams; "Road Maintenance and Repair," by A. H. Hinkle, State Highway Department; and "Industrial Housing and Town Planning," by Morris Knowles and Geo. W. Case. Secretary-treasurer of the society, John Laylin, Norwalk, Ohio.

Poor's Manual of Industrials for 1918 has just been issued. The general information is revised to April 18th. It contains the latest income accounts and balance sheets of all industrial companies in which there is a public interest. These are in most cases presented in a comparative form, showing at a glance the growth of the business. This is the first book issued that gives complete information regarding the present United States income tax on industrial securities. It states whether the companies assume a 4% tax or only a 2% tax or no tax at all. The book is invaluable to those who are interested in industrial securities. Published by Poor's Manual Co., 80 Lafayette Street, New York. Price, $10 a copy.

ENGINEERING INSTITUTE AT HAMILTON

WHILE attending the first general professional meeting of the Engineering Institute of Canada, which was held in Toronto a couple of months ago, Secretary Keith, of the institute, held a conference with a number of members from Hamilton, including E. R. Gray, the city engineer, regarding the possible establishment of a Hamilton branch of the institute. Mr. Gray undertook to discuss the subject with the other members in Hamilton and to find out whether it would be advisable to attempt the organization of a branch in that city. Meanwhile Mr. Keith brought the matter to the attention of the council of the institute, who endorsed the proposal. As a result it has been arranged for the secretary to go to Hamilton during the week of June 9th, in order to meet the members resident in that city, and to perfect the details of the organization.

CAN. SOC. C.E. ELECTIONS AND TRANSFERS

(Continued from page 490)

spection Co., Toronto Suburban Railway, C.N.R., Ottawa Capreol Line, etc.; 1915-16, assistant to Jas. S. Galletley, D.L.S., on government settlement lot survey in Manitoba; 1916 to the present time as coke plant engineer, Algoma Steel Corporation on extension and rebuilding of the plant.

STANSFIELD, EDGAR, of Ottawa, Ont., elected a member. Mr. Stansfield was born at Bradford, Yorkshire, England, in 1878, and received the degree of B.Sc. in 1910, and M.Sc. in 1903. Since 1907 to the present time he has been in charge of the fuel-testing chemical laboratories of the Department of Mines, Ottawa.

WARREN, WILLIAM ROBERT, of Regina, Sask., elected an associate member. Mr. Warren was born at Taunton, Eng., in 1876. In 1908 he was engineer in charge of the telephone system in the province of Saskatchewan, and since 1912 chief engineer, department of telephones in that province.

WRIGHT, WILLIAM GORDON, of Ottawa, Ont., elected a junior member. Mr. Wright was born at Montreal, Que., in 1891. He received a first class certificate in mechanical drawing at Kent, Eng., and is at the present time assistant to consulting naval engineer, department of naval service, Ottawa.

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Principal Contents of this Issue

ENGINEERING FAILURES

PROGRESS in any sphere of activity is often achieved by failure rather than by success, and he is a poor engineer, or at least a small-gauged one, who never makes a mistake or experiences a failure. If mistakes are not made unnecessarily and the lessons which they teach are not neglected, they are a most important part of an engineer's experience; oftentimes more can be learned from them and greater benefit can be derived for the planning and carrying out of new work, than from all the successful work one has ever done. The contribution which failures make to successful work is no mean one.

It doesn't follow always that mistakes and consequent accidents in connection with the carrying out of any engineering undertaking can be laid at the door of incompetence and bad judgment; they are in many cases incidental to new ways and unknown conditions and are really part of the price that has to be paid for improved efficiency, rapidity and economy.

All we know or have has come to us through either our own experience or the experience, good will and initiative of others, and we should therefore be glad to pass along to others the lessons that our failures teach us.

Publishers of technical papers are usually able to obtain, sooner or later, illustrated descriptions of engineering work successfully done. On the other hand, memory fails to record any great degree of success in securing articles descriptive of failures or mistakes. Is it not reasonable to suppose that except in flagrant cases, descriptions of construction troubles and their remedies benefit very much more than injure the interested parties, and that they will ultimately prove of more lasting value to the profession? One's own mistakes as well as those of his neighbor can be made to serve a useful purpose; they at least sound a warning which enables the entire profession to side-step danger points, and the profession is certain to be duly grateful for the information.

While the tendency is ever to put on the soft pedal when a failure takes place, it is open to question whether this invariably is the wisest course to follow in the best interests of engineering as a profession.

RESEARCH COUNCIL'S PLANT FOR MANUFACTURE OF LIGNITE BRIQUETTES

FROM the poorest quality of lignite coal in Canada, the Honorary Council for Scientific and Industrial Research intends to manufacture carbonized lignite briquettes. A plant costing approximately four hundred thousand dollars will be constructed at once near Estevan, Saskatchewan. The proposal is to take two tons of the poorest lignite in the world, having about 32% of moisture and 7,300 B.t.u. per pound, and turn them into one ton of briquettes having 5% moisture and 12,000 B.t.u.

In the Northwest there is a demand for anthracite to the extent of about five hundred thousand tons per annum, for which the consumers are willing to pay from ten to twenty dollars a ton in order to get clean fuel. The Research Council proposes to manufacture anthracite, or its equivalent, in Canada for about half these prices, using for the purpose two waste materials: lignite of such poor grade that it cannot be stored or shipped; and sulphite liquor.

Sulphite liquor will be used as the binder; it is smokeless and odorless. This liquor is the waste product from our pulp mills. Its use will result in the production of what the United States government in its tests has demonstrated to be at least the equal of anthracite in burning quality.

If the Research Council succeeds in this enterprise as it is confident it will succeed, the Council will have accomplished a fine stroke of true conservation,—the production of a valuable domestic fuel from two practically waste materials; as the only function of the sulphite liquor today is to poison the fish in our streams, and the lignite slack is a powder which cannot be shipped.

The Research Council has stated that this is not a laboratory experiment nor even a super-laboratory experiment, as the work has been done. Briquettes to the extent of a number of carloads have been manufactured from the identical lignites that will be used. The present undertaking is for the purpose of demonstrating the commercial feasibility of the project in a full-size plant; to test the commercial success of selling the product in the open market and through the present dealer channels.

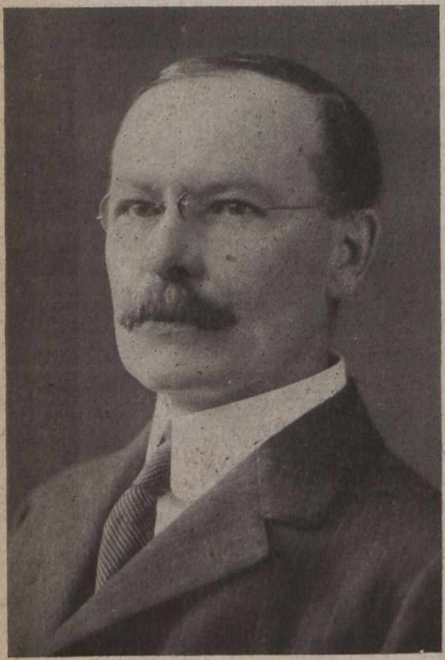
The coal interests of Alberta are said to be inimical to this briquetting project for fear that it will interfere with the market in Winnipeg which they have been trying to capture for the past twenty years. The Alberta interests will be benefited if the Research Council's project succeeds, because they will then be able to follow suit and briquette their slack, thus keeping their mines in operation during the summer months and producing a better domestic fuel than they are offering in Winnipeg at present.

Estevan was chosen as the site for the briquetting plant largely on account of freight rates. It was desired to locate the plant as conveniently as possible to the largest market and in the centre of an adequate supply of lignite. The quality of the lignite does not particularly matter, as satisfactory briquettes can be made from the poorer material, thus effecting greater conservation. If the process succeeds technically with the poorer lignite, there can be no doubt that suitable briquettes could later be made with the better lignite; but freight rates will have more effect upon the commercial success of the first plant than will the quality of the lignite used.

To defend themselves against possible short-sighted or uninformed criticism, the Research Councillors are now said to be printing a pamphlet discussing in detail the whole project.

PERSONALS

Robert Alexander Ross, E.E., has accepted the appointment of city commissioner of Montreal which was made recently by the government of the Province of Quebec. Mr. Ross was born August 28th, 1865, in Woodstock, Ont., and graduated from the University of Toronto in mechanical and electrical engineering. He started as an engineering apprentice with the firm of Robert Whitelaw & Co., Woodstock, Ont., later becoming works engineer of the Canadian General Electric Company at Peterborough, which firm he left to become chief engineer of the Royal Electric Company of Montreal, now called the Montreal Light, Heat and Power Co. Mr. Ross soon engaged in private practice, however, and has had a consulting office in Montreal for many years. He has now closed this office in order to devote his entire attention to his new civic duties and to the work of the Honorary Advisory Council for Scientific and Industrial Research, of which he is a prominent member. At various times Mr. Ross has been consultant to the Hydro-Electric Power Commission of Ontario, the Canadian Pacific Railway, the Hydro-Electric Power System of Toronto and to various cities and towns in the United States, Canada and abroad. He is the author of "Engineering Economics," and of various lecture notes for students at McGill College. Upon four different occasions Mr. Ross has been elected as a member of the council of the Canadian Society of Civil Engineers, and was vice-president of that society during the years 1914, 1915 and 1916. He is a fellow of the American Institute of Electrical Engineers, a member of the American Waterworks Association, and commodore of the Royal St. Lawrence Yacht Club, Montreal. Mr. Ross will be one of five commissioners who will have thoroughly autocratic powers for at least several years to come in managing the business of the city of Montreal. This commission will be independent of the mayor and council of the city and will be responsible for bringing all the civic affairs of Montreal out of the chaos into which they have been plunged in past years. The financial situation, the police force and the vice situation present the worst difficulties, but there will also be many problems to solve in the public works administration. The new commission's first stroke of business was to increase taxes 50% in order to make up deficits in the revenue. The commissioners have appointed heads for the four sections under which the work of the city, aside from financial matters, will be grouped. Paul E. Mercier, B.A.Sc., who has been city engineer of Montreal for several years, will be in entire control of public works; Chief Tremblay, of the fire department, will have charge of public safety; Dr. S. Boucher will superintend public health; and Senator David will head the secretarial department.



Sidney Johnson has been appointed city engineer of Stratford, Ont., in place of Lieut. A. B. Manson, who was granted leave of absence.

S. B. Wass, assistant superintendent of the Intercolonial Division, Canadian Government Railways, at South Devon, N.B., has been transferred to the engineering department at Moncton, N.B.

John C. K. Stuart, who was formerly a member of the engineering staff of the Montreal Tunnel and Terminal Company, has enlisted with the Royal Engineers. Mr. Stuart has latterly been in the employ of the Ford, Bacon & Davis Corporation, New York City.

Dr. W. G. Miller, Provincial Geologist of Ontario, has left for London, England, to attend the first meeting of the Imperial Mineral Resources Bureau. This bureau will have important duties in co-ordinating the mineral wealth of the various portions of the British Empire both during and after the war. The Federal Government appointed Dr. Miller as the Canadian representative on the bureau.

Major Charles Flint, B.A.Sc., University of Toronto, '10, has been awarded the Croix de Guerre for gallant and distinguished service with the 4th Battalion, Canadian Railway Troops. He was following his profession as assistant engineer of the C.P.R. at Winnipeg, when he enlisted with the rank of lieutenant in a Canadian Railway Construction Corps, and has been twice promoted while serving with his present battalion.

Major T. R. Loudon, professor in the Faculty of Applied Science and Engineering at the University of Toronto, who was invalided to England in January after prolonged service in France, has arrived in Canada on leave. He took his B.A.Sc. degree in 1905, and at the time of his enlistment, in addition to the academic appointment, was a member of the firm of James, Loudon & Hertzberg. Originally a lieutenant in No. 1 Can. Construction Battalion (now 1st. Can. Ry. Batt.), he was promoted captain and adjutant while on active service, and won his majority in France. Major Loudon, who is a son of Professor W. J. Loudon, of University College, was mentioned in despatches early this year.

COLONEL GEORGE G. NASMITH

In the personal column on this page of last week's issue, mention was made of the new degree earned by "Lt.-Col." George G. Nasmith. This military title was an error, as Dr. Nasmith is no longer a lieutenant-colonel, but is now a colonel, having been promoted fifteen months ago on the field.