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Mimico and New Toronto Joint Sewerage System

Details of a Combined Sewerage System Which Serves Two Progressive Municipalities—Basis of Agreement—Brushwood Used as Filtering Media —Description of Pumping Equipment and Sewage Filtering Apparatus

By T. LOWES

THE completion of a joint sewerage system for the adjoining towns of Mimico and New Toronto marks an important event in the history of these progressive municipalities.

Situated about three miles west of the Toronto city limits, with excellent railway facilities, good electric car service, and with the Toronto to Hamilton new highway running through both towns, they are fast becoming popular; Mimico for residential and New Toronto for factory purposes.

In 1912 the council of the corporation of Mimico felt the need of a sewerage system and had a report made. No further action, however, was taken until 1915, when it was decided to proceed with the nucleus of a sewerage and also a water supply system, which included the construction of a sewage pumping station, sewage treatment plant, force main and main trunk sewers, also waterworks pumping station, intake pipe, pump wells, filters and water supply mains. The estimated cost of these works was $130,000.

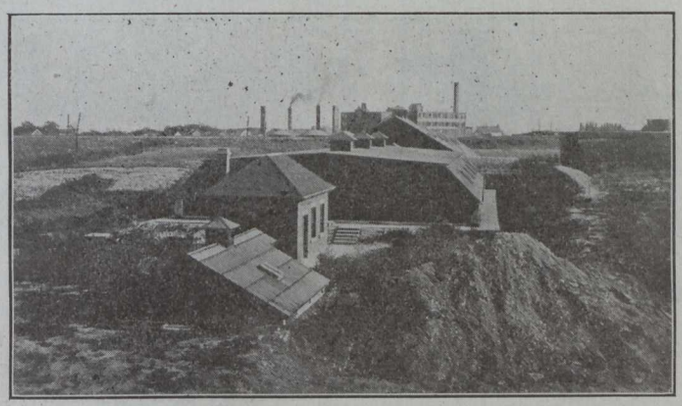

Fig. 1.—General Layout of Sewage Treatment Plant

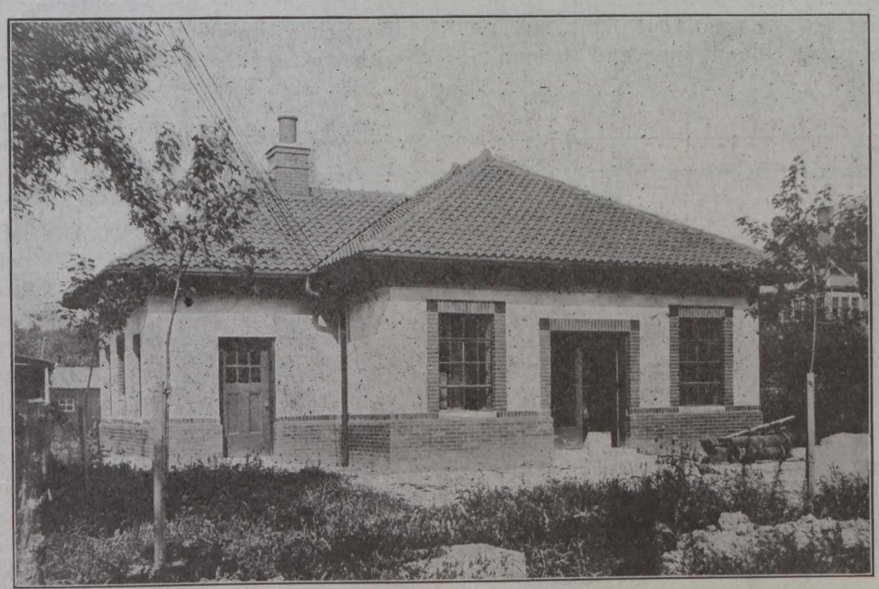

Fig. 2.—View of Pump House

At this time, however, the adjoining town of New Toronto was installing a water supply system, the need of which was being greatly felt, owing to the number of new factories locating there and the subsequent increase in population. A new sewerage system was also being discussed; although there was an existing sewage plant and a number of small diameter sewers, these were not adequate to take care of the increasing needs of the town.

Negotiations were opened between the two corporations and at a special meeting held in Mimico the writer was asked to report as to whether it was feasible and economical for the town of Mimico to obtain a good and sufficient water supply from the system being installed by the town of New Toronto; also, whether the sewage from New Toronto could be taken care of by the system proposed to be constructed by Mimico.

The report was in favor of both projects. Generally speaking, it meant the saving in cost of a waterworks pumping station, intake pipe, etc., and the overhead charges on a plant of this character to the town of Mimico; and a large saving in the cost of a separate sewage pumping station, sewage treatment works, etc., to the town of New Toronto. It was estimated that by these municipalities joining up on these public works a saving of about $80,000 could be accomplished.

Agreements were prepared and executed on the following basis:—

No. 1, re Water Supply.—That the corporation of New Toronto deliver water at the boundary line of the two municipalities on Struthers Street, provided that the corporation of Mimico supply a suitable meter at the point of delivery for the measuring of said water. The corporation of Mimico to pay eight cents per thousand gallons for the

first 50,000 gallons per day; all over 50,000 gallons and up to 100,000 gallons, at 7½ cents per thousand gallons; all over 100,000 gallons, at 7 cents per thousand gallons, provided that the corporation of Mimico shall take a minimum supply of not less than 50,000 gallons per day.

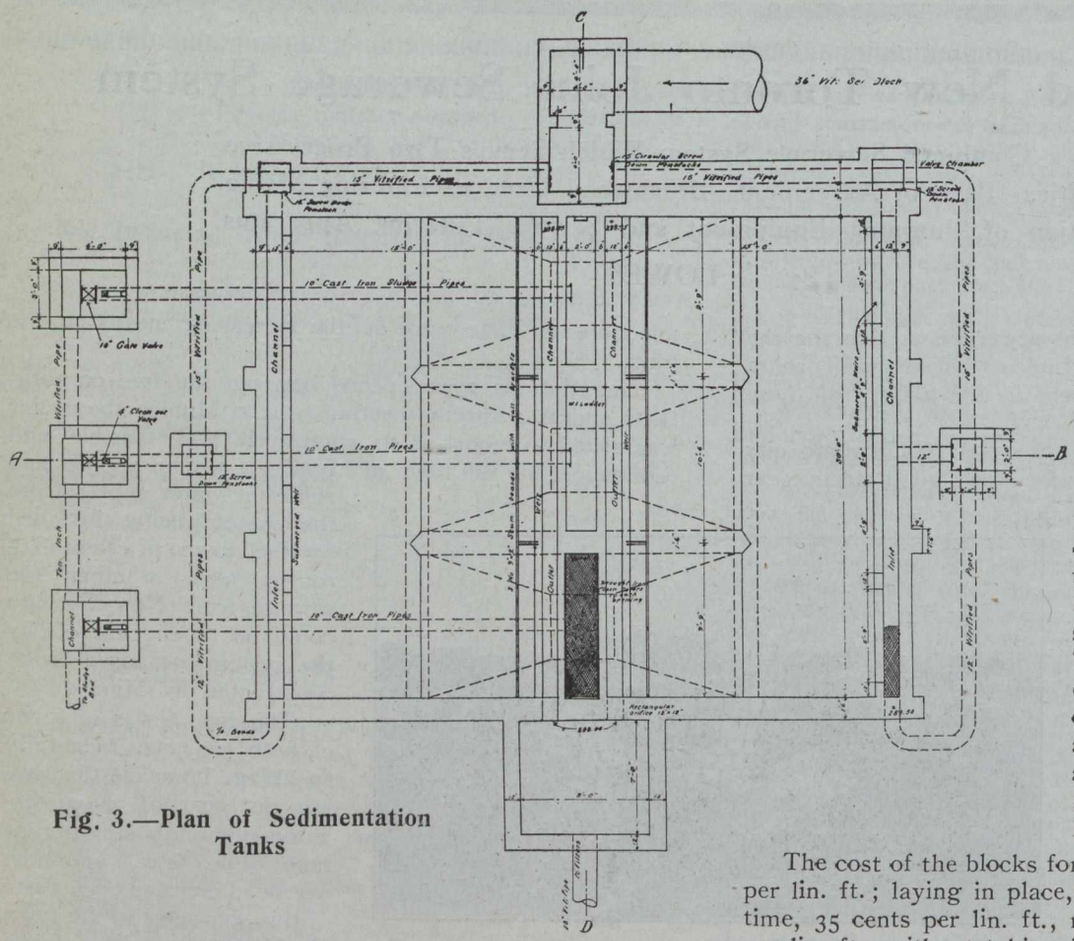

Fig. 3.—Plan of Sedimentation Tanks

No. 2, re Sewerage.—That the corporation of New Toronto and the corporation of Mimico each pay 50 per cent. of the cost of a joint sewage treatment plant, sewage pumping station, force main, effluent pipe and the maintenance charges on these works; also the corporation of New Toronto pay the extra cost for an enlarged trunk sewer to be constructed on the Lake Shore Road leading to the sewage pumping station.

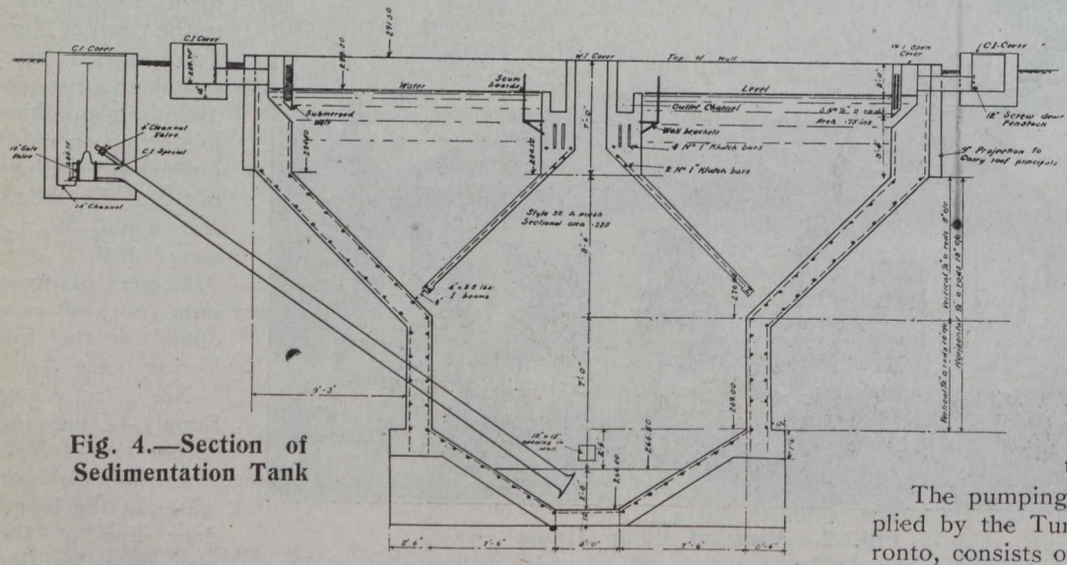

Fig. 4.—Section of Sedimentation Tank

The agreements were subsequently validated by the Ontario legislature.

In the fall of 1915 contracts were awarded for the construction of the following works: Sewage treatment plant, sewage pumping station, pumping machinery, 2,600 lin. ft. of 16-inch cast iron force main, 4,500 lin. ft. of 36-inch and 1,400 lin. ft. of 30-inch trunk sewer.

The trunk sewer commences at the eastern limits of the town of New Toronto and follows easterly along the Lake Shore Road to Superior Avenue, Mimico, where the sewage pumping station is located. This sewer was constructed of vitrified segment blocks manufactured by the Ontario Sewer Pipe Co., Mimico. Most of the excavation encountered was of shale rock and taken out by the use of explosives. The bottom of the trench was shaped half-round and blocks built in place similar to ordinary brickwork. The arch of the sewer was constructed by the use of a collapsible form. The blocks are extremely easy to lay and of a convenient size and weight for one man to handle.

The cost of the blocks for the 36-inch sewer was $1.80 per lin. ft.; laying in place, including mortar and men's time, 35 cents per lin. ft., making a total cost of $2.15 per lin. ft., without taking into consideration the cost of excavation.

The sewage, before entering the pump well, passes through a screening chamber. A wrought iron screen with bars set to make 1-inch spaces arrests matter which would be liable to choke the pumps. The screenings are taken away in a closed can and buried.

Fig. 2 shows a view of the pump house, which is of fireproof construction, composed of pressed brick and hollow tile stuccoed with a red tile roof. It is of neat appearance and of a design suitable for the locality in which it is situated, and tends to do away with the sentimental objection which one always meets with to a building of this character.

The pumping machinery, which was supplied by the Turbine Equipment Co., of Toronto, consists of one single-stage centrifugal sewage pump direct connected to a 50 h.p. Canadian Westinghouse motor, capacity, 1,000 Imperial gallons per minute; one single-stage centrifugal sewage pump direct connected to a 30-h.p. Canadian Westinghouse motor, capacity, 500 Imperial gallons per

minute; and one belt-driven single-stage centrifugal sewage pump connected to a 40-h.p. gasoline engine, capacity 750 Imperial gallons per minute. The electric units, which are operated by the Cutler Hammer self-starting device, take care of the daily flow of sewage, the gasoline unit being used only in cases of emergency.

The sewage treatment plant is situated on a plot of land north of the Grand Trunk Railway and facing Grand Avenue, and consists of sedimentation tanks, sprinkling filters, chlorine house, humus tanks and effluent pipe.

These works are only designed to take care of a population of 3,000; additional units may be added as the population increases.

Fig. 1 shows the general layout of the plant. Each building is roofed in for protection from the weather.

Figs. 3 and 4 show plan and cross-section of the sedimentation tanks. These tanks are in duplicate and of the two-story type. Each upper compartment is 30 ft. in length by 15 ft. in width by 7 ft. average depth. The sewage enters the tanks through submerged weirs and passes through at a slow velocity; the solids falling to the bottom impinge on the sloping aprons and pass through the trap into the sludge tank or lower compartment. This sludge tank has an estimated capacity of six months' sludge storage. The head of water in the tank is utilized for driving out the sludge from this compartment into a 10-inch pipe leading to the drying beds.

Figs. 5 and 6 show plan and section of the sprinkling filters. Each filter is 100 ft. in length by 25 ft. in width by 6 ft. in depth. It is proposed to use the travelling distributor in these filters, but it has been found impossible to obtain them on account of the War Office taking over the factories in which they are built. The plant is, therefore, at present being operated without filtration. Brushwood is the media which will be used.

Fig. 7 is a plan view of the chlorine house and gives a very excellent idea as to its general arrangement. The chlorine solution tanks and the piping arrangement are quite clearly shown.

Figs. 8 and 9 show plan and section respectively of the humus or final settling tanks. These are in duplicate and in design are similar to the sedimentation tanks shown in Figs. 3 and 4.

The effluent from these tanks is carried by means of a 24-inch vitrified pipe to the mouth of Mimico Creek, a distance of about half a mile.

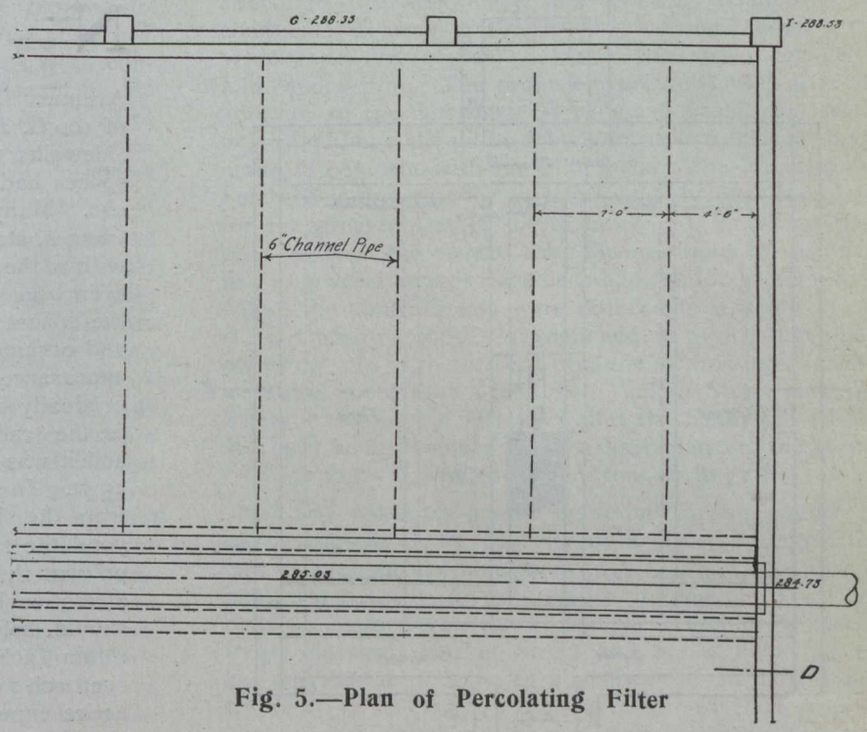

Fig. 5.—Plan of Percolating Filter

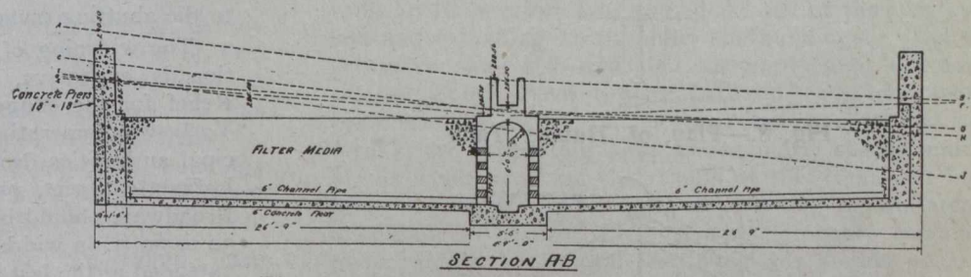

Fig. 6.—Section of Percolating Filter

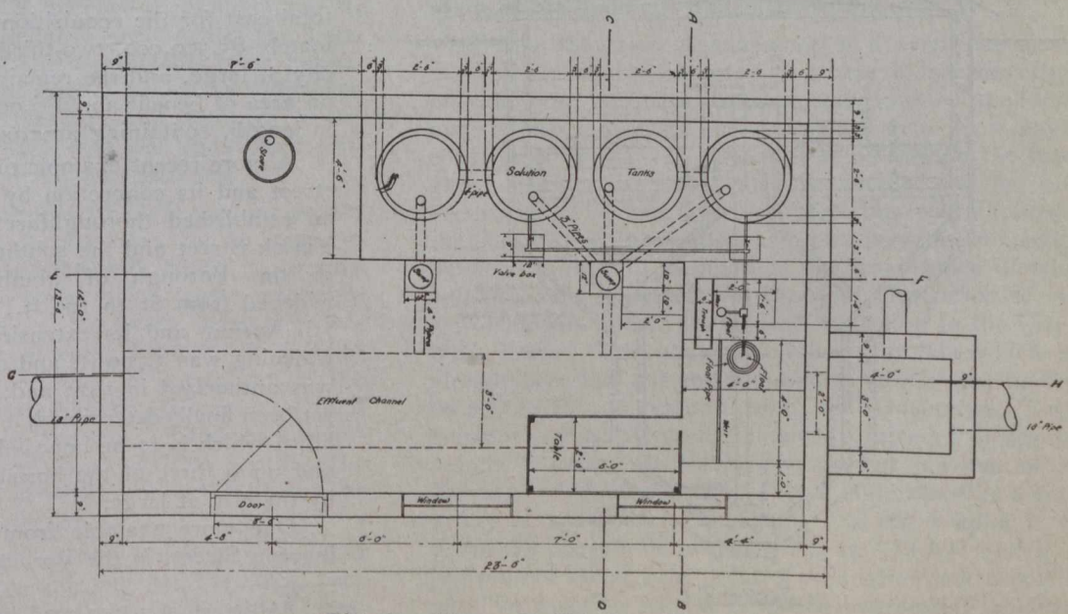

Fig. 7.—Plan of Chlorine House

The Mimico and New Toronto joint sewerage system described here cost approximately $119,700 and has been the means of clearing up the lake front for a distance of three miles.

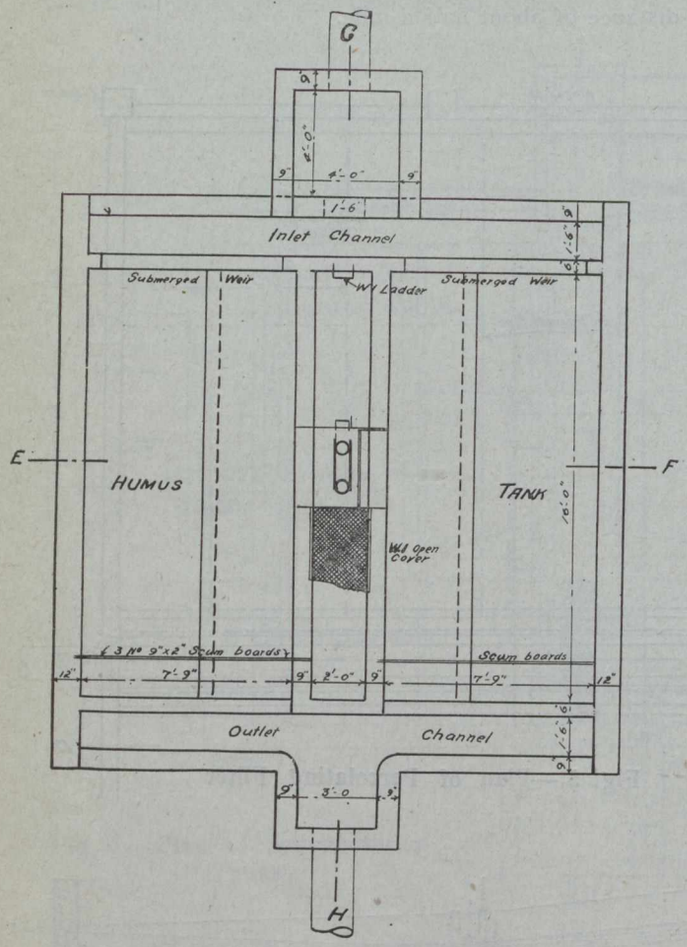

Fig. 8.—Plan of Humus Tank

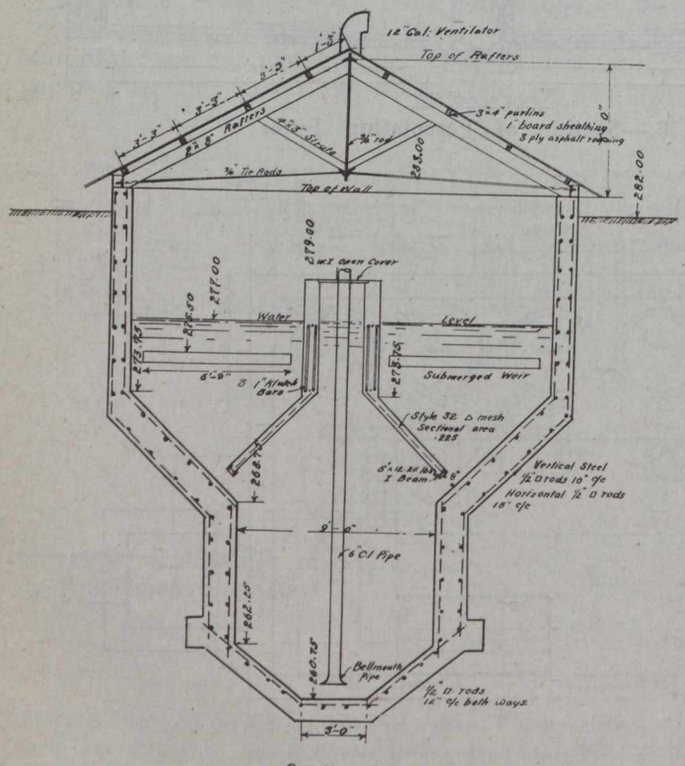

Fig. 9.—Section of Humus Tank

WIDENING EXISTING STREETS TO MEET TRAFFIC DEMANDS*

By Nelson P. Lewis
Chief Engineer, Board of Estimate and Apportionment, New York.

NEW YORK affords some notable instances of roadway widening during the last few years. Perhaps the most conspicuous of these is that affecting 5th Avenue. This street was laid out and acquired at a width of 100 ft. and was subdivided into a roadway of 40 ft. and sidewalks each 30 ft. wide. One-half of the sidewalk spaces had for many years been appropriated to private use. Many costly buildings had been erected, the entrances, steps and even supporting columns of which were within the street lines. In many instances fences had even been placed 15 ft. beyond the building lines and in the spaces enclosed by them there were sunken gardens and ornamental planting which added to the attractive appearance of the street. As the abutting property was gradually converted from residential to business use and as the traffic increased the roadway became inadequate, and it was decided that it should be increased from 40 to 55 ft. In order to compensate for the space thus taken from the sidewalks the removal of all encroachments beyond the street line was directed, although, in order to prevent the disfigurement of some very important and attractive buildings, it was agreed that owners who should, before a fixed date, remodel their buildings might retain such supporting columns or steps as would not encroach more than 2½ ft. beyond the building line. The entire expense of these changes had to be borne by the abutting owners. It has been estimated that the expense to the abutting owners aggregated about $2,000,000.

The widening of an existing street at a single operation is expensive, but occasionally it must be done. Relief for the congested condition of Broadway, New York, was imperatively necessary when in 1893 the municipal authorities decided that Elm Street, now known as Lafayette Street, parallel with and about 50 ft. east of Broadway, should be widened. The old street was from 50 to 60 ft. in width, and this was widened to 80 ft., and extended at the last named width as an entirely new street for a distance of over 3,000 ft. The entire length of the new thoroughfare thus created was about 6,000 ft. The total cost for the acquisition of property was approximately $5,500,000, two-thirds of which was borne by the city at large, and the remaining third was assessed upon an area of benefit about 3,000 ft. in width and 19,000 ft. in length, containing approximately 1,280 acres.

A more recent example of the widening of an existing street and its connection by means of a new street with an established thoroughfare is that of the widening of Varick Street and the southerly extension of 7th Avenue in the Borough of Manhattan. Varick Street was widened from 65 to 100 ft., this last being the width of 7th Avenue and its extension. The total length of the widening was 3,700 ft. and of the extension 2,700 ft. It was authorized in 1913 and, while the total cost has not yet been finally determined, it will approximate $6,000,000, all of which is to be imposed upon a local area of benefit and upon three of the boroughs, no part being assumed by the city at large.

One more example from New York is that of Livingston Street, in the Borough of Brooklyn. This street

*Abstract of paper read before the 9th National Conference on City Planning.

is parallel with Fulton Street, the principal business street of the borough, and about 300 ft. distant from it. The most important retail shops of this borough run from Fulton Street through to Livingston Street, and the latter, which was only 50 ft. wide, was so badly congested by the delivery wagons of these shops that it was useless for other purposes. It was widened to 80 ft. in 1905 for its entire length of about 4,300 ft. at a cost of a little over $2,000,000. A double track surface railway was constructed in it and it has been of incalculable benefit to this part of the city. It was proposed to assess one-third of the cost upon property deemed to be benefited, but mandatory legislation was secured relieving these property owners and imposing the entire cost upon the city.

Philadelphia also affords a number of instances of the widening of existing streets. Perhaps the most important undertaking of the kind has been the widening of Delaware Avenue along and in the vicinity of the Delaware River. This street will eventually extend from the Navy Yard on the south to Poquessing Creek on the north, a distance of about 17 miles. It was originally 50 ft. wide where in use, and the new width will vary from 100 to 250 ft. The improvement has already been carried out at a width of 150 ft. between Fairmount and Washington Avenues, a distance of two miles, and between Dyott and Cumberland Streets, a distance of one-third mile. The widening to widths of from 150 to 250 ft. between Washington Avenue and Hoyt Street, about 2¼ miles, is now in progress as a part of the South Philadelphia improvement. In portions of this street there are or will be from two to six steam railroad tracks. No estimate can be given of its total cost, but it has been financed from the proceeds of bond issues and without any local assessment.

A more modest improvement in Philadelphia is the widening of Oxford Avenue through the village of Fox Chase. This was originally a toll road, 50 ft. wide, and is occupied by a double track surface railroad. It has been widened to 70 ft. for a distance of about 1,200 ft. through the centre of the village. Some of the buildings were rebuilt and others were moved back to the new street lines, the amount paid in damages being about $57,000.

Two instances of street widening are taken from Boston, the first being what is known as the Pleasant Street improvement. This consisted of a widening from about 40 ft. to 60 ft. for a distance of about 1,700 ft. The work was carried out under a special act of the legislature passed in 1911, and the assessments were limited to one-half the cost and the area of benefit to a distance of 125 ft. from the line of the improved street, or to the middle of the block. The total cost was about $681,000. About $137,000, or 20 per cent., was assessed.

Another Boston improvement which it may be proper to include, although its purpose was not so much to widen a street already congested with traffic as to substitute for a narrow alley a street which might accommodate traffic, is what is known as the Avery Street improvement. This consisted of a widening from about 16 ft. to 40 ft., and it was also done under a special act of the legislature, with the provision that the assessments should be limited to one-half of the expense. Although the improvement extended for a distance of only 400 ft., the cost was over $1,300,000, of which amount $601,000, or about 46 per cent., was assessed.

The method of establishing new building lines and progressively carrying out a widening has been used very infrequently in this country, although it is quite a common practice in European cities. Probably the best examples in this country are to be found in Philadelphia. A well-known instance is that of Chestnut Street, formerly 50 ft. in width, which was widened to 60 ft. on the city plan by an ordinance adopted in 1884. It is a high-class retail shopping street and formerly had a roadway 26 ft. and sidewalks 12 ft. wide, the additional width being added to the sidewalks, the roadway remaining unchanged. Recent traffic counts showed about 4,600 vehicles passing a given point on this street between 5 a.m. and 9 p.m. The ordinance provided that after the adoption of the new lines no buildings should be erected or no buildings should be rebuilt or altered without being made to conform with the new lines. The improvement has been in progress for 33 years, and has been completed for the greater part of the distance. As buildings have been set back the owners have filed petitions for damages and in general awards have been allowed for ground taken where the abutting lots were reduced to a depth of 100 ft., but where a 100-ft. lot remained no awards have been allowed. Up to the present time the awards have reached a total of more than $500,000. Walnut Street and Arch Street, between the Delaware and the Schuylkill Rivers, are both being widened in this same manner, the former from 50 to 60 ft. and the latter from 66 to 72 ft.

A few instances are to be found in this country of increasing the traffic capacity of a street by converting one or both of the sidewalks into roadway and placing new sidewalks in arcades under the buildings. Philadelphia again furnishes a notable example. Fifteenth street, between Market Street and South Penn Square, has a width of 50 ft., with a roadway of 26 ft. and sidewalks of 12 ft. each. The curb on the east side was set back 11 ft., or within 1 ft. of the street line, while a sidewalk 19 ft. in width was provided back of the new curb line and extending 18 ft. under the buildings. This improvement was also extended eastward along the north side of South Penn Square between 15th and Broad Streets. The arcade thus formed has been treated uniformly, the supporting piers are regularly spaced and all of the same size, and the results of this treatment have been very satisfactory, the shops fronting on the arcade appearing to be desirable, and they probably command good rentals. The total length of this arcade on both streets is 335 ft. and the cost to the city in damages paid for the easements and the reduction of available floor space in the buildings amounted to $193,000.

Where the rapid development of a particular district may be reasonably expected or where it is necessary to provide more adequate street capacity in order that traffic may be accommodated and suitable transit lines may be constructed within the streets at some time in the future and expensive widenings may be avoided, it is often necessary to lay out streets of generous width following the lines of existing roads which now serve as connections between centres of population, the importance of which will probably increase. An excellent illustration of such a widening is offered by Queens Boulevard in the City of New York. This boulevard follows streets which had already been laid out and acquired at widths varying from 60 to 100 ft. It extends from the Queensboro Bridge across the East River to Jamaica, a distance of approximately 7 miles. It bisects the greater portion of the Borough of Queens, and its future importance as a traffic artery is apparent. For about 6 of the 7 miles it was given the exceptional width of 200 ft. and for the remaining mile of 150 ft., the point of contraction corresponding with its junction with a proposed intersecting boulevard varying from 100 to 150 ft. in width. For the first mile

the central portion of this street will be occupied by a three-track elevated rapid transit railroad built of concrete and of very attractive design. Beneath this will be located the surface railway tracks and there will be a wide traffic road on each side. The remainder of the boulevard, where the width is 200 ft., is to be divided into a central roadway of 44 ft., flanked on each side by park spaces of 30 ft., outside of which will be roadways 28 ft. in width, each one of which will accommodate a surface track railroad adjacent to the parked space. This generous width is, of course, designed not for present needs, but for those of the future, and, inasmuch as the abutting owners had already provided a street varying from 60 to 100 ft. in width, only 20 per cent. of the cost of the acquisition of the land needed for the widening is to be assessed upon a zone extending 800 ft. on each side of the street, 30 per cent. is to be imposed as a special tax on the Borough of Queens and the remaining 50 per cent. is to be paid by the City of New York at large.

Another example is taken from Philadelphia, and is that of Moyamensing Avenue. This street was widened from 50 ft. to 148 ft. for about ½ mile southwestwardly from Broad Street. Its extension southwestwardly, however, will be affected by the widening of Penrose Avenue from 50 to 248 ft., and it is designed to furnish a direct through traffic route between Philadelphia and Chester. The section 148 ft. in width is subdivided into two 18-ft. sidewalks, two 26-ft. driveways and a central planting space 60 ft. in width. This space, however, may subsequently be used in whole or in part for the widening of the roadways, for surface railway tracks or for a high-speed elevated or subway transit line.

The plan of making future widenings possible and economical by the establishment of setback lines is relatively new in this country, although in some American cities there is a distinction between the street line and the building line. In most of our cities, however, these terms are considered to be synonymous.

Setback lines have actually been established in some of the smaller towns in this country. For example, in Winchester, Mass., building lines 20 ft. back of the street lines have been fixed for one street for a distance of ¾ mile. On the chief business street a setback of 15 ft. on both sides has been fixed for a distance of 1,000 ft., and on another main traffic artery setbacks of 20 ft. on both sides have been established for a distance of ½ mile, while in another case on a short section of a business street a setback of 10 ft. on one side and 12 ft. on the other has been prescribed.

The forest fire losses in Ontario, Quebec, New Brunswick and Nova Scotia this season have been light, owing to wet weather and more vigilant control. British Columbia and Western Alberta have been the chief losers.

In a report on proposals to install hydro-electric power plants in the North Island of New Zealand, Mr. Evan Parry, chief electrical engineer to the Public Works Department of the country, says the scheme of development recommended is that three sources of water-power should be developed in the first place, namely, Lake Waikaremoana for the Hawke's Bay district; Arapuni Gorge (about eight miles from Horahora), or some other place to be selected, for the Auckland district; and the Mangahao River for the Wellington district. These three sources in a natural course of extension will be linked up, thereby enhancing the value of each source by adding to the security of supply and enabling a continuous output to be maintained throughout the whole of the North Island.

RAPID SAND FILTRATION*

By George A. Johnson
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THE first municipal water filter of the rapid sand type was built at Somerville, New Jersey, and thus began its wonderful history. From its very inception it established its popularity over all other hitherto attempted methods of purifying water, and has steadfastly held that position throughout the three score and two years which have since elapsed.

It is not the intention or desire of the writer to encroach unduly on this subject of slow sand filtration, which is to be discussed by Mr. Goodnough. He deems it necessary, however, to refer briefly to the use of that process of water filtration in America, and to present certain statistical data for comparison with similar figures for rapid sand filters.

Water Filtration and Disease Prevention

Twenty-seven years ago, when the art of water filtration was in its infancy in this country, 32,000 residents of Continental United States succumbed each year to typhoid fever. This was a death rate of about 50 per 100,000 population. To-day, with municipal water filtration plants in operation in 736 communities having a total population of 18,293,000, the number of typhoid fever deaths is about 13,000 annually, corresponding to a death rate of 13 per 100,000 population living. If the typhoid fever death rate of 27 years ago existed now some 750,000 people would suffer from it and 51,000 people would die of the disease in a single year. Since 1890, therefore, because of the public acceptance of lower standards of sanitation than exist to-day, 847,000 people died of typhoid fever in the United States, and easily 10,000,000 suffered from it but recovered.

These figures present a sinister economic aspect. Each death from typhoid fever represents an economic loss to the country of $7,500. ("The Typhoid Toll," Journal of American Water Works Association, Vol. 3, No. 2, page 254, June, 1916.) Accordingly, in the past 27 years, due to ignorance and faulty sanitation, the huge sum total of $6,352,500,000 has been dissipated through sickness and death from typhoid fever in the United States. This sum is twice the interest on the total debt so far incurred by all the nations actively involved in the Great War. It is twenty times the property loss in the greatest conflagration of all time—the San Francisco fire of 1906. It would build 200,000 miles of the best bituminous-macadam roads, and is equal to two-thirds of all the money on deposit in United States National and savings banks.

The present generation has seen great advances in numerous branches of municipal sanitation other than the purification of public water supplies. Unquestionably some of these have been potent factors in the diminution of typhoid fever in America, and while it is not the writer's intent to attribute to purer water the entire credit for this improvement, he believes the facts prove that the substitution of pure for polluted water supplies was by long odds the most important cause contributing to this

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*Abstract of paper read before the Hartford Convention of the New England Water Works Association, September 12, 1917.

end. A fair argument for this viewpoint is found in the following table:—

Table No. 1.—Typhoid Fever Death Rates and Filtered Water Populations

Year.	Estimated Urban Population of the United States.	Total Population Supplied with Filtered Water.	Proportion of Filtered Water Population to Total Urban Population.	Typhoid Fever Death Rate per 100,000 Population in Urban United States.
1890 ...	25,000,000	310,000	1 in 80	48
1900 ...	34,000,000	1,860,000	1 in 18	40
1910 ...	44,000,000	10,805,000	1 in 4	27
1917 ...	51,000,000	18,293,000	1 in 3	13

The figures shown in Table No. 1 are very suggestive. When the ratio of filtered water population to total urban population in the United States increased from 1 in 80 to 1 in 18 in the decade 1890-1900 the urban typhoid fever death rate decreased 17 per cent. When this ratio again increased from 1 in 18 to 1 in 4 in the decade 1900-1910 the typhoid fever death rate showed a decrease of 32 per cent. in the same period; and when the ratio of filtered water population to total urban population again increased from 1 in 4 to 1 in 3 in the six-year period ending in 1917, the urban typhoid fever death rate fell 52 per cent. The relationship between the increasing number of people receiving filtered water and the decrease in the typhoid fever death rate is too positive to permit the dismissal of the phenomenon on the grounds of mere coincidence.

There is another feature in connection with disease reduction by water filtration to which attention must be called and that is, that where one death from typhoid fever has been avoided by the use of better water, a certain number of deaths, probably two or three, from other causes have been avoided. This is known as Hazen's theorem. The records from fifteen representative cities* bear out this assumption in a striking manner, as follows:—

Table No. 2.—Death Rates from All Causes and from Typhoid Fever in Cities Before and After Filtration

Per 100,000 population.	Before filtration.	After filtration.
Total death rate	1,870	1,730
Typhoid fever death rate	67	25
Typhoid lives saved	—	42
Other lives saved	—	98

These data show with much positiveness the soundness of the so-called Hazen's theorem, and prove in a striking manner that where one typhoid life was saved by the substitution of pure for impure water, at least two other lives were saved from causes of death less well defined.

Growth of Water Filtration in North America

The accompanying diagram shows the growth of filtration of municipal water supplies in the United States since the first filter was built at Poughkeepsie in 1874, some 43 years ago. One of the most striking features of this diagram is the positiveness with which rapid sand filtration has outgrown the older slow sand method. Of the 18,293,000 people now supplied with filtered water in the United States 74 per cent., or 13,411,000, are supplied from 682 rapid sand filter plants, the remaining 26 per cent., or 4,882,000 people, being served from 54 slow sand filter plants.

Once the rapid sand process appeared in the field it assumed the lead, and has steadily forged still further ahead. The same thing is also true in Canada. In the Dominion there are now some 45 municipal filter plants

*"Present Day Water Filtration Practice," Journal American Water Works Association, Vol. 1, No. 3, Page 516, 1914.

Filtration Plants in Canada

City	Date Installed	Kind	Capacity M.G.D.
Alberta.			
Edmonton	-1911	Rapid sand	6.0
Lethbridge	-1917	Rapid sand	4.0
MacLeod		Rapid sand	
Medicine Hat	1914	Rapid sand	6.0
Manitoba.			
Brandon		Rapid sand	1.0
Neepawa		Rapid sand	0.35
Winnipeg Agric'l Coll.	1913	Rapid sand	1.0
New Brunswick.			
Fredericton	-1912	Rapid sand	2.0
Ontario.			
Arnprior	1901	Rapid sand	0.5
Chatham	1895-1913	Rapid sand	2.0
Coburg		Rapid sand	1.4
Deseronto	1896	Rapid sand	0.5
Danville		Rapid sand	0.5
Haileybury		Rapid sand	1.0
Hamilton		Slow sand	12.0
Kitchener		Rapid sand	0.4
Orillia	1914	Rapid sand	2.07
Owen Sound		Slow sand	2.0
Perth		Slow sand	0.5
Renfrew	1897-07	Rapid sand	0.7
St. Thomas	1891-02	Rapid sand	2.0
Sturgeon Falls		Rapid sand	
Thurso		Rapid sand	0.1
Toronto		Slow sand	40.0
Toronto		Rapid sand	50.0
Wallaceburg	1914	Rapid sand	0.65
Weston	1910	Rapid sand	0.29
Whitby		Slow sand	0.3
Welland	1914	Rapid sand	0.25
Quebec.			
Ahuntsic	1910	Rapid sand	0.5
Aylmer	1917	Rapid sand	1.0
Buckingham		Rapid sand	1.5
Cartierville	1915	Rapid sand	1.0
Cowansville	1912	Rapid sand	0.25
Fraserville		Rapid sand	0.25
Laval des Rapides	1915	Rapid sand	0.25
Longue Pointe	1911	Rapid sand	0.75
Longueuil	1895-1913	Rapid sand	1.7
*Montreal		Rapid sand	30.0
Point Autrembles	1911	Rapid sand	0.25
Ste. Hyacinthe	1917	Rapid sand	4.0
Sault-au-Recollet		Slow sand	1.0
Shawinigan Falls		Rapid sand	1.0
Ste. Rose	1915	Rapid sand	1.0
Three Rivers	1909-11	Rapid sand	3.45
Verdun	1908	Rapid sand	1.0
Windsor Mills		Rapid sand	
Saskatchewan.			
Prince Albert	1910	Rapid sand	0.9
Saskatoon			4.0

*Supplies Maisonneuve, Outremont and Westmount.

supplying a total of about 1,500,000 people, or about one in every six of the total population. Thirty-nine of these plants are rapid sand filters serving about 1,000,000 people.

In foreign countries there are some 81 municipal rapid sand filter plants with a total daily filtering capacity of about 175,000,000 U.S. gallons, and serving about 3,500,000 people.

Summarizing, the following shows the existing status of water filtration so far as the available data will allow:—

Table No. 3.—Status of Municipal Water Filtration in North America

January, 1917.	United States.	Canada.	Totals.
	Number of places.		
Rapid sand	682	39	721
Slow sand	54	6	60
Total	736	45	781
	Total population served.		
Rapid sand	13,411,000	1,000,000	14,411,000
Slow sand	4,882,000	500,000	5,382,000
Total	18,293,000	1,500,000	19,793,000
	Proportion of filtered water population to total population.		
Rapid sand	1: 7.6	1: 9	1: 7.7
Slow sand	1:20.9	1:18	1:20.6
Total	1: 5.6	1: 6	1: 5.6

Early Conceptions of Water Filtration

The earliest type of water filter was a bed of porous material through which water was passed to free it of visible impurities. So far as its relationship to disease prevention is concerned, filtration of municipal water supplies is an art which has been developed within the past 30 years. Some of the ancients had vague ideas of its hygienic usefulness, but for the most part such conceptions grew out of an apparent desire to obtain clearer or cleaner water. Although the germ theory of disease was not advanced until 1849, and although the idea that disease in any form could be water-borne had its practical genesis at about that time, it seems certain that some of the early philosophers came to the conclusion that something more than mere clarification was effected by water filtration. Thus we find in "Ousruta Sanghita," a book of medical lore written in Sanscrit probably some four thousand years ago, the statement: "It is good to keep water in copper vessels, to expose it to sunlight and filter through charcoal." The writings of Hippocrates and Pliny also disclose facts which indicate clearly that the ancients had some regard for pure water and a distrust in polluted waters.

Similarly, William Walcott's patented process (1675) for "making water corrupted fit for use" undoubtedly aimed at something more than mere clarification, but it is equally certain that the inventor did not know just what; and in 1790 Johanna Hempel patented a contrivance for filtering water, using sand, gravel and pulverized glass as the filtering media. It was not until 1829, however, that the first municipal water filter of which there is comprehensive record, was built by the Chelsea Water Company at East Chelsea, London, in compliance with the recommendations of the Royal Commission on the Metropolitan Water Supply. This filter was designed to operate merely as a mechanical strainer to effect clarification, although it is significant that in the same year that this filter was built typhoid fever was recognized as a specific disease. The germ of that disease was not discovered until 1880, some 50 years later, and it was not well understood until 1884, or some 33 years ago.

About 20 years after the construction of the East Chelsea filter the British Empire was visited by a severe cholera epidemic, and at about the same time the theory was advanced by an English scientist that cholera was a water-borne disease and that the general cause of the epidemic could be traced to the polluted water supply. Three years later (1852) came the really first important step in water filtration history. This took the form of an Act of Parliament which made compulsory the filtration of the entire water supply of the Metropolitan District of London.

While practical modern water filtration, if we may use the term, sprang into existence with the construction of the small East Chelsea filter in 1829, and while the art developed slowly in England and on the Continent during the ensuing 60 years, it remained for the stupendous cholera epidemic in Hamburg in 1892, and the happy experience of Altona, the sister city of Hamburg, to stamp indelibly on the public mind the conviction that impure water is responsible for much of the public sickness, and to furnish unmistakable proof of the efficacy of water filtration in making polluted water safe and minimizing the dangers invariably arising from the consumption of such waters. Actually, then, water filtration as an accepted science, and the important developments therein, must be considered as about 25 years old, or less.

It is also well known that as late as 1885, judged by comparative chemical analysis of raw and filtered water, the result was not at all favorably considered by sanitarians, as the purification effect by filtration, according to the standards of that time, was practically negligible. It is to be noted that in that day organic matter, whether living or dead, was believed to be the chief cause of water-borne disease. One of the most important factors in advancing the knowledge of water filtration at that critical period was the exhaustive work of Professor Percy F. Frankland, who, in 1885, by applying the then modern methods of bacteriological analysis to water filtration, showed that while from a standpoint of removal of the chemical constituents from water filtration was a disappointment, it was a marked success in the removal from water of bacterial life.

Scientific Investigation of Water Filtration

The earliest investigations on slow sand filtration were conducted at Boston, Mass., and Louisville, Ky. Then followed the inauguration in 1887 of the classic investigations of the Massachusetts State Board of Health at Lawrence, Mass. These latter investigations were followed by the construction in 1892-3 of the Lawrence City filter for the purification of the badly polluted Merrimack River water, and the decision to build this filter doubtless was hastened by the Hamburg epidemic of 1892 and the appearance of cholera in New York harbor in the same year.

Between 1887 and 1903 the water filtration experiments at Lawrence were confined to slow sand filters, but in the latter year a small gravity filter with a superficial filtering area of about 4 square feet, and containing 21 inches of relatively coarse sand (effective size 0.71 mm.) was put into operation as a rapid sand filter. The filters

of the rapid sand type tested at the Lawrence Experiment Station since 1903 were as small as the first one (No. 216) or smaller.

Since 1903 the experiments at Lawrence have also covered slow sand filter operation modified by the use of coagulating chemicals and with the allowance of a supplementary period of coagulation and sedimentation prior to filtration.

The first comprehensive tests of the rapid sand process of water filtration were conducted at Providence, R.I., in 1893-4. Much more exhaustive experiments were started in the winter of 1895 at Louisville, Ky., continuing through the better part of two years thereafter. Similar investigations were carried on at Pittsburgh, Pa. (1897-1898); Cincinnati, Ohio (1898-1899); Washington, D.C. (1899-1900); New Orleans, La. (1900-1901); Harrisburg, Pa. (1903-1904); and elsewhere. Aside from the aid they rendered in the solution of the local problems these carefully conducted investigations, which cost hundreds of thousands of dollars, more than anything else served to establish on a sound footing the entire reliability of the rapid sand process of water purification. These experiments were all conducted at a critical period in the history of this process, and the basic principles of the method were fully tested and proved.

The reports published upon the results of these various investigations were followed by a decade of extreme activity in filter construction. Between the dates 1900 and 1910, the decade in question, the number of people supplied with filtered water in the United States increased from 1,860,000 to 10,805,000, or nearly six-fold. Of this increase rapid sand filters provided 61 per cent. and slow sand filters 39 per cent. This was the most notable period of slow sand filter construction in the history of slow sand filtration in America. Since 1910 there have been but few important additions to the list of filters of this type built in this country. Rapid sand filter construction has steadily grown, however. Whereas between 1900 and 1910 new installations were made at the annual average rate of 78 million gallons daily filtering capacity, since 1910 the average annual rate of construction has been 139 million gallons of daily filtering capacity. The average rate of new slow sand filter installation since 1910 has been 13 million gallons daily capacity annually. The contrast is sharp.

"STUPENDOUS FOLLY," SAY MONTREAL RATEPAYING ENGINEERS RE AQUEDUCT SCHEME

THE committee of ratepaying engineers of the city of Montreal, who have from time to time protested against the aqueduct enlargement, and whose protests resulted in the appointment of a board of three consulting engineers to investigate the scheme, have addressed a letter to the city officials in which they review the majority report made by Messrs. St. Laurent and Vautelet and the minority report by Mr. McRae. They refer to the aqueduct power development as "stupendous folly." The letter is signed by W. F. Tye as chairman and Walter J. Francis as secretary of the committee, and by John Kennedy, Ernest Marceau, J. A. Jamieson, R. A. Ross and Arthur Surveyer. The letter, which was dated September 6th, is as follows:—

"The city's letter of August 25th, 1917, with its enclosures, addressed to Mr. W. F. Tye, chairman of the Committee of Ratepaying Engineers, has been referred to the committee.

"The three documents have been studied by the committee and, as a result, we desire to place ourselves on record in connection with certain of the points contained therein.

"Without going into details, we may say that our conclusions are as follows, namely:—

"1. The annual operating cost of hydraulic development, Scheme 2 of the Board of Engineers, is stated by the board to be the sum of $740,000. (Report of board, April 30th, 1917.)

"2. Under the present conditions of operation and without considering the savings which could undoubtedly be made by using modern machinery and efficient operating methods, the annual costs of purchasing electric power, in accordance with the tender of the Civic Industrial and Investment Company, for pumping an average of 100,000,000 Imperial gallons daily and providing for the requirements of the filtration plant, was unanimously determined by your Board of Engineers in consultation with Dr. L. A. Herdt, of McGill University, as the sum of $235,585. (Report of board, August 18th, 1917.)

"3. The total annual cost for the operation of the pump house at Atwater Avenue and of the filtration plant, for an average consumption of 100,000,000 Imperial gallons per day, based on the purchase of power as above at $235,585 plus the annual charges on the money expended if hydraulic development be abandoned, is unanimously stated by your Board of Engineers to be the sum of $606,991. (Report of board, August 18th, 1917.)

"4. By the purchase of electric power, the annual saving to the city when the average consumption will have reached 100,000,000 Imperial gallons daily will therefore be, on the above basis, the sum of $133,009.

"5. The present average consumption of water is 54,625,462 Imperial gallons per day. An average consumption of 100,000,000 Imperial gallons will not be reached for at least ten years. Therefore, the annual savings above shown will be much greater until the average consumption reaches 100,000,000 Imperial gallons daily. The total savings in the next ten years, without considering the investment of the annual savings or compound interest, will be the sum of $1,830,000. If the power contract be made for 40 years, as suggested, the total savings during the last 30 years of the contract, without considering interest or annual investment of the savings, will be the sum of $3,990,270. The total savings during the 40-year power contract, without annual investment of the savings or compound interest thereon, will therefore be $5,820,270.

"6. The Board of Engineers have not included in their calculations of annual costs of operation of the hydraulic development any allowance for sinking fund and depreciation. If sinking fund and depreciation be taken into account, as they should be, the annual savings will be increased by the sum of $200,000, which, without annual investment or compound interest, will, at the end of 40 years, amount to $8,000,000.

"7. The purchase of power by the city at the present time, instead of completing the hydraulic development, Scheme 2 of the Board of Engineers, will therefore represent a total saving in 40 years, without annual investment of the savings or compound interest thereon, of the sum of $13,820,270.

"8. Had the city purchased power before starting on the enlarged aqueduct power development, it could have saved about $750,000 annually, as compared with Scheme 2, and, without annual investment or compound interest, the total saving in 40 years would have been $30,000,000.

"9. If the annual savings be invested so as to yield 5 per cent. and be compounded annually in the ordinary way, the total savings in 40 years, as stated in conclusions 5, 6, 7 and 8 above, will be practically trebled.

"The stupendous folly of the aqueduct power development is at once evident from the above figures.

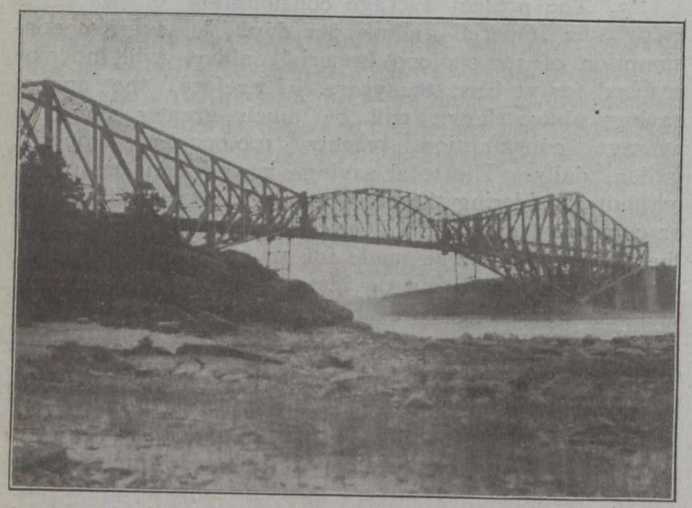
"We are pleased to note that Mr. McRae, in his letter of August 23rd, 1917, makes a recommendation practically agreeing with the solution of the problem as submitted by the ratepaying engineers, and we would once more urge that our solution be adopted without further delay."

QUEBEC BRIDGE SPAN IN PLACE

As announced in last week's issue of *The Canadian Engineer*, the central span of the Quebec Bridge was raised 24½ ft. on Monday, September 17th, and 34 ft. on Tuesday, the 18th.

The hoisting was continued on Wednesday, the 19th, which was the biggest day's work of the four days required to hoist the span into place, as the span was hoisted 54 ft. on that day. When the span was moored for the night late Wednesday afternoon it had, therefore, been raised a total distance of 112½ ft., and was within 38 ft. of its final position. This remaining distance was finished on Thursday, and the pins which held the span in place between the cantilevers were successfully driven before nightfall.

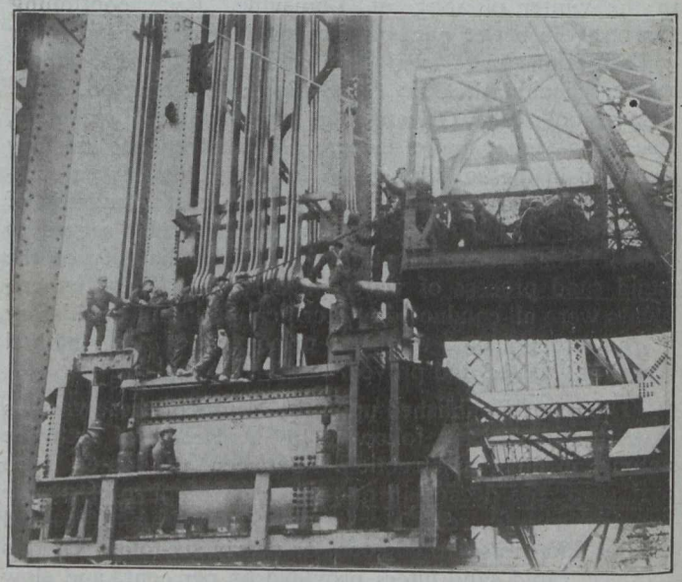
The accompanying illustrations show the span in place and also the operation of placing one of the pins through the eye-bars at the CMO joint. The successful placing of



Quebec Bridge, September 21st, 1917

these pins meant the end of all difficulties in regard to the erection of the bridge, as the remaining work is comparatively easy, consisting merely of the placing of some additional sway bracing, the replacing of a comparatively small number of bolts with rivets, the construction of the friction brakes between the central span and the cantilevers, the completion of the sidewalks and tracks, removal of the mooring trusses and lifting apparatus, the placing of false members between the top of the cantilevers and the top of the central span, painting, etc.

By Wednesday night the central span had been raised to such a height that an ocean-bound vessel was able to pass directly under it safely, the Dominion Coal Co.'s steamer "Lingan," passing upstream. A very steady gait was struck by the crews in charge of the lifting apparatus on Wednesday, and a lift was made about every fourteen minutes. The splendid weather which had been enjoyed from the time of the floating of the span, came to an abrupt end on Wednesday afternoon, when a heavy thunder storm struck Quebec just as the men were completing the afternoon's lifting. The storm was not ac-



Placing One of the Pins at the CM0 Joint, the Last Operation of the Hoisting of the Suspended Span

companied by much wind and the span was not in any danger.

The weather on Thursday was the worst encountered since the hoisting began, the wind having increased to thirty miles an hour, swaying the span about 1½ ins. Fifteen lifts of 2 ft. each were accomplished Thursday morning, leaving only four lifts to be done after lunch. The pins at the CMO joint were driven before four o'clock and the ensign of the Canadian Marine Department was then flown from the span, indicating that the river was again open for traffic and that the bridge was officially considered safely in place.

Locomotive cranes, air compressor plants, river steamers, tugs and other craft blew their whistles loudly and long, as soon as it became known that the pins were safely in place. The demonstration was carried down the river to Quebec, where thousands of bells clanged and the streets were transformed by bunting which the people hurried to hang out.

The officials of the bridge company and the members of the board of engineers were surrounded by the bridge workers and loudly cheered. In an interview with the newspapermen after the completion of the work, Col. Monsarrat, the chairman of the board, said that what remained to be done on the bridge to fit it for traffic would not require many weeks and that within a few months the bridge would be entirely completed.

While the span was being hoisted, a number of telephone calls were received by *The Canadian Engineer* from persons enquiring whether operations were being continued at night. No night work was done. Hoisting operations were stopped each day about 4.30 p.m.

DESIGN OF DOCKS AND WHARVES*

By W. H. Hoyt
Assistant Chief Engineer, Duluth, Missabe & Northern Railway Company.

BY conception of a dock and wharf we mean the act of the primary creator of the general idea who, as a railroad president, corporation director or property owner, conceives or puts together the plan of constructing and operating a dock and wharf, building his thought from a mass of separate ideas, business conditions, laws and physical conditions. He starts from a nebulous mass of information with or without few factors of evaluation of the numerous parts and directs the project into engineering channels, from which comes the final development and structure. The engineer, because of the knowledge he possesses of the properties and use of materials, their costs and relative economies, may even be called into or delegated to solve the problem in its conception as well as develop the plan.

Therefore, the problem of the conception of the plan is outlined here before taking up the factors of design.

If it were possible to give each factor of design a value the problem might be reduced to a mathematical basis, but the factors are variable and can only be expressed in general terms until a definite problem is studied.

In conceiving the general plan or scheme of a dock, wharf or waterfront improvement, the character of the service to be rendered or the mission of the completed property is of first importance. A dock and wharf is a means to an end. Except as the means determines the operating cost, the choice of the means is of less importance than the accomplishment of the ends. That plan which accomplishes the end with the lowest cost per year is the most economical. We must include in the cost per year charges which will secure all original invested capital. Each kind of business or service has its own peculiar requirements which call for appropriate qualities in the character of the dock and wharf.

By the definition given above, the dock being the water basin adjacent to the wharf and serving the purpose of giving approach to the wharf for appropriate vessels, is of fewer and simpler details. It partakes of the qualities of any sea road, that is, sufficient room to manoeuvre the boats with ease and dispatch, including boats of the present size and future increased size, sufficient frontage on wharf to accommodate the required number of vessels with depth to float loaded vessels of the present draft and future design.

Consideration must be given to allowing space enough for maintenance and dredging operations if the conditions are liable to cause changes in the depth of water.

The vessels inside the dock should not be unnecessarily exposed to rough water, and if possible the plan should be such as to secure favorable conditions at the entrance for boats during rough weather and various phases of the tide.

In some cases the dock may be constructed on line of two adjacent properties of different ownership, the dock area being chosen sufficient to serve both properties. The total area thus devoted to water surface may be less than the area required if both parties were to build separate docks. Dock property, which includes the land under the water, available for construction of both dock and wharf, has risen in value in recent years and economy in the plan which will minimize the area wasted in waterway is greatly to be desired. Community developments of dock property are very important. The United States government has spent large sums of money in developing harbors and approaches thereto and will continue to do so. This cost is borne indirectly by all and economy in use of the frontages on these harbors will lessen the total amount required to be spent on harbor development, besides producing the greatest returns to each individual property.

Sometimes the dock work is reduced to a minimum because the necessary service is secured by a pier run out into deep water.

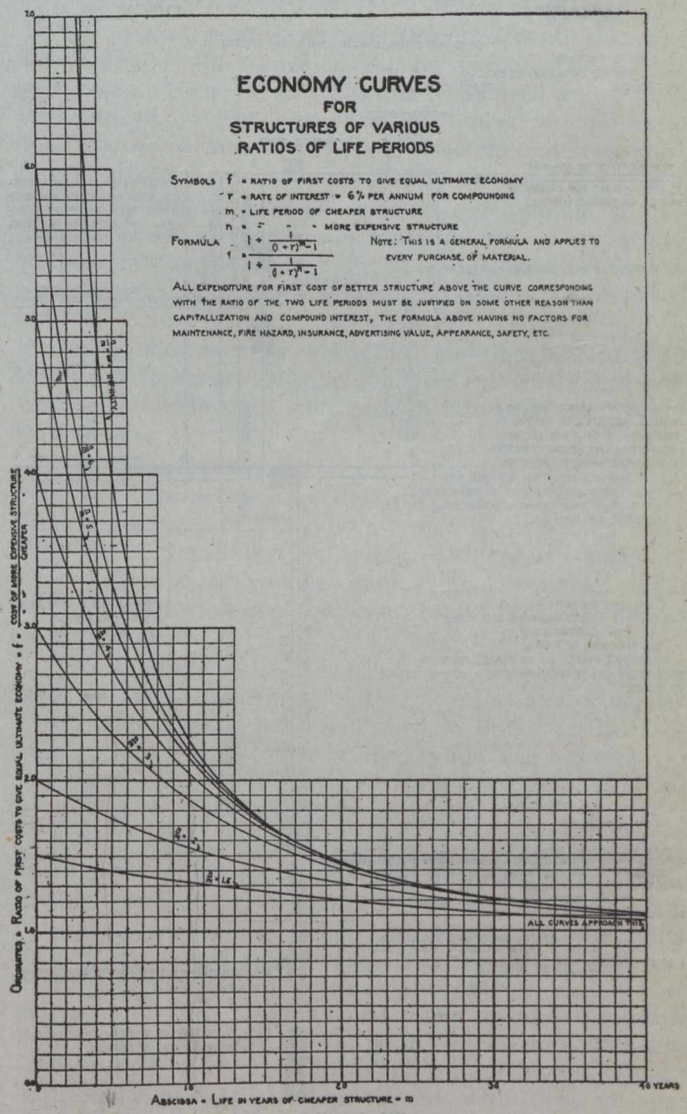


Plate A

The general scheme of a wharf will often be started with limitations of property available either because of prohibitive cost or the finished development of adjoining property by other owners. The shape of parcels of waterfront property is more liable to be irregular than regular, sometimes approaching the square, at other times a long strip between other strips. Sometimes when the shape is suitable, the approach is unsatisfactory because of developments of industries and surrounding communities. The facility of approach with the railroad tracks, complications of manufacturing and improved properties, general natural layout of the ground over which the ap-

*Abstracted from July Bulletin of the American Railway Engineering Association.

proaching railroads are to operate, may materially alter the general conception. These predetermined conditions may force unsatisfactory arrangements, but care must be given to eliminate constrictions at any point on the approach which will develop neck-of-the-bottle effects and limit the full use of the property.

Change in value of real estate and dock property should be considered. Property may become too valuable for use as originally intended and require a change to justify the interest charge which is always to be governed by present values.

Having in mind the property to be used, the possible approaches to it and the nature of service to be rendered

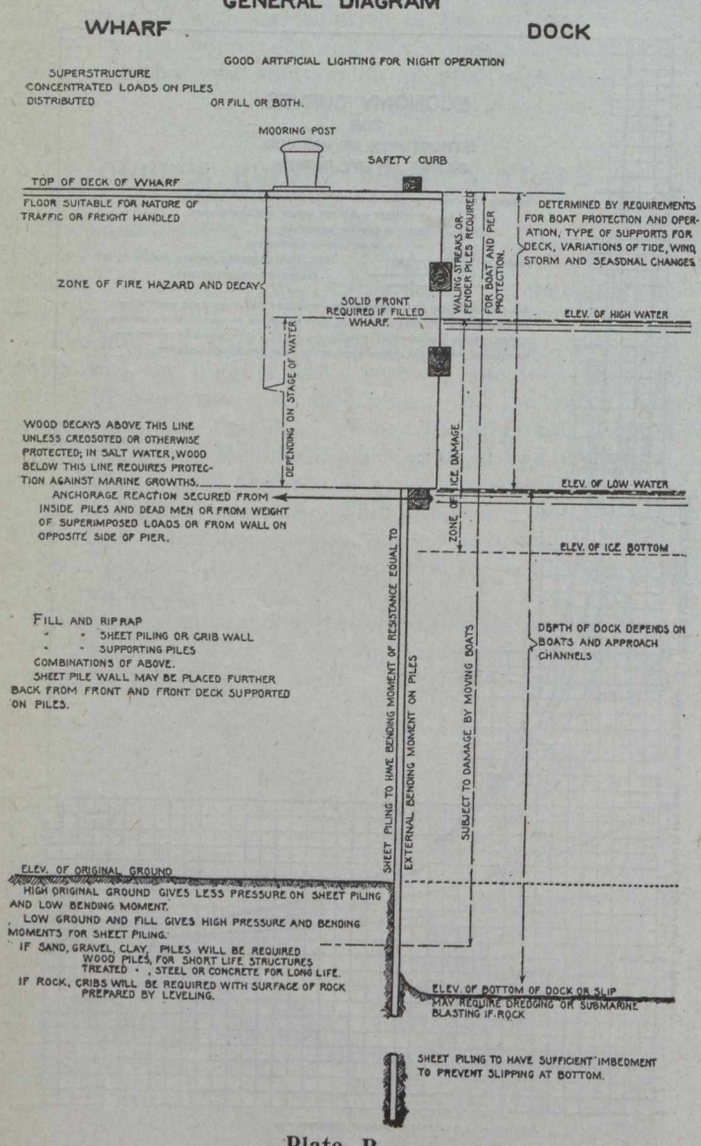


Plate B

by the developed work, a further discussion of the determining factors is given to show how wide the divergence in conception may go. With many factors, some natural and unchangeable, some man-made and changeable, some business and economic which are man- or community-made, but of such nature as not to be altered to any large degree, each person who has the duty of judging will put a different valuation and develop a different conception. Each factor has a different valuation for a short-life structure than for a long-time development.

The character of the service to be rendered is of prime importance. The effort should be to get the best degree of service because the welfare of the business depends upon the quality. Success in service promotes success in business.

Failure to select a layout which gives the best service will surely lead to a revamping, a process which nearly always entails loss of capital.

If the plant is to accommodate passenger service, its arrangement as to safety and convenience should be given careful attention. Ease of transferring passengers from trains or from land approaches to floating equipment, ample room for allowing rapid and safe movements, are factors which will largely control the general conception, as will also the passenger service whether ocean-going, long voyages or short-voyage ferry service. The character and number of passengers handled influence the valuation to be given to convenience and comfort. Passenger service coming in contact with human and psychological factors requires a higher state of perfection, dependability and safety, especially so if in competition.

If the dock and wharf property is owned and to be developed by an owner having diversified freight and passenger business to transact, a careful composition of all the factors of possible business development will be necessary.

The relation between the ownership of the docks and transportation equipment calls for attention. If the ownership of both is in the same interests, greater permanence to the business justifies broader development of the property.

At the present time the tendency toward government ownership and control may influence the amount of the expenditure to be made. In case of a transfer of ownership a permanent structure would bring a larger proportion of returns than one of temporary character.

The fire hazard and insurance rate on property of this kind is very important. If located in the immediate vicinity of structures whose materials increase the fire hazard, fire resistant construction would be advisable. Rates of insurance in different localities should be carefully considered.

The height of the structure is often determined by its location on a shore line subject to rise and fall of the water due to tides, wind action or flood conditions of a river.

The action of salt water upon different structural materials, the climatic and atmospheric conditions, decay and deterioration due to marine growths, violence of wave action, general prevalence of storm conditions, and ice accumulation will all have their influence on the choice of materials. The life of wood commonly used in each locality is a factor in choice of timber or some more permanent form of structure.

The foundation details are variously affected by the character of the soil upon which the structure is to rest. Soft alluvial deposit or sand will often require very long piles, while if rock bottom may be reached without great expense, cribs or piers may be economically constructed. River or stream flow may wash out foundations or fill up adjacent docks. The seasons of the year when wharf may be started might determine the character of construction chosen.

In most of our harbors conditions imposed by the general layout of the government harbor lines affect the general shape of the work. Where the government harbor lines are laid out far from the natural shore line, construction will develop into long and slender wharves, while if the harbor lines are close in shore, structures will

develop into broad and probably filled docks. If the adjacent channels have not been developed to their final form by government decision, it might be unwise to adopt permanent construction. Sometimes riparian rights have not been settled by court decisions and permanence of legal rights should precede permanence of construction.

The design of wharf structures fundamentally should start from the top and progressively work to the foundation on solid earth at the bottom, but because the elements of the foundation are simpler than the superstructure and the same foundation may serve many kinds of superstructures, it is thought best to give attention here to details of the substructure.

Any substructure may be divided into elements as indicated by the diagram (Plate B), and the notations thereon. The critical region where the greatest variation in design and construction occurs is that next to the dock basin or the part of the wharf which comes closest to the boats, for here we find a variety of forces and requirements.

The vertical loads are to be carried by piling, sheet piling, crib walls and fills. The horizontal pressures, where they exist, are to be carried by sheet piling or crib walls. Boat impact and mooring stresses are usually carried by the structure as a whole.

The quality of first importance in a foundation is permanence of form and position during the chosen life period of the wharf. The action of natural forces is destructive rather than helpful in maintaining a structure in place. Of the faults in the foundation uneven settlement is worse than uniform settlement because it sets up destructive stresses in the superstructure. Therefore if settlement seems unavoidable, attention should be given to keeping it as near uniform as possible. This can be attained by using a uniform system of support.

One of the most common causes of failure, and perhaps the most common defect in dock foundation construction, is the improper spacing of the supporting piling. The tendency is to space piling more or less uniformly throughout the structure with utter disregard of the unequal distribution of load. Often the parts of the dock carrying no load at all are supported by the same distribution of piling as the part of the structure carrying the maximum loads. Piles should be so placed as to receive uniform loading for each pile.

By far the greater number of all docks yet built or being built in this country are designed with wooden piling to carry their loads. In many cases they are being surmounted above water line by concrete piers either with or without timber grillage.

It is becoming more and more the practice at the present time to use treated timber and treated piling in all work subject to destruction by the teredo or other form of marine borers. In the replies to inquiries of the Committee on Docks and Wharves, this recommendation has often been made.

Where piling is driven in very deep water and future plans contemplate permanent filling of the dock, it is often good practice to fill in around the piling to a certain depth with rubble stone, thus stiffening the foundation and causing less damage to buildings and structures due to the shock of berthing boats.

Some structures are surrounded by timber sheet piling well anchored back with steel rods and the wharf then filled to the required height. A few have already used steel sheet piling for this purpose, thereby obtaining a very permanent foundation.

During the past a great many docks have been constructed of timber cribs sunk along the dock line without placing under them piling or other permanent form of support. These structures have been very unsatisfactory. They have caused trouble by settling under load, and by being easily overturned toward deep water whenever it became necessary to deepen channels. This practice has been almost entirely abandoned and it is now recognized that filled cribs should never be placed, except upon solid, unyielding foundations. Where the improvement will warrant the expenditure, the use of some form of steel sheet piling is very satisfactory, and its use will, doubtless, be increased very greatly in the future.

The present depth of channel as well as depth that may be required in the future should be given careful consideration. If the structure is one to be used a long time its future improvement by changing timber foundation to one of more permanent design of concrete and steel must be considered.

Filling behind sheet piling or in cribs should be distributed uniformly and in horizontal layers. Sheet piling walls and cribs should be tight so as to retain all fill permanently. Cribs should rest fairly on suitably prepared bottom.

Ample allowance for strength in the foundation for all loads and forces which may come on the wharf and prevention of overloading later is the best way of minimizing settlements.

The following is a list of the more important items to be given consideration in designing wharf foundations: Timber piling, concrete piling, wood sheet piling, steel sheet piling, concrete sheet piling, rock for masonry and fill, wood cribs, crib filling, sand filling, retaining walls, depth of channel or dock adjacent, future depth of channel or dock adjacent.

From the above list it will be seen that wharf design of details is an application of specifications and principles which have already been published in previous Proceedings and the Manual of this Association and reference to the indexes thereof will furnish a satisfactory fund of information on nearly all the topics above.

When a boat strikes a wharf or pier the damage done will depend on the size of the boat, its speed, its material, the mass of the pier, its fender system and material. The designer must consider where he wishes to direct the damage or cost of maintenance. There are two systems directly opposed in principle. The first is to build of materials of such elasticity and make up as will absorb the average service blows with very small damage. Usually this takes the form of elaborate timber framing with fender piles, sometimes backed with coil springs. The exposed points are usually protected with large groups of closely driven piles. However, this protection fails with square blow of a vessel under headway and usually results in expensive damage to the pier. This system has a reverse effect in lessening the skill of the boat captains who do not fear the contact of the wharf with their vessels.

The other system is to build of simple concrete masses or reinforced concrete of such amount and rigidity that boats strike the pier at their own peril. Here a premium is to be put on solidity and mass. Vessels can and do much damage even to these structures, but greater damage is usually sustained by the boat. This tends to increase the skill and diligence of the captains, lessening the frequency of such accidents and usually leaving the structure in a shape to be easily repaired after a destructive

blow. Such structures usually only have a rubbing waling strip of oak timber or fender pads of 12-inch by 12-inch timber hung over the side.

Timber piers usually are not adapted to the second system because lacking in mass and rigidity, hence some form of the first system is used.

Where passenger service is rendered by the pier, the second system is not advisable because of the effect on a large crowd of people on the boat of a smashing blow of impact with the pier. Rightly here the practice has developed elaborate systems of cushioning the blow and letting the damage be done to the dock.

Superstructure

The superstructures of many wharves constructed during the past few years are of a composite character. Timber, concrete and steel are used in various combinations, and there seems to be great diversity of opinion as to the best practice. Of course there are many conditions to be considered in planning a wharf for a particular locality to handle certain classes of traffic, and each is a problem by itself.

Designs submitted to the Sub-Committee on Docks and Wharves show considerable variation in the construction of dock floors. Timber structures are generally decked by cutting off the piling to proper level, capping same with standard sized timbers and placing a plank floor securely spiked to the caps. This form of deck is very satisfactory for wooden structures and, up to the present, on account of the low price of timber, has probably returned more on the investment than would have been produced by any permanent form of construction.

In the past few years some designers have placed concrete decks on timber structures, others have used concrete with asphalt wearing surface. It would seem that either of these methods of construction were hardly satisfactory. Concrete or asphalt decks should be placed on filled or permanent structures so they would not deteriorate rapidly from the action of an unstable foundation.

The superstructure of many wharves is of very simple construction, being principally a more or less extensive roof supported upon posts from the foundation. Of late years many very fine examples of steel and concrete buildings have been erected and the tendency in all our large shipping centres, at the present time, is to erect structures of this character.

The danger of fires and the tremendous loss incident to the destruction of wharves and their contents, as well as the loss that may entail on shipping in the immediate vicinity, has been a very decided factor in producing a permanent form of construction. The constant rise in prices of timber in all forms and the lower prices of steel and concrete is making it more feasible to put up fireproof structures of permanent design.

Plans for proper distribution of electric current for light and power, water pipes for drinking purposes and sanitary uses and fire mains, together with fire-alarm and hose-storage points, are all questions to be carefully considered in designing superstructures.

Economy Curves (Plate "A")

The formula for these curves is given with the curves. By assuming that n and m have a fixed ratio and using various life periods, it is possible to calculate values of f for each ratio of life periods and different lengths of life. By plotting these values of f and joining points calculated for the same ratio of life period, we get curves showing values of f for any life period within the limits of the curves. For convenience, those of even life ratio were plotted. For any fractional ratio of life period values of f can be found approximately close by interpellation between the appropriate curves. The curves start at zero life and ratios of cost equal to the ratio of life period and approach the ratio one as the life periods lengthen until at infinity f = one, irrespective of the ratio of cost at the start. The curves are calculated with interest rate at 6 per cent., but the principle would be the same whether we used 3 per cent., 4 per cent., 5 per cent. or 6 per cent. except that the higher the rate the more rapidly do the curves fall to the ratio one.

Example: A tie lasts ten years, how much are we justified in spending for treated tie if it will last twenty years because of treatment? Entering the diagram at 10 at the bottom, carrying our eye up the curve of ratio 2 and reading from the scale of ordinates at the left we find ratio of cost equals 1.55, or if our untreated tie costs 60 cents a treated tie should not cost over 1.55 times 60, or 93 cents. If we spend more than 93 cents we must obtain longer life than double or some other advantage must accrue to the roadbed.

From these curves we can read off by interpellation what life we must get from the more expensive material with a given ratio of first cost.

Example: Wood lasts 10 years and steel may cost twice as much to accomplish the same ends. Entering the diagram at the ratio 2 at the left and noting the intersection with the 10-year life line it is seen that the intersection lies about three-quarters of the distance between the three and four curves or the steel must last 3.75 times as long as the wood or 37.5 years.

By a study of the curves it will be seen that a larger ratio of first cost is justified for short-life structures than for long-life structures even if the ratios of life periods are the same.

Example: A softwood floor with a life of five years and a hardwood floor of 10-year life we find on the curve 2 that we are justified in spending up to 1.75 times the cost of the softwood floor for the hardwood. With a hardwood floor of 10-year life and a concrete floor of 20-year life we can spend up to only 1.55 times the cost of the hardwood.

From this principle it will be seen that every additional year which we can add to the life of the lesser cost structure lowers the ratio of justified cost of a longer life structure, even though the longer life structure does last the same ratio of life. For example: Treated timber with a life of 25 years and steel of 50 years have a justified cost ratio of only 1.23 and even if we were to get infinite life from the steel only a cost ratio of 1.30 is allowable. This does not prove that steel should not be used, but indicates that where steel is used some other important factor such as maintenance or fire hazard must be the basis for spending a greater amount.

More than $7,500,000 are paid annually into the provincial and federal treasuries of Canada as timber and pulpwood dues by commercial companies. British Columbia receives the largest amount, over two million dollars a year.

The completion of the New York State barge canal has been delayed by lawsuits brought by the railroads over the cost of eighty-six bridges. This matter has now been settled, and it is expected that this year the canal will be opened from Lake Ontario to the Hudson, and to Buffalo next season, only 7 per cent. of the work remaining to be done.

LAKE OF THE WOODS LEVELS

AN excellent Atlas has been issued to accompany the report to the International Joint Commission relating to the Official Reference respecting the Lake of the Woods Levels, by Mr. Arthur V. White, of Toronto, and Mr. Adolph F. Meyer, of Minneapolis, both well known consulting engineers. Only a limited edition of this Atlas has been published and hence it cannot be generally distributed. Copies, however, have been filed for reference purposes in some of the leading public libraries and government departments, in both Canada and the United States. The volume, which is well produced in every way, contains a large number of maps showing topographic details with exceptional clearness, and the work reflects great credit upon Mr. White and Mr. Meyer, who were responsible for its production. The Atlas was published for the Commission by the Government Printing Department, Ottawa, and the engraving work was performed by its Engraving Branch.

The following is a list of its contents:—

(*a*) Index Map of Lake of the Woods Sheets—Southerly Shore, showing sheets 1 to 25.

(*b*) Map showing Triangulation Control of Lake of the Woods and Shoal Lake Surveys.

(*c*) Lake of the Woods Sheets—Southerly Shore, series of twenty-five sheets. Sheets Nos. 1-19 showing surveys from the Northwest Angle Inlet to Big Grassy River. No. 1, Northwest Angle Sheet; No. 2, Buckete Island Sheet; No. 3, Oak Island Sheet; No. 4, Garden Island Sheet; No. 5, Driftwood to Stoney Sheet; No. 6, Stoney Creek Sheet; No. 7, Reed River Sheet; No. 8, Buffalo Point Sheet; No. 9, Elm Point Sheet; No. 10, Warroad Sheet; No. 11, Willow Creek Sheet; No. 12, Rocky Point Sheet; No. 13, Long Point to Zippel Sheet; No. 14, Zippel Sheet; No. 15, Four Mile Bay Sheet; No. 16, McGinnis Creek Sheet; No. 17, Windy Point Sheet; No. 18, Little Grassy River Sheet; No. 19, Big Grassy River Sheet. Sheets Nos. 20-22 showing surveys of portions of Bigsby and Big Islands. No. 20, Bigsby Island Sheet; No. 21, Big Island Sheet (East); No. 22, Big Island Sheet (West). Sheets Nos. 23-25 showing areas surveyed around Shoal Lake. No. 23, Hay River Sheet; No. 24, Rice Bay Sheet, and No. 25, Falcon River Sheet.

(*d*) Rainy Lake Sheets showing surveys of portions of shore of Rainy Lake in the vicinity of Rat Root River and Stanjikoming Bay. Series of four sheets. Sheets Nos. 1-4—No. 1, Rat Root River Sheet; No. 2, Black Bay Sheet; No. 3, Cranberry Bay Sheet; No. 4, Stanjikoming Bay Sheet.

(*e*) Kettle Falls Sheets showing surveys of Lakes above Kettle Falls. Series of four sheets. Sheets Nos. 1-4—No. 1, Kabetogama Lake Sheet; No. 2, Namakan Lake Sheet; No. 3, Sand Point Lake Sheet, and No. 4, Little Vermilion Lake Sheet.

(*f*) Map showing surveys of Connecting Channels of Lakes above Kettle Falls.

(*g*) Plan showing Cross-sections of Overflow Channels between Kabetogama, Namakan and Rainy Lakes, also certain sections in Channels at Kettle Falls.

(*h*) Key Map of the Lake of the Woods Reconnaissance Sheets—Northerly Shore.

(*i*) Lake of the Woods Reconnaissance Sheets, Northerly Shore. Sketches of Portions of Northerly Shore from Shoal Lake to Big Grassy River. Series of three sheets. Sheets Nos. 1-3—No. 1, Sketches 1 to 75; No. 2, Sketches 76 to 133, and No. 3, Sketches 134 to 190.

(*j*) Watershed Map of the Lake of the Woods, compiled mainly from maps of the Department of the Interior Canada, and Map of the State of Minnesota, prepared (1912) by the United States Geological Survey.

A copy of this watershed map, we are informed, will accompany the forthcoming complete Report of the Consulting Engineers, and in this way be available for more general reference.

The data shown upon the maps in the Atlas were used by the Commission in their consideration of the important questions centering around the effects of various lake stages upon low lands surrounding certain lakes on the Lake of the Woods Watershed.

At the times the various maps were issued, copies were supplied to parties interested in the Lake of the Woods Investigation, including many government branches in both countries. Many of these maps were bound up by the parties receiving them. With these and the Atlas now sent out, the results of the surveys made by the Commission have been very well distributed for future reference.

IRON ORE TAILINGS IN TOP FINISH OF CONCRETE SIDEWALKS

Iron ore tailings have been used at Albany, N.Y., since 1912 in the top finish of concrete sidewalks. The specifications require the wearing surface to be mixed in the proportion of 1 bag of cement to 2 cu. ft. of clean iron tailings, to which is added and mixed 1 lb. of pure dry lampblack to darken the walks and lessen the glare on sunny days.

The use of the iron ore tailings gives a harder surface and while it does not entirely eliminate dusting, has reduced it so that there is no complaint. It has been noticed that some of the walks in the business section subjected to heavy and constant pedestrian traffic have taken a noticeable polish, so much so that they become somewhat slippery in unfavorable weather. The obvious remedy for this is to make the surface mixture on sidewalks subjected to heavy and constant traffic less rich.

Iron ore tailings cost about $1.60 per yard on cars, while sand costs about 27 cents per yard at the bank. The wearing surface being but 1 in. in thickness, the large difference in cost between the tailings and sand does not make a very large difference in the cost of the concrete walks per square foot. The total thickness of concrete walks constructed in Albany is 6 ins., 5 ins. being of 1 : 2½ : 4 concrete; the top wearing surface has a thickness of 1 in. and is composed of a mixture as above given.

A 6-in. concrete walk is built in place of the ordinary 4-in. walk because it is felt that the additional bulk of thickness of the former gives a greater stability and is less liable to heave, to get out of line and to crack. It is easy to break, for instance, a 4-in. concrete walk by throwing ice or heavy boxes or anything of this description on the walks.

The special committee on Industrial and Scientific Research, of which Mr. Thomas Roden is chairman, will shortly hold a meeting to hear reports. At this meeting it is expected that a sub-committee will be appointed to draw up a scheme and submit it to the government for the establishment in Toronto of a bureau of industrial and scientific research, to which manufacturers may bring their problems for solution.

Letters to the Editor

Sands and Consistency of Concrete

Sir,—In your recent issue of September 6th, on page 201 appears an article by Mr. L. N. Edwards on certain specifications for sand for the manufacture of concrete, one element of which specifications states that not over 5 per cent. of a proportion of sand, sand being classified as passing the one-quarter inch screen, should be passed through the 100-mesh sieve. I presume that Mr. Edwards' specifications being based on a series of experiments is intended to produce a concrete which is of maximum strength in compression.

Mr. Edwards does not consider the question of watertightness, nor does he consider in respect to either strength or watertightness economy in the use of Portland cement.

I agree with Mr. Edwards that we should give up immediately those simple specifications for sand which define its maximum size and which pay no attention to the grading of the particles. We should give up our definition of "sharp sand" as a good sand. Sharp sand is anything but a good sand. Excepting crusher dust, all sand grains are individually round and therefore individually not sharp. If we screen the sand into bins separating all the various sizes, we will find that the sand in each bin is harsh to the feeling inasmuch as the sand in each bin will have about 45 per cent. voids. If we take a proper quantity from each of those bins from dust up to the maximum dimension of one-eighth inch or one-quarter inch, as may be chosen, and mix these quantities so as to obtain a well-graded sand, we can reduce the proportion of voids to about 20 per cent. or less, and to the feeling such sand is not sharp but smooth, and such sand is the most suitable sand for obtaining a dense, strong and watertight product.

After a long series of experiments the specifications for sand adopted by the Water District engineers for the construction of a sufficiently strong and watertight concrete required:—

1. That the maximum size should be such as would pass the one-eighth inch screen, assuming the maximum size of the stones or gravel with which this sand is to be mixed has passed the one and one-half-inch screen, the small proportion of larger material being considered as plums;

2. That of this sand not five parts, but from 10 parts to 15 parts should pass through a screen having 100 meshes to the inch;

3. That the intermediate sizes of sand should be in such proportions as would furnish the grading required for Fuller's ideal curve.

Our first step was to discover a gravel pit which should contain materials in such proportions as would, with a minimum waste of sand, enable us to produce a concrete aggregate containing not more than 35 per cent. of sand and the sand in which pit should in all parts contain or be furnished with the proportions of dust above referred to. Concrete carefully manufactured from such aggregate will develop in 28 days, if consisting of a mixture of one part cement to six parts aggregate, a strength of about 2,800 pounds per square inch and a six-inch wall of such concrete will be watertight against a hydrostatic pressure of 200 feet head. A concrete aggregate containing a slightly less proportion of sand to stone, say, 31 or 32 per cent. of sand, will be difficult to work, although if properly worked it will be quite as strong when set. A sand containing from 6 per cent. to 10 per cent. of dust will be nearly watertight when properly worked. Practical consideration, however, which includes the probable limits of segregation in transport, handling and placing of the aggregate as concrete, requires that the gravel or stone should be "fattened" by the inclusion of slightly more sand, and that the sand itself should be fattened with slightly more dust.

I believe that the use of a thoroughly hydrated lime would make the mortar portion of the concrete sufficiently fat without quite so much dust and probably with slightly less water for mixing, but it is very uncertain whether the commercial lime can with economy be absolutely hydrated and it must be used, therefore, with great caution.

Referring to an article on page 197 of your issue of September 6th, by Mr. Marshall, and to an article concerning rolling of fresh concrete in roads, on page 453 of the Engineering News Record of September 6th, I desire to express an opinion that too much emphasis cannot be placed by engineers and responsible builders upon the necessity for thorough mixing and working of concrete in the making. Especially do I find it necessary at certain portions of structures to insist that freshly poured concrete shall be worked by spading and tamping until the process of setting shall make it too stiff to work. Only by this method can I get satisfactory results in density, strength and watertightness in the completed structures when the concrete is mixed with enough water to make it practicably fluid.

W. G. CHACE,
Chief Engineer, Greater Winnipeg Water District.
Winnipeg, September 12th, 1917.

LOWER STANDING FOR ENGINEERING COURSE

It has been decided by the Faculty of Applied Science of Queen's University, Kingston, that it is advisable during the period of the war to admit students with lower requirements in mathematics, namely, pass matriculation. This decision was brought about because war conditions have caused a larger demand for men with education in engineering, and it is evident that after the war there will be a call for more such men. It is desirable, therefore, under these circumstances, to take measures to hasten the preparation of men for engineering work and to encourage young men to enter upon engineering courses.

The deficiency will be made up the first year by devoting a larger amount of time to mathematics, so that the total requirements for a degree will remain exactly the same.

At a meeting of the Sociedad Espanola de Construccion Naval, held at Madrid, the directors were empowered to proceed with the preliminaries of a scheme for large works to supply the necessary material required by the national arsenals and the shipbuilding industry, such as forgings, castings, and special steels of every kind, and copper, brass and special bronze. The aim henceforth will be that ships and war material shall be built in Spain entirely of materials produced in the country, for which purpose large works with an annual output worth £1,000,000 are to be established with the technical co-operation of a British group at a cost of about £800,000.

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.

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BOOK REVIEWS

Examination of Water: Chemical and Bacteriological. By William P. Mason. Published by John Wiley & Sons, Inc., New York; Canadian selling agents, Renouf Publishing Co., Montreal. Fifth edition. Price, $1.25. (Reviewed by Joseph Race, city bacteriologist and chemist, Ottawa.)

The demand for a further edition of Professor Mason's manual bears testimony to the general excellence of the work and its general utility to both students and laboratory men.

The greater part of the book is devoted to the chemical analysis of water from the sanitary standpoint and this section, in addition to the usual determinations made in a sanitary analysis, also contains a number of paragraphs on the detection and estimation of metals and their general significance; these are especially commendable at present. The importance of the metallo solvent properties of water supplies is given proper emphasis and a recommendation is made that these should be carefully considered, both qualitatively and quantitatively, when a new supply is contemplated.

The chemical methods of analysis generally accord with the last edition of "Standard Methods" but there are notable exceptions that will not tend towards harmony of opinion in the rising generation of sanitary chemists.

Hard and fast standards for the interpretation of results are regarded as impossibilities and although "comparates" are given for many determinations, a warning is given against their use in any but the most catholic manner. This is a delightful antithesis to the dogmatism of Wanklyn and his confrères.

The section dealing with the bacteriological examination of water is rather elementary but sound, although the space given to the quantitative estimation of the gas formed by B. coli and the ratio of the gas constituents might perhaps have been utilized to better purpose.

The book is written in a most attractive manner and is very free from typographical errors; only one omission was observed, *viz.*, the iso-chlor maps referred to on page 36. Although these are for Massachusetts and Connecticut only, they would have been of more than passing interest to workers in other parts of the country. It is to be hoped that the day is not far distant when iso-chlor maps will be available for the whole of North America.

Calculus. By Herman W. March, Ph.D., and Henry C. Wolff, Ph.D. Published by the McGraw-Hill Book Co., New York. First edition, 1917. 360 pages, 5 x 7½ ins., illustrated, cloth. Price, $2. (Reviewed by Prof. Alfred Baker, University of Toronto.)

It is not easy to introduce any very startlingly new features in an elementary work in the Calculus; the subject has been dealt with so frequently. March and Wolff, however, have produced a book in which the treatment of the matter is characterized by good judgment and sound commonsense. It is an excellent class book. The absolutely practical character of the Calculus is kept constantly in view, and this is done by giving to infinitesimals their proper importance, and by many illustrative examples from those sciences with which the Calculus, by reason of their nature and its nature, is intimately associated. It is an excellent arrangement of the work that the Differential Calculus and Integral Calculus are not treated as separate subjects, but run concurrently. Altogether the work of March and Wolff will be found to be a very valuable book for use with classes.

Railroad Construction: Theory and Practice. By Walter Loring Webb, C.E., M.A.S.C.E., M.A.R.E.A., Assistant Professor of Civil Engineering (Railway Engineering), University of Pennsylvania, 1893-1901. Published by John Wiley & Sons, Inc., New York, and Chapman & Hall, Limited, London; Canadian selling agents, Renouf Publishing Co., Montreal. Sixth edition. 846 pages, 4¼ x 6¾ ins., 218 figures and 10 plates, flexible binding. Price, $4 net. (Reviewed by A. L. Hertzberg, M.Can.Soc.C.E., division engineer, Canadian Pacific Railway, Toronto.)

A text book on the theory and practice of railroad location and construction.

This book should be found very useful, not only as a text book for students of railroad engineering, but also as a hand-book for the use of railroad location and construction engineers. For a book of its size it is exceptionally thorough in its minute treatment of preliminary reconnaissance and location work. A very instructive section deals with the organization, equipment and discipline of the survey party, including instruction in first-aid and medical treatment in the event of accident or sickness. The details of camp equipment are perhaps rather fuller than might be thought necessary in a book of this kind.

Although there is an appendix on the adjustment of the transit and level instruments, it it thought that some space might have been advantageously devoted to drawings and details of surveying instruments. The tables are very complete and include tables for use in barometric levelling.

More information on the design of structures, maximum loadings, etc., would be an improvement, and Chapter LV. on "Trestles," might have been enlarged to include more details of the strength of materials and the practical design of steel, ferro-concrete and wooden bridges, etc.

It is thought that less space might have been given to rolling stock and more to actual railway construction, electric as well as steam railways.

The book is well arranged and the printing is good.

Handbook of Engineering Mathematics. By Walter E. Wynne, B.E., and William Spraragen, B.E. Published by the D. Van Nostrand Co., New York. 220 pages, 113 illustrations, 4¼ x 7 ins., flexible leather. Price, $2 net. (Reviewed by Prof. Alfred Baker, University of Toronto.)

This book contains in most convenient form the various formulæ and results in mathematics and physics which engineering students have encountered in their college days and to which reference is continually necessary in the subsequent practice of their profession. It is something more, however, than a mere list of formulæ; throughout most valuable suggestions and reminders are given as to how results are reached; and thus the book is a sort of compendium of the mathematical and physical studies of the engineer. It is seldom that one meets with a book in which scientific knowledge has been so judiciously combined with teaching skill and sound commonsense. By keeping this work with him the engineer is saved the trouble of carrying about a considerable library; and, most important, he will be prevented from forgetting what he laboriously acquired when a student. To engineering students it will prove a valuable condensation of their work in mathematics and physics. The book has an additional use to teachers of mathematics and physics who are not themselves engineers—it suggests what portions of various subjects should be given to classes in engineering. The tables at the end of the work will be found to be those to which the profession most frequently has need of reference. As an illustration of the printer's and binder's art the book, in a way, is perfection. It can conveniently be carried in the pocket. Any engineer who sees the work will at once feel he must own it.

Operation and Maintenance of Irrigation Systems. By S. T. Harding, Assistant Professor of Irrigation University of California. Published by the McGraw-Hill Book Co., Inc., New York. First edition, 1917. 271 pages, 6 x 9 ins., 25 illustrations, cloth. Price, $2.50. (Reviewed by A. S. Dawson, M.Can.Soc.C.E., M.Am.Soc.C.E., chief engineer, Department of Natural Resources, Canadian Pacific Railway, Calgary.)

As brought out in the author's preface, the subject is one of broad interest; and there is comparatively little published material relative to the subject, which is easily obtainable and generally available.

The book consists of nine chapters and an appendix. Chapter 1, "General Maintenance," deals with difficulties met with, detrimental agencies to earth work, silt problems, vegetable growth, etc.

Chapter 2, "Maintenance of Irrigation Systems," deals with the serviceable life of various types of structures and the class of materials used.

Chapter 3, "Organization for Operation and Maintenance," deals with the necessary staff and the duties of same.

Chapter 4, "Methods of Delivering Irrigation Water," deals with the merits of continuous flow vs. rotation delivery, forms used for water delivered, and results obtained.

Chapter 5, "Measurements of Irrigation Water," deals with hydrography, measuring devices, and water records.

Chapter 6, "Rules and Regulations," deals with many important matters relative to this particular subject.

Chapter 7, "Payment for Structures and Operation Charges," gives a comparison of charges made and factors affecting such.

Chapter 8, "General Operation," refers to many of the difficult problems met with in such work, and deals with matters of policy as affecting economy.

Chapter 9, "Operation and Maintenance Accounts," deals with accounts, reports, circulars and records.

Each chapter is supplemented by a list of references, some of which have been made use of in the text. The book as a whole would form a valuable addition to the library of any one interested in the general question of operation and maintenance of irrigation systems.

The book is not technical, and only attempts to cover the problems met with on such work in the United States, and to a limited degree in Canada.

Public Utility Rates. By Harry Barker, Mechanical Engineer, Associate Editor "Engineering News," Mem.Am.Inst.E.E. Published by the McGraw-Hill Book Co., Inc., New York. First edition, 1917. 387 pages, 6 x 9¼ ins., cloth. Price, $4. (Reviewed by George T. Clark, designing engineer, Toronto Harbor Commission.)

The growth in the demand for information regarding the valuation of public utilities has been remarkable in recent years. There are a number of reasons for this demand, one of which is that many public utilities are being put in charge of commissions which, when asked to authorize additions to securities or changes in rates, usually request that valuations of the properties be made.

A great deal of valuable information relating to the valuation of utility property and the fixing of utility rates existed in numerous public papers, but the contradictory views expressed by those engaged in the work and the opposite positions taken by the public authorities and courts as to the proper basis of valuing such property, indicated that no real effort to digest and compile this material had been made, and that prior to 1912 "there existed no general practise or well-formulated theory of the valuation of utility property or the fixing of utility rates."

In 1912 two books were published, "Engineering Valuation of Public Utilities and Factories," D. Van Nostrand, by Foster, and "Valuation of Public Utility Properties," McGraw-Hill, by Floy.

These two volumes dealt with valuations and purposes of valuations, discussing at length the questions of structural and intangible costs, franchises, good-will, going value, appreciation and depreciation, with numerous examples of appraisals of public utility properties.

In the volume under review, the author goes farther afield and seems to have for his purpose "the presentation of a broad survey of the rate problem free from the mass of obscuring detail which necessarily marks individual cases."

In general terms it covers a discussion of: (1) Such corporation and municipal activities as affect service and rates; (2) the trend of public opinion and court and commission decisions; and (3) the most important engineering and economic problems involved.

The work consists of 387 pages divided into sixteen chapters with appendices and index. Chapter 1 includes a definition of public utility and public rights. In Chapter 2 a distinction is made between product and service companies and between unit and flat rates. Chapters 3 and 4 are important in that they discuss various bases for rates, distinguishing between market value basis, investment basis and equivalent substitute basis.

Chapters 5 and 6, on valuation, are important and outstanding, for, after all, a rate can be fixed only after a valuation has been made. Chapters 7, 8 and 9 deal with the question of reasonable returns, including the much-discussed subject of depreciation and other indirectly related problems. These matters are dealt with at considerable length both in the abstract and in the concrete.

Chapters 10 to 16, inclusive, deal with the rates in connection with the following specific utilities: Railways, street and interurban railways, express transportation, water, gas, electricity and telephone.

Appendix "A" consists of tables giving probable approximate costs of brick buildings. Appendix "B," tables for sinking fund and present value computations. Appendix "C," life expectation tables for public utility properties. Appendix "D," typical citation abbreviations of law reports met with in utility decisions.

Although the nature of the studies presented demands essentially an engineering and economic analysis, an attempt has been made to keep the subject matter within the understanding of those not technically trained.

The author states that it is due to all those approaching the subject with an open mind to warn them that some of his opinions, while supported by the views of many eminent engineers, are not accepted by some others equally prominent. But the author is generous enough where such divergence exists to present both sides of the question, and the work will be found on the whole fair and temperate in tone. Complete agreement with all the author's views so fully set forth is not to be expected. To consulting engineers, public commissioners, company officials and to students of municipal affairs this volume seems destined to render a real service.

The Elements of Hydrology. By Adolph F. Meyer, C.E., Associate Professor of Hydraulic Engineering, University of Minnesota. Published by John Wiley & Sons, Inc., New York, and Chapman & Hall, Limited, London; Canadian selling agents, Renouf Publishing Co., Montreal. First edition, 1917. 487 pages (including index), 287 figures, 45 tables, 6 x 9 ins., cloth. Price, $4. (Reviewed by T. H. Hogg, A.M.Can.Soc.C.E., assistant hydraulic engineer, Ontario Hydro-Electric Power Commission, Toronto.)

This is the first treatise to treat the science of hydrology in a comprehensive manner. Many books have been published and innumerable articles dealing with specific phases of the subject, such as precipitation, run-off, evaporation, etc., but hitherto no one has attempted to correlate the available data and prepare a volume covering the principles of the subject.

Before reviewing the book it would be well to give the author's definition of the subject, "Hydrology is the science which treats of the phenomena of water in all its states; of the distribution and occurrence of water in the earth's atmosphere, on the earth's surface, and in the soil and rock strata, and of the relation of these phenomena to the life and activities of man."

Chapter 1 (introduction) is a preparatory chapter in which the limits and limitations of the subject of hydrology are treated.

Chapter 2, "The Atmosphere," discusses the temperature pressure and circulation of the atmosphere, describing the methods of measurement, winds, etc.

Chapter 3, "Water," describes the various states in which water occurs and their properties, taking up in turn, ice, steam and vapor, and discussing the physical laws governing change from one state to another.

Chapter 4, "Precipitation." This chapter takes up at some length its occurrence and distribution. A very good discussion of maximum precipitation on watersheds is included.

Chapter 5, "Evaporation from Water Surfaces." The author here tabulates the evaporation formulas in use and discusses very fully the data available from tests. The material is presented very clearly and the treatment is good.

Chapter 6, "Evaporation from Land Areas," covers the rate of evaporation as affected by temperature, relative humidity, vegetation, etc.

Chapter 7, "Transpiration, or the Process of Vaporization of Water from the Breathing Pores, or Stomata, of Leaf and Other Vegetable Surfaces." The effects of temperature, humidity, wind, light, etc., in transpiration are discussed and values to be used for transpiration losses are given.

Chapter 8. "Deep Seepage" is covered in a short discussion with references to Hazen's and Slichter's formulas.

Chapter 9, "Run-off," gives an extended treatment of this phase of the subject, treating it under the following headings: Surface flow, seepage flow, run-off from typical watersheds, floods due to rainfall and snowfall, and the effect of temperature and precipitation on winter and spring floods. Flood flow formulas are analyzed and data are given on some of the most severe floods. A short discussion is introduced on the low water flow of streams.

Chapter 10, "Stream Flow Data." In this chapter the methods of stream flow measurements are described, and a statement is given wherein stream flow data is published.

Chapter 11, "Supplementary Stream Flow Data." This chapter gives a synopsis of the author's method for computing run-off in considerable detail.

Chapter 12, "Modification of Stream Flow by Storage," treats the influence of storage on stream flow. Reference is made to reservoir sites, effectiveness of reservoir storage, storage for municipal purposes, irrigation, logging, navigation, flood prevention, and for power. The conflict of the various interests in conserving water for different purposes is discussed.

The above résumé gives some idea of the scope of the book. The volume is very well written and splendidly illustrated with good, live drawings and cannot be criticized from a typographical or literary standpoint. Since the science of hydrology is in its infancy, it follows that the available knowledge of the subject is essentially fragmentary and by no means exact. For this reason the subject is a difficult one to treat satisfactorily.

A careful reading of the volume, however, leads the reviewer to believe that this book should prove invaluable to the engineer interested in any of the many phases of hydrology. The treatise is by no means a handbook, nor can the reader get much from it by cursory reading; but the amount of information it contains, together with the compilation of precipitation records, evaporation data, etc., should almost make it essential to the engineer's library.

The profession is indebted to the author for presenting in this volume a correlated and crystallized treatment of what is practically a new subject.

Elementary Qualitative Analysis. By A. Beston Dales, Ph.D., and Oscar Leonard Barnebey, Ph.D. Published by John Wiley & Sons, Inc., New York, and Chapman & Hall, Limited, London; Canadian selling agents, Renouf Publishing Co., Montreal. 205 pages, 5 x 7¼ ins., cloth. Price, $1.25 net. (Reviewed by C. H. Heys, Thomas Heys & Sons, Technical Chemists, Toronto.)

This textbook covers in a brief, but thorough and systematic arrangement, the study and practical examination of bases and acids, together with much valuable information to students of practical chemistry.

The authors rightly offer the book to students who have had a year's study of elementary chemistry.

Chapters 1 and 2 covers briefly, but clearly, an understanding of the principles of Qualitative Analysis, Chemical Reactions, and Equations.

Chapter 3 systematically defines the divisions and grouping of the bases and acids according to their analytical reactions.

Chapter 4 gives valuable advice in the care, handling and preparation of chemical reagents.

Chapters 5 to 8 deals with the bases, following the well-defined system of grouping the elements according to their reactions. The chemical tests numerated for the various elements have been well selected to enable students to readily recognize the results.

Chapters 9 to 11 cover the acids in the same commendable manner as the bases.

Chapters 12 to 18 continues systematically and thoroughly to prepare and carry out the analytical methods of testing unknown elements.

As a laboratory guide the book is highly recommendable to students in this grade of chemistry.

How to Make High-Pressure Transformers. By Prof. F. E. Austin, Hanover, N.H. Second edition. 48 pages, illustrated. Price, 65 cents. (Reviewed by Alfred S. L. Barnes.)

This book sets forth in a brief and simple manner the general principles underlying the design of transformers and then proceeds to describe the method of procedure to be adopted in designing and building a single-phase, 1,000-watt, 20,000-volt transformer, for 60 cycles, stepping up from 110 volts.

In such a small compass as this book furnishes it has, of course, been impossible for the author to do more than skim over the subject, but enough information is given to enable the amateur to gain a fair idea as to what a transformer is and does, and also to enable him to design and build a transformer, suitable for experimental or other work, having a fairly high efficiency.

Instructions for building a 1,000-watt, 4,000-volt transformer are given and these are followed by some five pages of matter dealing with "The possibilities of a transformer as a frequency changer," and "How to obtain unity power factor," the usefulness of these latter in this particular book being very doubtful owing to the manner in which the subjects are treated; *e.g.*, under the second heading the use of a condenser, for the purpose named, is proposed and calculations are given showing how to arrive at the required capacity but no beginner or amateur would have any idea as to what actual size his condenser would have to be, either as to the area of the plates or the number of them.

A slight knowledge of both electricity and mathematics on the part of the reader is presumed.

On page 14 a printer's error occurs where "page 2" should read "page 12," and again on page 22 the word "hysteric" should be "hysteretic."

Some very necessary cautions regarding the handling of high-pressure apparatus are given, and the book on the whole will prove very useful to anyone desiring to make a transformer for his own use, the cost working out, as the author shows, to about one-third of that of the ordinary purchase price from the manufacturers.

PUBLICATIONS RECEIVED

Precise Levelling.—Vol. 3, No. 8, publications of the Dominion Observatory, Ottawa. Issued by the Department of the Interior, Canada.

Magnesite Deposits of Grenville District, Argenteuil County, Quebec.—By M. E. Wilson. Memoir 98, No. 81, Geological Series, Department of Mines, Canada.

Association of Ontario Land Surveyors.—Annual report and proceedings of the twenty-fifth annual meeting, held in Toronto, February 20th to 22nd, 1917.

T-A Pumps.—Circular illustrating Tod-Attwood Patent Vacuum Pumps, giving data regarding the various sizes manufactured. G. H. Tod Co., Limited, Toronto.

Problems Relating to the Mineral Industry of Canada. By W. J. Dick, mining engineer, Commission of Conservation, Ottawa. Reprinted from the eighth annual report of the Commission.

The Utilization of Pyrite Occurring in Illinois Bituminous Coal.—By E. A. Holbrook. Circular No. 5 issued by the Engineering Experiment Station, University of Illinois, Urbana, Ill. Price, 20 cents.

Mineral Production of Canada.—Preliminary report for the calendar year 1916, prepared by John McLeish, B.A., chief of the Division of Mineral Resources and Statistics. Issued by the Department of Mines.

Concrete Ships.—A compilation of data collected by the House Committee, Sixty-fifth Congress United States Government, on the merchant marine and fisheries. Forwarded to us by the Portland Cement Association, 111 West Washington Street, Chicago.

The Macon Concrete Paving Roller.—Four-page illustrated leaflet issued by the Ransome Concrete Machinery Co., 115 Broadway, New York, describing the Macon concrete paving roller for finishing concrete highway pavements, originated by Capt. J. J. Gaillard, city engineer, Macon, Ga., and manufactured by the Ransome Company.

The Canadian Mining Manual, 1916-1917.—Edited by R. E. Hore. Published by the Mines Publishing Co., Toronto. This is the third edition of the new series of this useful handbook of information concerning the minerals and mines of Canada. Contains 448 6 x 9-in. pages. Bound in cloth. Price, $3.

Editorial

THE QUEBEC BRIDGE

The successful completion last Thursday afternoon of the hoisting into place of the central span of the Quebec Bridge is a vindication of the methods adopted by the builders of this bridge, and proves that such work is not beyond the scope of engineering science, and that last year's loss of the span was purely accidental and not due to any inherent defect in the mode of operation.

To all the engineers who have taken part in any way whatsoever in this great Canadian undertaking, *The Canadian Engineer* extends its congratulations.

THE ENGINEER AND PUBLIC AFFAIRS

An engineering work of magnitude means the co-ordination of many activities and is like a nation drawn to a small scale.

The commercial man believes that he runs the Empire, but in reality it is the engineer who underpins him. Without the work of the engineer modern commerce could not exist. The merchant is a medium for exchange; the engineer effects the exchange. A bank, in crediting cheques and effecting transfer of assets, does not create wealth; that is the work of trade and production dependent in turn upon transit and power. Agriculture and engineering effort are the two greatest fields from which modern wealth springs.

The agitation for business government by business men, whoever they are and whatever is implied by the term, is not half so valid as the need for engineer-statesmen who will put into national practice their experience of works management and the lessons learned in the organization of labor.

The usual definition of business is much too narrow. In its limited sense it appears to be something which inhabits offices and whose raw materials are ink and paper. The engineer is not inexperienced in business but his view is wider, for his office is simply a control point and a matter of convenience, not an end in itself. The small cunning needed in some businesses has no place in the broader transactions of the engineer who is often disgusted with the methods of so-called purely business men.

First and foremost the work of the engineer consists in rendering service; no one can be in association with engineering effort without being struck by this aspect of its effects.

The engineer is above all an executive; he gets things done. Bluff does not deter him, nothing but proven and valid fact will turn him aside. His judgment of men and material is acute and he has to make the best of hampering circumstances. Resource is his sheet anchor; when one method proves impossible he must originate another, for he must win through whatever the trouble.

He can never abandon the job; having started in, he must win at the finish, however long delayed.

The result of this is that he is bound to grow in mental stature. His latent ability is continuously exercised and wherever he is placed he is sure to cut precedent and find an original solution to difficult tasks.

It is high time that the engineer obtained the recognition already much overdue, and a definite and conspicuous place in public council.

The public in general does not know the facts, and it is advisable that a leaf out of the professional politician's unwritten notebook be taken. If you would gain popularity, public esteem and trust, hide not your light under a bushel. In that direction lies extinction.

OUR LAST WEEK'S ISSUE

In the belief that the engineering fraternity throughout Canada were very deeply interested in the hoisting of the Quebec Bridge central span, *The Canadian Engineer* made special plans for covering the event thoroughly, and we are pleased to be able to state that the articles appearing in our issue of September 20th, were the only articles on this work which appeared in any technical paper last week. Special arrangements were made by our representative at Quebec for obtaining the necessary information, for doing special drafting work and photography, and for having engravings made in time.

Two complete papers had to be "set up" in our office last week, both ready for press, because much of the information given in last week's issue, and many of the photographs and personal notes, could not have been released had the undertaking resulted in another unfortunate accident like that of September, 1916. Fortunately, the hoisting of the span was completed successfully just in time for us to print all the reading section of the paper which appeared last week, and by keeping in telephonic communication with Quebec we were able to bring out an issue giving the story of the raising up to 11 o'clock Tuesday night, practically simultaneously with the completion of the hoisting operations.

Special feats of this kind, involving large outlays of money and effort, have frequently been accomplished by daily newspapers, but have never previously been attempted by technical papers in Canada. Many members of our editorial and mechanical staffs worked continuously for thirty-six hours to accomplish the result.

THE NEXT WAR LOAN

Sir Thomas White has pointed out that from this time forward the continued prosperity of Canada during the war will depend largely upon the thrift of the people and the success of the government's war loan issues. Canada can get all the export business she can finance and no more. He states that the demands upon the Dominion treasury at this time are of a two-fold nature; first to provide Canada's war expenditure here, and secondly to establish credits out of which the Imperial government may purchase, not only munitions, but essential foodstuffs such as cheese, bacon, flour, grain and canned goods for the army in the field and the civilian population at home. The amount of foodstuffs which Great Britain can purchase in Canada depends upon the amount of money which the Canadian government can supply the

Imperial treasury for the purpose, and this again depends upon the savings of the people of Canada and their willingness to place these savings at the disposal of the government by subscribing to war loan issues. Save your money now in anticipation of the next war loan.

PERSONALS

B. SHARPE has been appointed assistant roadmaster, Toronto Suburban Railway, Toronto.

Lieut. W. H. RICHARDSON, B.C.E. (Manitoba), was recently awarded the Military Cross.

FRANK PINEO, of Malahide Township, has been appointed road superintendent of Elgin County.

C. STANLEY GILBERT has been appointed manager of the Canadian Iron Company at St. Thomas, Ont.

JNO. W. WALKER has been appointed superintendent of rolling stock and substations, Toronto Suburban Railway, Toronto.

CHARLES F. GIBSON, former town engineer of Bowmanville, who left some time ago for the West, reached Vancouver recently, and will probably locate there.

A. M. ROBERTSON, formerly on the staff of the Dominion Glass Co., has been appointed mechanical engineer of the Acadia Coal Co., New Glasgow, N.S.

A. W. PERLEY, a well-known Canadian railroad man, has been appointed general superintendent of the Oregon & Washington Railroad with headquarters at Portland.

DOUGLAS MUTCH, mining engineer, of the Hudson's Bay Mines, has been appointed by the shareholders of the Temiskaming Mines to make an investigation of the Temiskaming property.

A. W. MCLIMONT has been appointed general manager of the Winnipeg Electric Railway Company, to succeed Wilford Phillips, who has occupied the position for fifteen years and is retiring.

Lieut. CHARLES S. L. HERTZBERG, who was some time ago awarded the Military Cross, has been appointed acting assistant adjutant at the Spadina Military Convalescent Hospital, Toronto.

L. S. BROWN has been appointed general superintendent of the Canadian Government Railways, Moncton, N.B., vice J. K. McNeillie, resigned; and A. C. BARKER has been appointed assistant to Mr. Brown.

Capt. EVANS, civil engineer, who was formerly employed by the Canadian Pacific Railway at Fort Steele, B.C., recently received promotion to his present rank and was invested with the Distinguished Service Order.

THOMAS BATE has been appointed mechanical superintendent of the Davenport Works of the Canadian Allis-Chalmers, Limited. Mr. Bate was formerly assistant works manager of the Angus Shops, Montreal.

E. N. HORSEY, resident engineer in charge of maintenance of way, city and suburban lines, British Columbia Electric Railway, Victoria, B.C., has been elected an associate member of the Canadian Society of Civil Engineers.

ROBT. GILBERT, purchasing agent, Toronto Suburban Railway, who was a lieutenant in the 255th Battalion, Queen's Own Rifles, Toronto, during its recruiting and training before going overseas, has returned to his business duties.

J. E. NOULAN CAUCHON, A.M.Can.Soc.C.E., Ottawa, has been requested by Thomas H. Mawson, the well-known English town-planning expert, to collaborate with him in the re-planning of the city of Salonika, which was recently burned.

Capt. J. R. COCKBURN, of the teaching staff of the School of Practical Science, Toronto, has been sent to Egypt in charge of an engineering unit. Capt. Cockburn, who went over with an infantry battalion, was transferred to the Royal Engineers on arriving in England.

W. G. Ross, chairman of the Montreal Harbor Commission, has been re-elected president of the American Association of Port Authorities. This is said to be the first time in the history of the association that the president has been elected for a second term.

Prof. H. E. T. HAULTAIN, M.Can.Soc.C.E., professor of mining engineering at the University of Toronto, has been retained in a consultative capacity by the Dominion Military Hospitals Commission for the purpose of delimiting the educational work of vocational training.

MELVILLE P. WHITE, who for the past eleven years has been manager of the Architectural Bronze and Iron Works branch of the Canadian Allis-Chalmers, Limited, has had his jurisdiction extended to include also the management of the Davenport Works under the title of works manager.

E. JORDAN, Toronto, has been appointed general manager and chief engineer of L'Air Liquide Society, in succession to E. Royer, who resigned to go in business on his own account in Montreal. The company are building a new factory at Halifax and an addition to their plant in Toronto. The head office is in Maisonneuve, Que.

Lieut.-Col. J. S. DENNIS, assistant to the president of the C.P.R., and president of the Canadian Society of Civil Engineers, will be in charge of a big campaign in the city of Boston, Mass., to obtain recruits for Canadian and British regiments. This campaign has been originated since the arrival of Brigadier-General W. A. White, in charge of the British recruiting mission.

Gunner ROBERT JOHN THOMPSON, a student at the School of Applied Science, 1919, has been reported missing. He enlisted with the Divisional Cyclists in February, 1916, afterwards transferring first to the 44th Battalion and later to a machine gun battery. Gunner Thompson, whose home is in Toronto, was reported as wounded, but remaining on duty, in November of last year.

OBITUARIES

JAMES P. BECK, general manager of the Portland Cement Association, with headquarters at 111 W. Washington Street, Chicago, died September 8th at the Presbyterian Hospital, Chicago.

Capt. HUGH CALDWELL ANDERSON, who prior to his enlisting in the 127th York Rangers was manager of the Toronto branch of John Millen & Sons, has been killed in action. At the time of his death he was serving with the Canadian Railroad Battalion.

Sergt.-Major SCOTT BARTLEMAN, formerly of the 111th Battalion, is reported killed in action. Deceased was born in Scotland 33 years ago. When he came to Canada he located at Galt, Ont., where, after a short time, he was appointed secretary of the Board of Works and later superintendent of the waterworks department.

Coast to Coast

Blairmore, Alta.—A recent fire wiped out practically the whole business section of the town.

Chatham, Ont.—The construction of a new and up-to-date station to replace the one which was burned to the ground at Charing Cross, has been commenced by the Michigan Central Railway at the site of the old depot. The plans and specifications call for a much larger and more modern building which will be, when completed, 70 feet long by 20 feet deep.

Claresholm, Alta.—Claresholm is to have electric light, water and power under a franchise of the Claresholm Light, Water and Power Co., which has been given a charter by the provincial department. Calgary will be the head office, and the capital is set at $100,000.

Galt, Ont.—The Standard Paving Co. will shortly commence work on the construction of new pavements.

Guelph, Ont.—Col. Royce, president of the Toronto and Suburban Railway, arrived in the city on September 19th over the new radial line, on a tour of inspection. It is understood that this inspection tour means that the road is being turned over to the operating department for the first time, having been in the hands of the construction department since the line was built.

Kingston, Ont.—That Kingston would be linked up with hydro-electric power the first of October, was announced by R. H. Toye, chairman of the civic utilities, who recently returned from Toronto, where he had a conference with hydro engineers. Work on the line from Napanee is almost completed and it is expected that the hydro will be able to furnish the entire need of the city this fall and winter.

Ladysmith, B.C.—The smelter which was recently put in operation by the Ladysmith Smelting Corporation, will be capable of handling 1,200 tons of ore per day, although the initial capacity is 700 tons. There are two blast furnaces, one 42 in. x 120 in., and the other 42 in. x 160 in. The boiler plant consists of two 80 h.p., one 88 h.p., and one 104 h.p. boilers. Two electric generators furnish power for the motors and lighting system.

London, Ont.—Government Engineer William Losee, of the Ontario Department of Public Works, in company with Middlesex County Engineer Charles Talbot, has commenced the annual inspection of the road improvements of the county. Upon Mr. Losee's report will depend the amount of the government grant for road making in the county next year. His report will be submitted at the December sitting of the county council. This year's grant from the government was $28,000 for construction and maintenance purposes.

New Glasgow, N.S.—A 4,000 kilowatt steam turbine is now being erected at the Allan mine. This addition to the existing system will give a plant of 7,000 kilowatts, constituting one of the largest power plants in the province.

Newmarket, Ont.—The new reinforced concrete bridge that is being erected at the north end of the town by the York Highway Commission is now rapidly nearing completion, and should be ready for traffic in about a month. The new bridge, when completed, will cost about $4,000.

Ottawa, Ont.—This year only a little work is being done on the proposed provincial highway, and that is being done around the township of Pickering. The work is just temporary repairs, such as replacing old culverts and gravelling and surfacing the road to keep it in as good a condition as possible till the real work begins after the war is over. The Ottawa-Prescott highway will not be begun till next spring at the earliest. This decision has been arrived at after careful consideration. The condition of the labor market and the price of materials is the reason for the delay in this work.

Penticton, B.C.—A good roads convention was held here on September 6 and 7, at which delegates were present from Vancouver and interior towns. The primary object of the convention was to boost the Canadian national highway project.

Perth County, Ont.—The Ontario Government has contributed $10,573.44 to the county of Perth, as its share for the construction and maintenance of the county roads for the year 1917, under the Ontario Highway Act.

Quebec, Que.—The City Council recently voted the sum of $6,000 asked by the Health Committee to carry on the work of purifying the city's water supply. It is necessary to improve conditions at the source of supply in the St. Charles River.

Regina, Sask.—The value of the building permits issued in this city during the month of August was $164,670, and for the first eight months of the year the total was $330,670.

Scarborough, Ont.—The Hydro-Electric Power Commission has notified the Township Council that work has been started on a line to go through Birchcliffe, Scarborough Junction and Agincourt. It is hoped to complete the work this fall.

Sherbrooke, Que.—McBean and Williams, Montreal, the contractors for the new dam on Frontenac St., have taken action against the city for $82,029.36, which amount they claim is due to them under their contract, and for the value of certain extraordinary work, which they allege they were obliged to do last winter owing to severe climatic conditions.

South Vancouver, B.C.—Under a recently completed agreement with the city of Vancouver, South Vancouver has been given direct connection with the high pressure mains of the city system. This does not mean, it is stated, that the district will get any better pressure, but it is hoped that it will mean a material reduction in operating expenses for the municipality.

Stouffville, Ont.—The electric light plant, which was formerly operated under steam, has been changed over to a gas engine. It is anticipated a saving of $1,000 a year will be effected.

St. Thomas, Ont.—The Michigan Central Railway Company's pumphouse at Lake Pinafore is now being operated by hydro-electric power, furnished through the city's power station. Eighty-five horse-power is being supplied for the plant, which furnishes water for all the locomotives at this point.

Toronto, Ont.—According to a statement made before the Board of Control by G. H. Gooderham, the Toronto-Hamilton highway will be completed in a month.

Toronto, Ont.—A deputation from Etobicoke Township recently waited on the Minister of Public Works, Hon. Finlay Macdiarmid, with the request that the Toronto-Hamilton highway be widened in Etobicoke to 56 ft., with an open drain, instead of as at present proposed, 50 ft. and a tile drain.

Toronto, Ont.—The Shaft and Tunnel Contract Co. have obtained letters patent under the Ontario Companies Act, with a capital of $40,000, and are locating their head office in this city. The firm propose to carry on the business of general contractors and to undertake engineering works of all kinds, including general mining operations.

Trail, B.C.—Last week another important step in providing an adequate water supply for Trail was taken, when Victor Bianco, who has the contract at $7,037, started a gang of men at work on trenching for the conduit pipe line, from Cambridge Creek to Violin Lake. The line is 1,950 feet in length, the salt-glazed, vitrified pipe is 14 inches inside diameter and will connect the lake, which will be used eventually as a storage reservoir, with the creek. Later, the dam at the south end of Violin Lake will be constructed by the city. Mr. Bianco also has a contract from the city for laying about five miles of steel water mains throughout the municipality and is well advanced on the work, all the steel pipe having been received and much of it laid.

Windsor, Ont.—On account of the new act affecting approval for real estate subdivisions the border chamber of commerce is recommending to the various municipal councils of this metropolitan district that the services of Thomas Adams, town planning expert, be secured at once, and that he be instructed to prepare a plan as a basis for all future expansion within and beyond the corporate limits of the seven border municipalities of Sandwich East, Ford, Walkerville, Windsor, Sandwich, Ojibway and Sandwich East. Each of these councils will be asked to appoint one of its members to a joint town planning committee, with power to act.

Woodstock, Ont.—The value of the building permits issued during the month of August amounted to $16,883, an increase of $2,917 over the corresponding month last year. For the first eight months of the year the total is $79,027, as compared with $75,623 during the corresponding period last year.

Construction News Section

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

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

ADDITIONAL TENDERS PENDING.

Not Including Those Reported in This Issue.

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

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Eriksdale, Man., erection of building	Oct. 1.	Sept. 20.	58
Maisonneuve, Que., erection of factory	Oct. 15.	Sept. 13.	50
Toronto, Ont., stop valves, valve operating pumps, special castings	Oct. 2.	Sept. 6.	56
Winnipeg, Man., cast-iron pipe and special valves, vitrified clay pipe, etc.	Oct. 3.	Sept. 20.	56
Youngstown, Alta., erection of school	Oct. 1.	Sept. 20.	60

BRIDGES, ROADS AND STREETS

+—Barton Tp., Ont.—Township Council let contract to CHARLES BRAYLEY for the building of cement walks in Homedale and in the Mills' survey on the mountain, the price for walks being 16 cents a square foot and for crossings 17 cents.

Calgary, Alta.—F. W. Lent, president of the Alberta Auto League, at a meeting held here on September 19th, stated that the Alberta Legislature would hold a special meeting for the purpose of passing a vote of $30,000,000 to be used on the construction of highways in the province.

Calgary, Alta.—Speaking at a meeting of the Alberta Automobile League F. W. Lent stated that the Alberta Legislature would hold a special meeting for the purpose of passing on a vote for a considerable amount to be used on construction of highways in the province.

+—Campbellford, Ont.—The construction of the Trent Canal has made it necessary for the Grand Trunk Railway Co. to build a new bridge here, and work is now proceeding on this new structure. The company's engineers, under the direction of H. R. Safford, chief engineer, A. S. Going, engineer of construction, and W. G. Swartz, resident engineer at Campbellford, are doing the necessary grading and track changes. The abutments and piers of the bridge are of concrete. The contractors for the sub-structure are the FOUNDATION CO., LTD., while the superstructure is being built and erected by the HAMILTON BRIDGE WORKS, CO., LTD.

Chippawa, Ont.—Tenders will be received by Chas. Weinbrenner, clerk, up to September 27th, 1917, for the construction of concrete sidewalk on one side of Road St., from Bridgewater St. to Mechanic St., about 250 yards, more or less. Plans and specifications may be seen at the office of W. E. B. McKenzie.

Finch, Ont.—The United Counties of Dundas, Stormont and Glengarry intend to build sixty miles of county road by contract. Contracts to be awarded at the October session of the Council. J. G. Cameron, county road superintendent.

+—Galt, Ont.—City Council let contract to the STANDARD PAVING CO., LTD., Central Chambers, Ottawa, for pavement on Dickson St., from Wates to Wellington, costing $8,860.

Kent County, N.B.—Tenders are being received by the Department of Public Works, Provincial Government, Fredericton, until October 5 for the erection of the St. Nicholas River bridge.

Niagara Falls, Ont.—City Council received tenders from L. Sacco at $8,398.70 and V. C. Thomas at $8,535.60 for concrete pavement on Walnut St.

+—Pierson, Man.—Municipal Council let contract to SAM BROWN, Bank of British North America, Winnipeg, for reinforced concrete abutments.

Quebec, Que.—Hon. J. A. Tessier, of the Provincial Roads Department, announces that next season's work will include the repairing with gravel of the road from Beauce Junction to Sherbrooke, a distance of 80 miles, and macadamizing the road between Joliette and L'Assomption to join the Montreal-Quebec road. A party of engineers are now engaged in preliminary survey work locating a road between Levis and Montreal.

Sandwich East Tp., Ont.—The township engineer's report on concrete walks on Fairview Boulevard, Belle Isle View Boulevard, East Lawn Ave., Intersection Rd., Reaume Rd., St. Joseph and Franklin Streets was adopted by the Township Council. Clerk, Wm. A. St. Louis, Ford.

Sandwich East Tp., Ont.—Township Council instructed Engineer R. W. Code to report on the proposed pavement on Seminole St. Clerk, Wm. A. St. Louis, Ford.

Shawinigan Falls, Que.—Tenders are being received for the erection of a steel and concrete bridge between here and Ste. Flore by the Municipal Council. Plans and specifications with the city engineer, Raoul Rinfret.

+—St. George, N.B.—Contract let to A. E. SMYE, Alma, for construction of canal bridge by the Department of Public Works, Provincial Government.

+—Stonewall, Man.—DAVID WOOD, care of secretary-treasurer, V. W. McFarlane, has been awarded the concrete contract for concrete bridge for the Highway Commission, Provincial Government, Parliament Buildings, Winnipeg.

Three Rivers, Que.—The tenders for the Three Rivers-Grandmere road were received by the Provincial Government last Thursday. Half the cost of the road is to be paid for by the Provincial Government, and half by the Shawinigan Water & Power Co., the Canadian-Belgo Pulp & Paper Co. and the Laurentide Co., all of Grandmere. The road is 30 miles long and will be all gravel surface excepting 1¾ miles on hillsides which will be concrete. The grading of the road has been nearly finished by Alexandre Carrier. T. A. Rousseau and Mr. Ahern are the engineers on the work, under the superintendence of Hon. J. A. Tessier.

+—Verdun, P.Q.—City Council let contract for construction of sidewalks to the M. J. STACK PAVING & CONSTRUCTION CO.

+—Windsor, Ont.—City Council let contract to the CADWELL SAND & GRAVEL CO., LTD., 84 Sandwich St. W., for pavement on Cataraqui, from Mercer to Marentete. Estimated cost, $6,927.

+—Windsor, Ont.—City Council let contract to MERLO, MERLO & RAY, 296 Windermere Rd., Walkerville, for resurfacing pavement on Bruce St. at a cost of $14,467.

+—Yamachiche, Que.—Village Council let contract to ALEXANDRE CARRIER, Ste. Tite, for $20,000 macadam road.

WATER, SEWAGE AND REFUSE

+—Downie Tp., Ont.—Township Council let contract to WM. CONNELLY, care of clerk, P. Smith, R.R. No. 3, Stratford, for drainage system costing $3,500.

London, Ont.—Sealed tenders addressed to the chairman and members of the Board of Control, will be received at the office of the city clerk, up to 9 a.m., on Friday, September 28th, 1917, for the construction of approximately 500 lin. feet of 10-inch tile sewer and 1,566 lin. feet of 8-inch tile sewer, together with private drain connections, etc. Plans and specifications may be seen at the office of H. A. Brazier, city engineer.

London, Ont.—The City Council intends to construct a tile sewer on Duchess Ave. Estimated cost, $2,031.13. City clerk, S. Baker.

▲—Mimico, Ont.—Tenders, addressed to the Town Clerk, will be received until noon, Monday, October 8th, 1917, for construction of approximately 1,000 lin. ft. of 15-inch; 650 lin. ft. of 12-inch; 3,800 lin. ft. of 8-inch sanitary sewer. Forms of tender may be obtained and plans and specifications seen at the office of the Engineer, T. Lowes, Library Building, Mimico.

Plympton Tp., Ont.—Tenders to tile the Gordon and Steadman drain will be received at the Township Office, up to Saturday, September 29th, 1917. Plans and specifications may be seen at the clerk's office, Plympton.

Prince Rupert, B.C.—The city contemplates extending the water main system. Estimated cost, $10,000. City clerk, E. A. Woods.

Sandwich South Tp., Ont.—Sealed tenders will be received by John McAuliffe, clerk, up to 6 p.m., on Friday, September 28th, 1917, for the repair of the south portion of the Little River drain. Plans and specifications, etc., may be seen at the clerk's office, Maidstone, or at Owen McKay's office, Walkerville.

+—Sandwich, Ont.—Town Council let contract to the CHICK CONTRACTING CO., McDougall St., Windsor, for sewer pipe.

Sandwich East Tp., Ont.—Township Council instructed Engineer Owen McKay, Walkerville, to report on the proposed extension of the water main on Intersection and Lauzon Roads.

St. Catharines, Ont.—City Engineer W. P. Near submitted a plan to City Council of proposed sewer system for a portion of the western hill.

+—Toronto, Ont.—Board of Control awarded the contract to the GODSON CONTRACTING CO., LTD., Manning Chambers, for the construction of a storm sewer to run from Clarendon Ave., along Russell Rd., east on St. Clair to Avenue Rd. Another section connecting with this will run from the High Level pumping station up Poplar Plains Rd. to Clarendon. The total cost will be about $151.000. The sewers will be 6½ feet in diameter.

Toronto, Ont.—Tenders addressed to W. C. Wilkinson, secretary-treasurer, Board of Education, will be received until Thursday, September 27th, 1917, for drain work at Strathcona School. Specifications may be seen at the office of the superintendent of buildings, Administration Building, 155 College Street.

+—Verdun, P.Q.—City Council let contract for the construction of new sewers to the M. J. STACK PAVING & CONSTRUCTION CO.

+—Windsor, Ont.—City Council let contract to the CHICK CONTRACTING CO., McDougall St., for sewer pipe.

+—Windsor, Ont.—City Council let contract to the CHICK CONTRACTING CO., McDougall St., for sewer, estimated to cost $4,100.

Windsor, Ont.—Plans have been prepared for a sewer extension estimated to cost about $28,300 on Moy and Hall Streets, from Giles Boulevard to Essex terminal tracks. City engineer, M. E. Brian.

LIGHT, HEAT AND POWER

Bradford, Ont.—A by-law will be submitted to the ratepayers on October 6 to authorize an expenditure of $15,600 on installing a hydro-electric transmission system.

Brantford Tp., Ont.—The offer of the city of Brantford not being acceptable, Brantford Township will itself go ahead with the construction of a hydro-electric system throughout the township, with Reeve McCann and Councillor Scace in charge of the work.

+—Bridgeburg, Ont.—THE CANADIAN GENERAL ELECTRIC CO. OF CANADA, Toronto, has been awarded the contract by the Town Council covering the purchase of transformers and switchboard, necessary in connection with the installation of electric duplex pumps in the municipal pumping station by the Smart Turner Co., of Hamilton. The additional expenditure will reach approximately $1,130.

Cobalt, Ont.—Town Council extended time for receiving tenders on installation of telephone system to September 27th.

Collingwood Tp., Ont.—Township Council passed by-law to allow the Osprey Municipal Telephone system to extend its lines into Collingwood Tp.

Fort William, Ont.—By a vote of 548 to 82 the ratepayers ratified a by-law to enter into an agreement with the Hydro-Electric Power Commission of Ontario.

Granby, Que.—The Southern Canada Power Co. will build a sub-station and office here.

Lethbridge, Alta.—It is expected that a new steam turbine and generator will have to be ordered in order to provide power for the increasing load. It is estimated that a new unit will cost $50,000.

Yamaska River, Que.—The Miner Rubber Co., Granby, contemplates the erection of a $3,000 power house.

RAILWAYS

Bridgeburg, Ont.—The Grand Trunk Railway will shortly double-track its line from here to Welland.

+—Calgary, Alta.—City commissioners recommended that contract be let to the UNITED STATES STEEL CORPORATION for 50 new car wheels of manganese steel, at $2,537.50.

Walkerville, Ont.—Ratepayers passed a by-law giving the Sandwich, Windsor and Amherstburg Street Railway Co. the right to build an extension on Ottawa St., from Walker Rd. to Lincoln Rd.

FACTORIES AND LARGE BUILDINGS

+—Brandon, Man.—Contract let to the HARPER CONSTRUCTION CO., 130 Grain Exchange Building, Winnipeg, for grain elevator and alterations to mill costing $25,000 for the Western Canada Flour Mills Co., Kelly Block, Eighth St.

+—Brantford, Ont.—Contract let to A. J. CROMAR, 446-8 Colborne St., for a $35,000, three-story, brick storage building for Massey-Harris Co., Ltd., South Market St.

Brantford, Ont.—Public School Board plans erection of a technical high school. Secretary, A. E. Burwell.

+—Brighton, Ont.—The Dominion Canners Company have awarded a contract to the BURNS CEMENT-GUN CONSTRUCTION CO., LTD., Toronto, for covering 35,000 sq. ft. of metal surface of the buildings of the plant with a protective coat of gunite.

+—Chatham, Ont.—THE DICKIE CONSTRUCTION CO., Ryrie Building, Toronto, have the general contract for $20,000, two-story, stone and brick bank for the Canadian Bank of Commerce, head office, Toronto.

+—Consort, Alta.—Contract let to A. McDOUGALL, Grain Exchange Building, Calgary, for $15,000 school for the Consort Public School District.